CNADS' STANCE ON THE NATIONAL INTEGRATED ENERGY AND CLIMATE PLAN (PNEC)

April 2019

In a meeting held on December 18, 2018, the National Council for Environment and Sustainable Development (CNADS) decided to create a Working Group (WG) with the objective of elaborating a Stance on the National Integrated Energy and Climate Plan (PNEC).

The Working Group is coordinated by Counsellor João Guerreiro and includes Counsellors Luísa Schmidt, Eugénio Sequeira, Jaime Braga, João Joanaz de Melo, José Guerreiro dos Santos and Nuno Ribeiro da Silva.

This Stance briefly analyses the main lines of reflection and action advanced by the PNEC and is structured as follows:

1. Elaboration process of the National Integrated Energy and Climate Plan
2. General objectives and issues
3. Characterisation of the current situation of the national energy sector and defined objectives for 2020
   - 3.1. Objectives set for 2020: quantified targets; foreseeable development; implementation difficulties, by sector
4. Strategy for 2030. Projections
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There is no planet B
Scream launched by young people in demonstrations
organised on March 15, 2019 in more than 110 countries

1. Elaboration process of the National Integrated Energy and Climate Plan

The National Integrated Energy and Climate Plan (PNEC) emerges following a decision by the European Union to ensure the energy transition and the achievement of the greenhouse gas (GHG) emission reduction targets. The decision was taken by the European Union following the Paris Agreement (2015). A dramatic challenge was launched for all countries of the world, recognising that it was imperative and urgent to take measures that would contribute to minimising the impacts of climate change and to ensure that global warming of the planet did not reach 2ºC above the pre-industrial levels.

The decision of the European Union created the conditions for Member States to draw up Plans aimed at defining the conditions of the new medium- and long-term energy model and to identify the necessary interventions to mitigate the impact of climate change.

The National Integrated Energy and Climate Plan will be the instrument which, at the level of each country, should condition public policies in these areas, addressing not only the future societal framework but also the various components of social and economic dynamics that will not compromise the strategy resulting from the Paris Agreement. As will be understood, the component of support and encouragement to the various institutional agents (companies, institutions and households), translated into appropriate public policies, should occupy a large part of its measures and actions.

The PNEC execution period will be the decade from 2021 to 2030, which is also, globally, a period of programming of the European Structural Funds, which could facilitate the options that are demanding in public investment, in incentives to the various activities and financial support directed at families.

The preliminary version of the PNEC was presented to the European Commission in December 2018. Its drafting strictly followed the format previously defined by the European Commission itself. It is on this provisional version, placed in public debate, that the CNADS elaborates this Stance.

It is recognised that the effort is being made towards the public presentation of the plan, covering several *fora*, namely the five administrative regions of the continent and the Autonomous Regions. There could have been a prior hearing with the main actors in the sector to support the preparation of the Plan, although it is recognised that the timetable and format of the Plan defined by the European Commission were hardly adequate for this purpose. The dimension of this debate, which is hopefully extent, could give the PNEC increased capacities of clear feasibility, in a framework that is recognised to be extremely complex, as will be seen below.

The plan will also be formally submitted to public consultation, a situation that reinforces the possibility of achieving an instrument capable of creating the best conditions in order to enable and facilitate the full achievement of its objectives.

The definitive presentation of the National Integrated Energy and Climate Plans, drawn up by the various Member States, is scheduled for the end of 2019.

Alongside the elaboration of the PNEC, the strategy for the deep decarbonisation of the Portuguese economy was also conceived, translated in the national Roadmap for Carbon Neutrality 2050 (RNC2050), it integrates a set of future perspectives, defining prospective scenarios with regard to the evolution of the energy model and covering the impacts in the various sectors of society (economic and logistic activities, household), in a framework of inevitable transition to a society characterised by an Increasingly circular economy. The PNEC should be the executive instrument that contemplates the adoption of the strategic perspectives of the RNC2050 for the decade 2020-30.

The CNADS notes that the PNEC elaboration process did **not contemplate** the articulation with the various programmes with intervention in the territory, with the financing programmes and with the public policies with impact on the territory, evoking as of now the PNPOT (National Program of Territorial Planning Policy), the PNA (National Water Plan), the National Strategy for Active Mobility and the POEM (Maritime Spatial Planning Program).

2. General objectives and issues

The CNADS considers it of decisive importance to establish a strategy, with quantifiable objectives and with a timetable for execution, covering the period of the Plan, and to give substance to the necessary adoption of a new paradigm regarding the way of life in Society. This new paradigm has a decisive effect on the organisation of energy generation and use, consumption habits, the pattern of production of goods, urban planning models, the exploitation and appreciation of waste (urban and industrial) and its transformation into raw materials, influencing how one can foresee the social organisation itself. In this domain, there will have to be a special focus on urban areas (and especially metropolitan areas), large energy consumers and, in most cases, characterised by patterns of organisation of their stocks and flows that imply an excessive and wasteful consumption of energy.

This new paradigm cannot be adopted without a profound change in the behaviours of the various actors (companies, household, administrations). It is about **changing living standards, social cultures, social organisation models**, but whose financial impact will be equally significant.

It is acknowledged that it is not easy to collectively adopt a new paradigm; there is always a great difficulty in ensuring the execution of strategies that represent changes, regardless of whether they are harmonious and coherently defined. This challenge becomes more complex when these same strategies introduce disruptions (in this case deep) in the course that would be considered normal of the socioeconomic and environmental system.

The journey of the energy transition is necessary (one might say mandatory) to ensure a balanced development of life on the face of the planet. It should be borne in mind the multiple

Systemic Relationships that the alteration of the energy paradigm will bring, with impacts on virtually all sectors that characterise society, making this equation even more difficult to solve. In addition to the production model and the standard of living, several other domains will be called to profound reconversions in order to find new performances, from the use of the heritage that is made available to the communities, to public infrastructures, to the priority of Investment, the quality of employment and the requalification of work, the concept of training and education, among others. Considerations that will force behaviours to be adjusted, reconvert assets, and reorient activities.

Structural changes of this kind, albeit without the expected depth attributed to the ones that are needed, have existed in society, often with dramatic impacts on the levels of employment, the location of activities, the profile of infrastructures, and the services or processes that foster cohesion and social inclusion. The changes demanded by this process of transition in the generation and energy consumption, require planning of interventions covering the various sectors of activity and diverse social areas, although permanently guaranteeing their respective complementarities.

It should be recognised that adjustments of different dimensions have been introduced over the years at various stages of social evolution, driven by technological disruptions, innovative activities (which stand out from possible archaisms) or by professions that become obsolete. Usually, these discontinuities which have a varying degree of social drama, try to be compensated, often successfully, with an additional effort in qualifying citizens and betting on selective investment. The levels of rupture and the capacities of society to reconvert its economic, social and environmental fabric require a profound reflection and a definition of the best solutions to overcome these situations. In the case of the adjustments motivated by energy transition, the changes are revealed with a colossal scale, requiring reflection, forecasting, scheduling and the creation of mechanisms capable of variegating these social impacts.

Particular reference should be made of the positive impacts that the energy transition and the reduction of greenhouse gas emissions have for **public health**. Many of the pathologies that affect current societies result from lifestyles, chemical contamination and environmental pollution to which communities are subjected.

The role of **public policies** in these domains is fundamental. It creates legal constraints, promotes financial incentives, guides the activity of administration entities, affects investment in areas considered decisive, influences education and training, encourages the production of knowledge and mobilises society to better respond to challenges, in this case, of climate change. In this domain, the outcome of the strategy cannot lead to a sectoral policy, but rather of an articulated, coherent and demanding intergovernmental framework that overcomes the issues that are often addressed in a fragmented way, thus affecting the execution of public policies.

It is in this sense, that it is argued that the design of public policies with intervention in this area, as well as social mobilisation (household, companies, workers, various entities), will require a new type of governance model, one in line with the respective strategies, oriented to guarantee the promotion of the expected results and to give coherence to the dynamics of society.

These profound changes in social organisation, demanded by the energy transition and by mitigating the impacts of climate change, require the incorporation of high levels of **knowledge**.

The component of scientific research, experimentation and extension will be fundamental in generating new products, new processes and new forms of organisation. The promotion of renewable energies, the structuring of a productive line dedicated to technology and new equipment that meet their respective needs are lines of R & D, preferably applied, that will allow the implementation of the PNEC strategies.

The measures related to the **sufficiency and energy efficiency** that we consider decisive as will be seen below, are also part of the R & D effort that should be associated with the PNEC. One could mention, as an example, the housing stock, referred to only generically in the PNEC, but which will require the search for new building materials, the determination of new building standards, including intervention in the existing stock, fully exploiting the potential of passive energies and rehabilitating buildings, transforming them eventually into active entities in a new paradigm of decentralised generation of energy and shared use of energy resources.

The examples could be multiplied, although this is not the scope of this Scope. The creation of support lines for projects that associate, on the one hand, research units and groups and, on the other hand, business capacities or public investment availabilities in a framework of subordination to strategic priorities cannot be forgotten. It will require the mobilisation of all potential actors in this process: economic agents (including workers), administrations, universities, research units, civic associations and entities of Interface for knowledge transfer. The management should finally define the regulatory framework that will guide the energy transition process, in its various dimensions (technical, financial, economic, social, environmental, etc.).

The Scope briefly analyses the main lines of reflection and action advanced by the PNEC. Notwithstanding a globally positive assessment of the CNADS's launch of a public debate on climate-related issues and the energy issue, the CNADS will, in the end, present some Recommendations which, in the Council's view, will help to improve the correspondence between the strategy adopted at the PNEC and the practical conditions for its implementation.

The Recommendations presented at the end of this Scope implicitly recognise that the PNEC reflects an excessively optimistic picture at two fundamental levels. The first concerns the assessment of the present situation which, given the complexity of the matter, cannot cover all the topics foreseen in the original Guide drawn up by the European Commission, some of which are considered decisive for strengthening the strategy. The second covers the prospects for the execution of the Plan, in the period up to 2030, welcoming certain theoretically and technologically attainable objectives, but with a reasonable degree of uncertainty regarding their capacity to execute.

3. Characterisation of the current situation of the national energy sector and defined objectives for 2020

The characterisation of the initial situation deserves a first evaluation, recognising that the analysis of the energy balance in the first years of the 21st century reveals, in its general lines, the crossed result of the behaviour of the various agents that use energy in their activities (household, companies or other institutions), the evolution of technology, the market, but also the strategy and intensity of public policies.

According to the National Energy Balance (provisional) of 2017, the structure of the primary energy used and the evolution of the final energy consumption by sectors of activity have evolved considerably in relation to what was found in 2005 (Table 3.1). It will be worth making some quick comments regarding this.

Table 3.1
Primary energy consumption (excluding non-energy oil)

Type of energy	2005	2010	2017	*% Variation 2017/2005*
	toe	toe	toe	*%*
Coal	3 348 835	1 656 757	3 247 292	*-3*
Oil and derivatives	15 713 997	11 332 608	9 245 931	*-41*
Natural Gas	3 761 084	4 506 617	5 437 966	*+45*
Electricity[1]	1 185 854	2 474 507	1 582 833	*+34*
Non-renewable waste	17 564	54 190	202 644	*+1 154*
Biomass and other renewable resources	2 896 626	3 168 351	2 980 460	*+3*
TOTAL	26 923 960	23 193 030	22 697 126	*-15.7*

[1] Import balance and electricity from renewable source.
Source: DGEC, 2019.

It is acknowledged that the values for the year 2010, as will have been those of the year 2014, can hardly be compared with 2005 or 2017 since those were very humid years. The production of electricity from coal remained stable, although it undergoes the variations that depend on the level of energy production of hydric origin.

Oil needs (and its derivatives) are presenting a negative evolution, mainly for three reasons:

- Oil products are no longer used in the production of electricity;
- Natural gas has replaced oil by-products, both in the combined production of heat and electricity, and in the energy needs of industry and services;
- There was a reduction in transport consumption, for better efficiency and, certainly, for greater supplies abroad.

Natural gas has become the mature energy for heating, for industry and for generating electricity, while biomass needs (and availability) have remained stable. In general, during the period 2005-2017, the country reduced its primary energy consumption by 15% because of the crisis to which it was submitted.

This table will be more radical if the prospects indicated in the PNEC for 2013 are met (Table 3.2), which should respond to the global commitment of the EU's energy efficiency commitment of 32.5% by 2030.

Table 3.2
Objectives of the PNEC 2021-2030 (primary energy use)

Primary Energy Consumption (PNEC)	**2005**	**2020**	**2030**	***% Variation 2030/2005***
	Mtoe	Mtoe	Mtoe	%
	26.9	21.8	20.2	*-25*

Source: DGEC, 2019

The evolution of energy for final consumption (excluding non-energy oil) has also suffered a development which can be observed (Table 3.3).

Table 3.3
Energy in final consumption (excluding non-energy oil)

Types of energy	**2005**	**2010**	**2017**	***% Variation 2017/2005***
	toe	toe	toe	%
Coal	16 216	50 200	11 004	*-32*
Oil and derivatives	10 558 480	8 692 320	7 250 270	*-31*
Natural Gas	1 299 765	1 514 215	1 728 644	*+33*
Electricity	3 932 414	4 288 615	4 011 129	*+2*
Heat	1 159 873	1 335 963	1 136 489	*-2*
Non-renewable waste	33 925	54 169	95 258	*+181*
Biomass and other renewable resources	1 742 113	1 349 278	1 068 950	*-37*
TOTAL	18 742 786	17 284 760	15 301 744	*-18.4*

Source: DGEC, 2019

The primary energy use decreased by 4.2 Mtoe (Table 3.1), surpassing the energy used for final consumption, which dropped 3.4 Mtoe in the same period (Table 3.3). This means that the final consumption has reduced more than the primary energy use, perhaps due to the contribution to the renewable energy mix. If we look at Table 3.3:

- Final consumption was reduced by approximately 3.4 Mtoe and the value of primary energy decreased by approximately 4.2 Mtoe; but, in relative values, the final consumption had a greater reduction than the primary energy use;
- There was a large fall in the consumption of oil derivatives by a reduction of 1 Mtoe in transport and of almost 1 Mtoe in industrial consumption;
- According to the estimates of the Directorate General of Energy and Geology (DGEG), based on the respective national survey, the value of biomass consumption and other renewables is greatly reduced by the re-evaluation of the consumption of firewood in the domestic sector.

The final energy consumption shows a stable trend (Table 3.4), contrary to the evolution trend of 2005/2017 and the expectations of greater energy efficiency.

Table 3.4
Objectives of the PNEC 2021-2030 (final energy consumption)

	2005	2020	2030
Final energy consumption (Mtoe)	18.7	17.5	17.7

Source: PNEC v. December 2018

The final energy consumption, by sector of activity (Table 3.5), reflects recent behaviours of our society, not only the aspects related to the economic crisis and price changes but also those related to lifestyle habits, technology evolution and the options (or lack thereof) of public investment.

Table 3.5
Energy in final consumption, by sector of activity

Sector	2005	2010	2017	*% Variation 2017/2005*
	toe	toe	toe	%
Agriculture and Fisheries	509 454	454 601	458 869	*-10*
Extractive Industries	106 959	134 831	79 765	*-25.4*
Manufacturing Industries	5 358 510	5 063 534	4 369 456	*-18.5*
Construction and Public Works	336 799	241 320	157 231	*-53.3*
Transport Sector	6 818 751	6 447 154	5 773 449	*-15.3*
Domestic Sector	3 231 279	2 953 884	2 561 756	*-20.7*
Services Sector	2 381 033	1 989 436	1 901 218	*-20.2*
TOTAL	18 776 786	17 284 760	15 301 744	*-18.5*

Source: PNEC, 2018

The **agricultural sector** has great stability, perhaps due to contradictory reasons that result, on the one hand, from the reduction of its activity reflected in the reduction of the UAA and, on the other hand, from the increase in productivity revealed in several regions and in the cultural options adopted there.

In the **industrial sector**, the reduction is due to the combined effect of changing the profile of the chemical, textile, ceramic and cement sectors, the latter two of which have been driven by the construction crisis, but also by an increase in energy efficiency, identifiable both in the results of the Energy Intensive Consumption Management System (SGCIE) and in the energy intensity statistics (DGEG).

In addition to the effect it had on the industrial sector, the **civil construction** crisis also contributed to a reduction of energy consumption and non-energy products in 12 years to a level below 50%.

In the **transport sector**, the reduction was more moderate (around 15%), although some recovery is observed after 2015. The main cause of reduction seems to be the improvement of vehicle efficiency since there were no significant structural changes in the transport system.

In the **domestic sector**, the drop was 20%, mainly due to the increase in the price of electricity (23% VAT) combined with technological developments, saturation in essential equipment and, in recent years, due to the economic crisis, the reduction in household income available, but also, according to the reason mentioned above, due to the correction resulting from the consumption of firewood. Consumption in the domestic sector fell back almost 20 years!

Finally, the reduction of final energy consumption in the **services sector** is due to a considerable reduction in the use of oil derivatives, only partly offset by the increase in electricity consumption and the doubling of natural gas consumption.

Table 3.6
Forecast of the evolution of the Final Energy consumption by type of source and by sector of activity, according to the scenario "Existing Policies"

Types of energy	**2020**	**2025**	**2030**	**2035**	**2040**	***% Variation 2040/2020***
	toe	toe	toe	toe	toe	%
Oil	8 103	8 250	8 183	8 075	7 668	-5.4
Electricity	4 172	4 474	4 753	5 083	5 445	+30.5
Natural Gas	1 712	1 786	1 837	1 892	1 954	+14.1
Renewables	1 068	1 123	1 166	1 209	1 255	+18.4
Heat	1 257	1 299	1 326	1 359	1 395	+11
Others (includes hydrogen)	108	111	120	136	160	+48
TOTAL	16 412	17 043	17 385	17 754	17 876	+9

Final energy consumption without non-energy uses	**2020**	**2025**	**2030**	**2035**	**2040**	***% Variation 2040/2020***
Transports	5 591	5 696	5 702	5 720	5 458	-2
National Air Transport	92	102	113	124	137	+48.9
National Maritime Transport	88	92	95	97	99	+12.5
Rail transport	40	39	39	40	40	-
Road transport	5 371	5 463	5 455	5 459	5 182	-3.5
Industry	4 642	4 798	4 899	5 017	5 152	+11
Domestic	2 707	2 880	2 999	3 116	3 240	+19.7
Services	2 034	2 152	2 218	2 282	2 354	+15.7
Agriculture and Fisheries	407	420	429	439	451	+10.6
TOTAL	15 381	15 946	16 247	16 574	16 655	+8.3

Source: PNEC (page 69)

Under this scenario, the following sectoral developments are expected:

- Return of the energy consumption in agriculture to the levels verified between 2010 and 2017;
- Increase in total energy consumption in the extractive and manufacturing industries compared to those in 2017, a situation that presupposes an expansion of certain branches of these sectors;
- Very small variation of energy consumption in the transport sector, despite the electrification objectives within this sector;

- Significant increase of energy consumption in the domestic sector, despite the energy efficiency objectives in buildings and the improvement of the technology associated with household equipment;
- Increased energy consumption in the services sector, following the expected evolution of the industry consumptions, that is, the PNEC presupposes a significant economic growth.

According to the PNEC, the evolution of electricity generation in the first years of the 21st century have been based on the technology mentioned in Tables 3.7, 3.8 and 3.9.

Table 3.7
The evolution of electricity generation

Mode of production/consumption	2005	2010	2017	*% Variation 2017/2005*
	toe	toe	toe	%
Conventional production (thermoelectric power plants)	2 842 042	1 787 691	2 682 854	*-5.6*
Cogeneration	499 794	616 277	614 742	*+23*
Renewables	1 185 854	2 474 507	1 582 833	*+33.5*
Self-consumption of the energy sector	-595 275	-589 099	-869 289	*+46*
AVAILABLE TO FINAL CONSUMPTION	3 932 415	4 289 376	4 011 140	*+2*

Source: PNEC, 2018

Table 3.8
Mix of fuels in the conventional generation of electricity and cogeneration

Fuel	2005	2010	2017	*% Variation 2017/2005*
	toe	toe	toe	%
Coal	3 319 651	1 597 427	3 236 601	*-2.5*
Oil Derivatives	2 367 997	847977	291 792	*-87.7*
Natural Gas	2 325 840	2 857 665	3 364 469	*+44.7*
Biomass	1 154 512	1 497 722	1 659 867	*+43.8*
TOTAL	9 168 000	6 800 791	8 552 729	*-6.7*

Source: PNEC, 2018

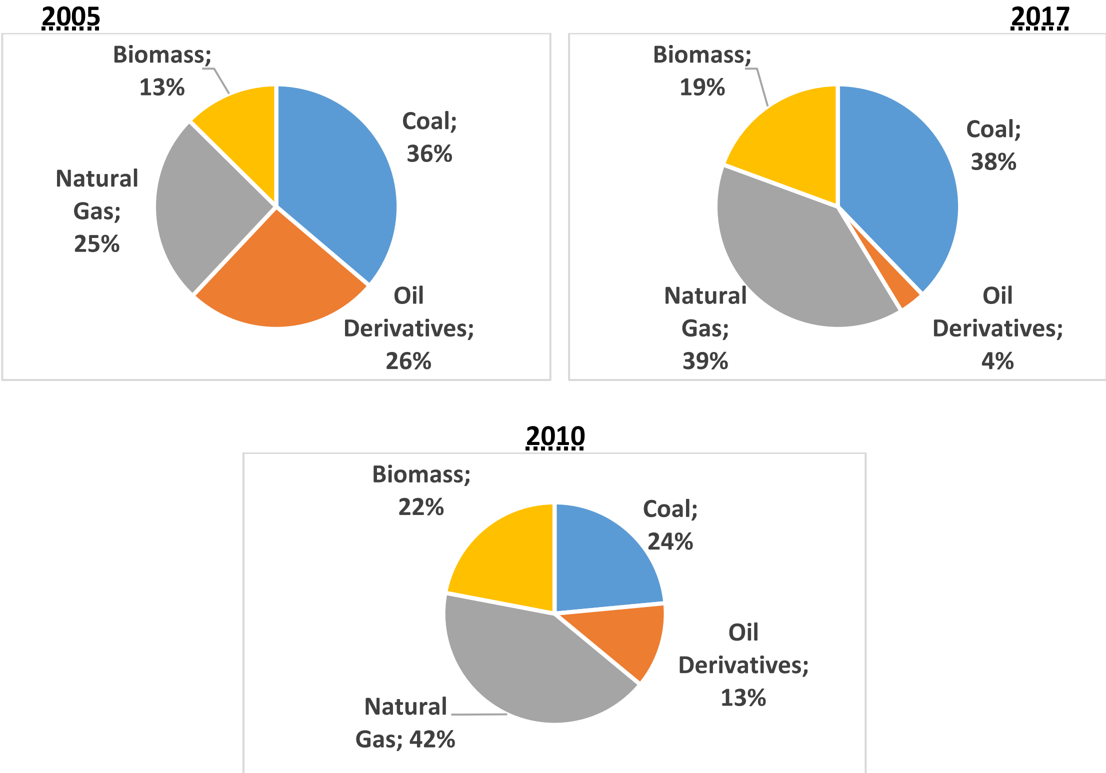


Figure 3.1 - Mix of fuels (Source: Table 3.8)

Table 3.8 shows that today, the use of oil by-products in electricity generation is very small, having been replaced by natural gas or renewables. The consumption of coal has been stable, depending only on the climatic and hydrological characteristics of each year. The biomass contribution increased due to growth in the pulp and paper sector.

It should be noted that the combined generation of heat and electricity (cogeneration) is approximately 44% renewable and that the large increase in the demand of this sector is mainly due to the energy used in water pumping.

Table 3.9
Mix of renewables in the generation of renewable electricity

Primary source	**2005**	**2010**	**2017**	***% Variation 2017/2005***
	toe	toe	toe	%
Hydroelectricity	440 148	1 423 033	656 312	*+49.1*
Wind	152 478	789 615	1 053 315	*+590.8*
Photovoltaic	258	19 331	85 396	*+32 999.2*
Geothermal	6 106	16 950	18 633	*+205*
Biomass and biogas (electricity generation)	≈600 000	≈500 000	≈820 000	*+37*

Source: PNEC, 2018

It should be recalled that 2005 was a very dry year, and, like 2014, 2010 was a very humid year, which limits the direct comparisons that one intends to make. The increase in the use of biomass is due to the investment aimed at increasing the capacity of the pulp and paper sector.

3.1 Objectives set for 2020: quantified targets; foreseeable development; implementation difficulties, by sector

Given the PNEC forecasts, it will be worth assessing the 2020 targets, assuming that the successful implementation of these objectives by the end of the second decade of this century will allow 2030 to fully comply with what is included in the Plan. The performance of the various actors and the full implementation of public policy measures will condition what is expected for the realisation of the PNEC in the next ten years.

It must be recognised that the recent impetus announced for the licensing of new renewable energy generation capacity, notably in the photovoltaic field, is unlikely to produce significant effects until 2020. The strategy adopted for biofuels assumed a reduction of its incorporation, apparently without justification, and will not contribute positively to the 2020 targets.

It should be noted that maintaining the complex investment licensing system, usually embedded in an interminable and permanent web of bureaucratic procedures, does not contribute to achieving the desired objectives by 2020.

Due to these issues that are mostly related to the context (especially with the decline of investment in alternative energy in recent years) and very little to do with the availability of adequate technology, it is predicted that the country will have some difficulty in reaching 2020 with the fully implemented objectives related to the power generation.

As seen in Table 3.10, the evolution between 2005 and 2010 shows, above all, improvements in energy efficiency. Between 2010 and 2017, this result was due to the combined effects of these improvements and the clear modification of the activities profile, due to the drastic reduction of activity of the sectors most related to construction and public works.

Table 3.10
GVA, consumption and energy intensity evolution in the Portuguese industry (2005-2010-2017)

VARIABLES	2005	2010	2017
GVA industry (10^6 euros) (current prices)	24 366	26 594	31 068
GVA industry (10^6 euros) (prices 2017)	28 986	29 030	31 068
Energy consumption in the industry (toe)	5 455 964	5 198 365	4 448 221
Energy intensity in the industry (toe/10^3 €) (prices 2017)	0.188	0.179	0.143

Sources: Eurostat/INE; DGEG; self-elaboration.

The achievement of the 2020 objectives should further enhance and ensure the implementation of measures in the following three areas:

a) **Energy efficiency**;

b) **Transportation**;

c) **Interconnections in the power grid**.

These areas, which in the following chapter will be further developed from the perspective of 2030, should be considered as pillars of the energy approach path until 2020. In some cases, the PNEC targets seem to be unambitious in the face of past trends and available technology (e.g. indicative use of primary and final energy); however, in other cases, they appear to be very ambitious, bearing in mind that the conditions facilitating the execution of the various measures are still in the design and implementation stage.

For example, in the field of energy efficiency, the measures defined throughout the Plan, in particular chapter 4.3 (existing policies and measures), are still focused on diagnosing the situation and on generic intervention patterns, such as the energy performance of buildings, which evokes the existing norms without defining concrete lines of action. Recognising that this is a fundamental domain dependent on the strongly concerted combination of specific measures and intangible components, the expectation is that the concrete actions and measures, that might be proposed, could counteract those difficulties and represent a substantial chapter of the PNEC. The intense urban rehabilitation activity observed in the country, especially in the cities of Lisbon and Porto, should be used to introduce substantial improvements in the energy efficiency of buildings.

4. Strategy for 2030. Projections

The 2030 strategy, aligned with the European Union, points to the scenarios presented in Table 4.1.

Table 4.1
Objectives defined for the European Union and Portugal as part of the energy and climate strategy

OBJECTIVES	2030	
	European Union	Portugal
Energy from renewable sources in the gross final consumption (%)	32%	47%
Reduction of greenhouse gas emissions (base: 1990) (%)	-40%	-
Reduction of greenhouse gas emissions without LULUCF, Regulation (EU) 2018/842 (base: 2005) (%)	-30%	-17% (Regulation) -45 to -55% (national target)
Increase in energy efficiency (% of the reduction in primary energy consumption compared to projections for 2030 from the PRIMES model for the European Commission, 2007)	-32.5%	- 35%

Electrical Interconnections	15%	15%

Source: PNEC v. December 2018 e Regulation (EU) 2018/842

The national objectives and targets for the period 2020-2030 elicit the following comments:

4.1 Dimension of decarbonisation

The PNEC contains a strong policy statement towards decarbonisation and full adherence to the objectives of the Paris Agreement, which in itself is very positive. The targets now set for 2030 - a reduction of 45 to 55% compared to 2005 of GHG emissions without LULUCF - being ambitious, is technologically achievable. This was demonstrated in the RNC2050. More complex is the question of the paths and means necessary to achieve these goals.

In terms of a general approach, the PNEC seems to ignore a key issue that has already been identified by the IPCC (Intergovernmental Panel on Climate Change) and by many other observers: the decarbonisation strategies that are not based on sufficiency and resource efficiency risk generating serious conflicts with harmful environmental and social consequences (IPCC, 2018). The PNEC seems to believe that it is possible to continue to exploit natural resources at the pace of what happens at present day, without substantial changes in our lifestyle and with unlimited growth assumptions of the economy and the demand for energy and other services. It is, after all, the current model of society that will have to be scrutinised.

The objectives foreseen for 2020, which require reaching 31% share of renewable sources, cast doubt on their feasibility. The lack of investment in recent years has led to the understanding that the objective is overly optimistic.

In order to decarbonise, the PNEC correctly identifies the need for a parallel and coordinated intervention in multiple domains, and we recognise that in many of them, the paths indicated are correct or necessary. There remain, however, several significant points where the indicated paths are counterproductive or ineffective. We will mention the failures that seem most evident to us:

- The most serious and structural failure is, as already mentioned, the undervaluation of the energy efficiency dimension and, in general, the problem of the sufficiency of the use of resources. It is not enough to emphasise that this dimension must be present in decarbonisation; it is also necessary to identify the measures that must be adopted, the preferential sectors that need to be addressed, the incentives and support that must be created, the awareness raising that is required, the objectives segmented by the various areas that must be clearly established and the results expected to be achieved in the various processes developed in this scope.

- The PNEC's commitment to photovoltaic energy is correct and the established targets are, in technological terms, likely to be achieved. However, it is not possible to identify the necessary and consequent strategy (measures and actions) for the promotion of decentralised micro-production, which is essential, since the main potential stakeholders (households and SMEs) do not have the financial resources to implement it. In this chapter, the strategy for centralised photovoltaic generation is also unclear, despite the public statements by members of the Government on the auction proposals; it should be recalled that the main constraint is the characteristics of the network needed to incorporate the electricity produced by the entities that are launching in the installation of photovoltaic plants, in addition to the better resolution of the storage problem.

- Regarding the retrofitting and renewal of wind and hydroelectric systems, no clear, quantified strategy is presented for achieving this, although the PNEC itself claims that this axis has enormous potential.

- There is no justification for the PNEC to ignore the important solar thermal component intended for the heating of sanitary waters and the production of heat in the industry. There are even two contradictory predictions: one of them (p.17), the total effective contribution of the solar thermal drops about 6% by 2030; in another reference (p. 60), that same contribution presents a growth of 10% by 2030,which is by itself a modest target.

- The PNEC correctly identifies mobility as a key sector for decarbonisation. However, it does not contain a clear strategy or a set of feasible and effective measures that will enable the achievement of the stated targets. There are two areas that the CNADS considers critical and urgent: metropolitan collective transports and the national rail network.

- In certain areas that could contribute to strengthening the country's energy strategy, such as offshore wind, geothermal, wave and tidal energy, or even biomass, the reflection is not deepened.

- The PNEC insists on the strategy of the National Program of Dams with High Hydroelectric Potential (PNBEPH), defending the bet on new large dams. It is recognised that this approach is problematic and lacks adequate environmental assessment, pondering the balance of the impact of each project to be carried out, as it generates a number of significant impacts, particularly in social and environmental areas (with benefits eventually disproportionate to investments), in eutrophication (with poorly known methane emissions, so they are not guaranteed to effectively contribute to decarbonisation) or in limitations to hydroelectric production due to the decrease in rainfall caused by climate change[1].

With regard to the reduction of greenhouse gas (GHG) emissions associated with waste management, the PNEC targets seem reasonable. However, the following strategy for the overall reduction of waste and for the appropriate use of the organic fraction should be clarified.

The carbon sequestration strategy, regarding land-use planning, particularly forest management, is unclear and inconsistent. In this area, the necessary articulation with the National Spatial Development Policies Programme (PNPOT), and particularly with the Regional Forest Territorial Plan (PROF), should be clarified in order to quantify the foreseeable contribution of forest cover to carbon sequestration. Better forest management and the recognition of the role it can play in the decarbonisation process places actions to defend the

[1] Recall the position already taken by the CNADS in the "Preliminary Reflection on the Environmental Report of the PNBEPH", dated December 12, 2007, available at: https://www.cnads.pt/index.php?option=com_docman&task=cat_view&gid=53&Itemid=84

forest against rural fires as a high priority, with adequate knowledge, professionalism and investment in the area of prevention/planning and better coordination.

Agriculture could also strengthen its role in a decarbonisation strategy by changing its cultural mosaic, giving value to organic farming integrated protection practices (and mixed agrosilvopastoral systems), capable of establishing balances in the joint management of its components (agricultural crops, pasture, livestock and forest).

4.2. Dimension of energy efficiency

In the field of energy efficiency, the above-mentioned assessment could be strengthened by highlighting the low ambition and lack of effective concrete measures to achieve it.

Reiterating what has been the practice for decades, the dimension of energy efficiency in the PNEC remains the poor relative of energy policies, even questioning the declaration of intentions that points to energy efficiency as one of the priorities of this Plan. There is nothing in the PNEC to evaluate the (in)effectiveness of the scarce efficiency measures currently in place.

The targets stated in the PNEC could be more ambitious and more realistically identify the steps that should be taken to achieve those targets. The reductions envisaged for energy consumption are based on questionable methodologies since they are based on questionable starting levels of energy consumption. It will be more appropriate to work with energy intensities, which are related to the actual technological evolution.

The energy consumption forecasts, proposed in the PNEC, assume a minimalist reduction of primary energy and an increase in final energy consumption by 2030 when compared to 2020 (see PNEC, Table 9 and Figure 2, page 18). Referring to chapters 4 and 5 of the PNEC, it is found that the prospects for energy savings are modest and fall far short of what is possible and desirable. These forecasts seem to be based on the assumption that the gains in energy intensity will be marginal: they undervalue innovation, ignore the effect of energy price on demand, and overlook the energy efficiency penetration capacity associated not only with technology but also effective incentives and behavioural changes. This very conservative approach, in addition to not adhering to past reality, conflicts with any future sustainability perspective, because it assumes unlimited resources (energy, raw materials, water, soil, biodiversity, emission of pollutants). In the PNEC, the only limited environmental resource appears to be GHG emissions (certainly indispensable, but not sufficient).

It should be noted that, since 2005, the evolution of the Portuguese energy system contradicts these assumptions seeing as the primary and final energy consumptions have been decreasing in a systematic way, both in absolute terms (see Chapter 4 of the PNEC and Chapter 3 of this Stance) and in overall energy intensity and by sector (Figures 4.1 and 4.2).

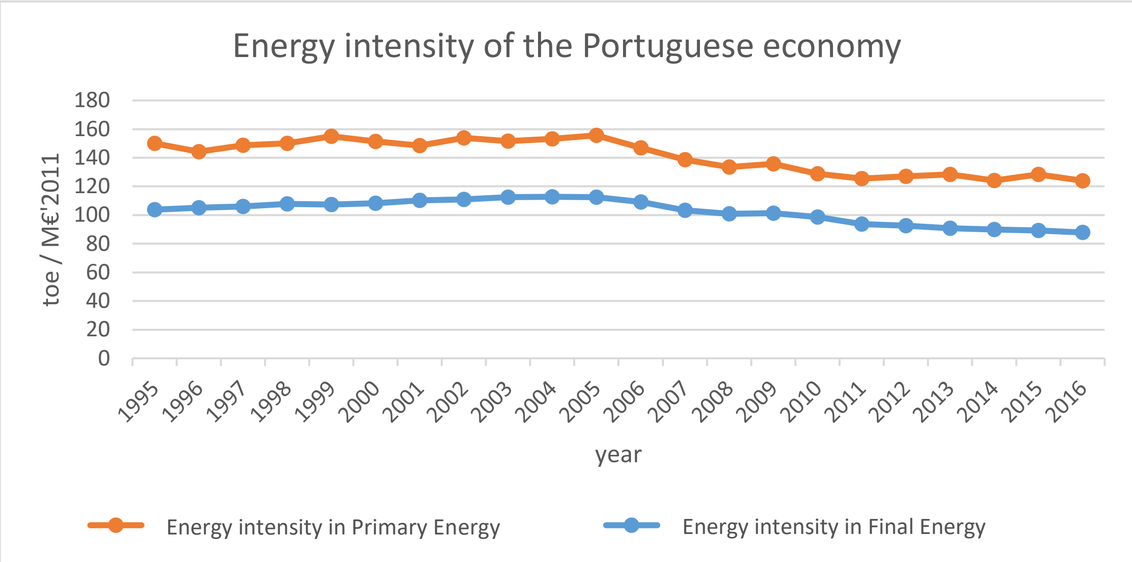


Figure 4.1 - Energy intensity of the Portuguese economy (Source: DGEG)

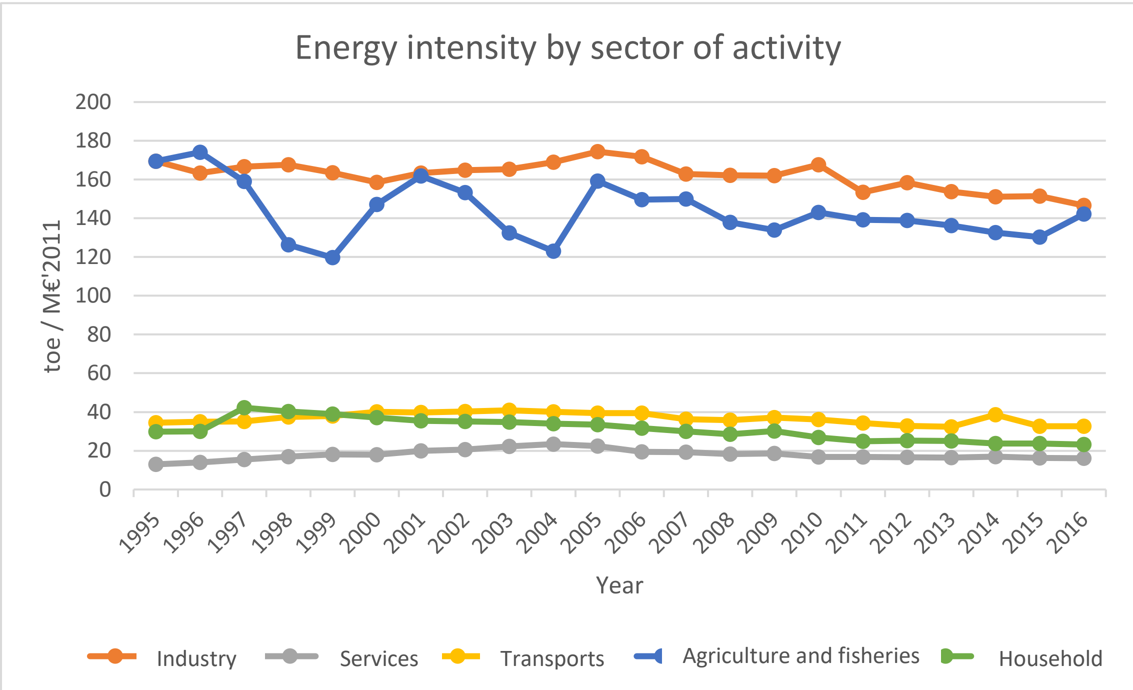


Figure 4.2 — energy intensity by sector (Source: DGEG)

The slow evolution of the energy system, in the sense of its efficiency, results from several factors. The main factor is what we can observe with the simple technological evolution and with the progressive renovation of equipment, verified in all sectors. Other factors also characterise this trend, such as the increasing trend of the real energy prices since 2005, the gradual (albeit slow) progression of energy efficiency measures and some energy management practices. In the household sector, the reduction in intensity is due to a combination of technological developments and saturation in essential equipment, associated in recent years with a reduction in disposable income.

Not belittling a range of initiatives that have certainly generated positive effects (e.g. the Valoren Program, the E4 Programme, the SGCIE), the reality is that there has never been a strong policy in Portugal to promote energy efficiency. In particular, there has never been any serious support for the housing sector, SMEs or public administration. The recent "Efficient House" programme, with the support of the European Investment Bank, predicted the mobilisation of 100 million euros for loans with an interest subsidy; was not successful because of the mistaken assumption and lack of interest from the banking sector. Most of the notices for energy efficiency subsidy schemes have also failed with families and businesses, becoming heavily criticised for the scarce amounts involved and for excessive bureaucracy.

Over the period 2007-2012 only about 5% of public sector energy investments and support have been spent on promoting energy efficiency; the remaining 95% was spent on increasing capacity, either in production or in transportation (Brazão, 2012). In the NSRF period (since 2013), the situation seems to have improved, although it is still difficult to quantify due to the fact that the available information is insufficient for this type of analysis; but there is no doubt that even during this period, energy efficiency continued to deserve low support (Serra, 2018).

The Energy Efficiency in Public Administration (EcoAP) programme, dedicated to public administration buildings, also failed due to the lack of human and financial resources. For most of these programmes, there is no information available to assess their implementation and to conclude on their potential effectiveness.

Estimated potential savings from energy efficiency, foreseen not only in programmatic documents (such as the PNAEE and the RNC), but also in the scientific literature, reach, in all sectors, 20 to 30% of the current consumptions under the present market conditions. These numbers have been maintained or expanded in different studies over the years, indicating that technological developments have accompanied or surpassed the adhesion by the economy to progressively more efficient technologies - but always far below attainable potentials.

Table 4.2 indicates potential savings for housing. In the industrial sector, the available information indicates that the interesting savings potentials amount to more than 20% of the present consumption, although varying according to the sub-sector (Brazão, 2012; Serra, 2018). However, companies rarely materialise investments with payback periods of more than 3 years due to financing difficulties, and a significant part of savings potentials are found in measures with a return period of 3 to 6 years. In retail (commerce), technologically attainable savings potentials reach 54% of present consumption; potential with lower return periods, at 3 and 6 years, reach 27% and 32% of the present consumption (Sequeira & Melo, 2016). The known studies for service buildings point to savings potentials of the same order of magnitude, 20 to 50% (Pinto, 2017). The Association of Construction, Public Works and Services (AECOPS) (2009) estimates that 42% of public buildings in Portugal have rehabilitation needs, which represents an investment of around 6 000 M €. Finally, Pinto (2017) estimates that there will be 17,900 public buildings lacking rehabilitation, with a significant potential for improvement in their energy performance.

Table 4.2

Scenarios for energy savings in housing at national level

(Adapted from Lopes & Melo 2011, Grilo 2012, Melo 2015)

Potential savings in housing				**Investment (M€)**	**Return (years)**	
Type of measure	(Mtoe/a)	(%base)	(M€/a)		Scen.BAU	Scen.RFV
Change in habits	0.06	2%	400	0	0	0
Equipment renovation	0.60	23%	2 000	6 400	3.2	3.2
Solar thermal	0.41	15%	800	8 600	11	7.5
Rehabilitation building	0.27	10%	2 000	30 000	15	10.5
All measurements	**1.34**	**50%**	**5 200**	**45 000**	**8.7**	**6.4**
Base consumption	**2.68**	**100%**	Scenario RFV: 30% of large investment support			

BAU = Business as usual; RVF = Green Tax Reform

In the case of housing, it must be taken into account that one of the major problems is the need for comfort that is unsatisfactory. Nowadays, several Portuguese families suffer from cold during the winter due to the poor thermal performance of their houses, which can be due to several factors (insulation, building materials, building orientation, etc.). In the short term, the simplest way to solve the problem is through the installation of air conditioning; but this option, in a sustainability strategy, has problems, since air conditioning facilitates overuse and, therefore, tends to generate excessive consumption, in addition to creating a permanent future cost. The option of investment in rehabilitation, based on passive cooling, is much more interesting in the long term, because it creates comfort and structural savings, allowing to accommodate the impact of climatic extremes (for example, heat waves) that are projected more frequently in the Iberian Peninsula region. It is, therefore, more resilient to climate change and failures in active HVAC systems. It has, however, the difficulty of demanding higher investments. The corollary is that the rehabilitation of the housing stock will not be based on purely economic motivation, but by a combination of several factors: seeking a higher level of comfort and strong incentives, or new financing models, that make these investments bearable for the families. It is worth remembering that about 2/3 of the accommodations in Portugal were built until 1990, thus not having the modern requirements related to energy efficiency.

According to Lopes and Melo (2011), 75% of first housing did not meet the modern standard of thermal behaviour certification. This situation is also confirmed by the Energy Observatory (2019) based on the certifications that have been granted. In this last decade, there has been some investment in this area, but the requirements have also become more demanding, so the number of properties to benefit will not be far from that value.

Naturally, for various reasons (lack of information or interest, lack of financing, opportunity costs), not all of these investments are realisable; but the potential exists and a significant part can certainly be realised if appropriate incentives are created. It is, therefore, reasonable to bet on targets that are much more ambitious than the current ones.

The numbers briefly displayed are indicative values only. The reality is much more complex, with a wide variety of situations, which, although known, require detailed analysis when moving towards concrete measures. Creating an effective incentive system is a laborious and complex approach because it means understanding where the obstacles are and what levers allow achieving sector by sector, business by business, household by household, transforming the already known potentials. This domain is less studied than the technological dimension, but it is still possible to point out some paths. The current version of the PNEC is sparing on this issue.

4.3 Dimension of energy security

Diversification of energy sources is an appropriate objective that is welcomed in the PNEC, although the guidelines or measures advocated fall into different planes of importance.

The improved profitability of the network and natural gas storage makes sense over a medium-term horizon, in a perspective of resilience and geo-strategic independence of Europe vis-à-vis third parties.

In addition, the long-term objective, by 2050, points to a drastic reduction in the use of all fossil fuels, including natural gas. The balancing of these two lines should anticipate the reorientation of their respective infrastructure.

The safety and reliability of the electrical system nowadays in Portugal is excellent. In the field of installed capacity, we are even grossly in surplus due to a policy of large investments predicated on the dogma of consumption growth. A useful indicator for assessing capacity is the "coverage ratio" of the electricity system (ratio of actual available power to peak power demand for the grid). The ideal value of this indicator depends on the electric mix, considering that for a diversified mix such as the Portuguese, it should always be higher than 1.1. Even with the foreseeable increase in energy generation from renewable sources (which are by nature variable), a substantially higher coverage ratio is not expected to be necessary for four reasons: (i) It is highly predictable that the increase of generation will be in the solar segment; (ii) storage systems tend to diversify and become increasingly competitive; (iii) smart grids will allow for a much more flexible management of energy consumption and generation; and (iv) the resilience of the system will improve significantly with the increased capacity of the Spain-France interconnections.

Statistically, between 2014 and 2018, the coverage index presented a minimum of 1.3 on a weekly basis and 1.6 on a daily basis (see Figures 4.3 and 4.4). Even if we want to give a big margin, we are facing highly elevated installed capacities. In particular, the hydroelectric pump storage operating capacity of 2.74 GW (DGEG, 2019) largely exceeds, in the present situation, the defined target of 2.0 GW (INAG et al, 2007), excluding the Tâmega Electroproduction System. In the future, the situation will need to be closely monitored, taking into account not only the deactivation of coal-fired power plants in Portugal and Spain, the gradual deactivation of the Spanish nuclear power plants but also the variability of the generation of renewable sources.

Figure 4.3 — Characteristics of the electrical network on a weekly basis
(Source: Ribeiro et al., 2019, adapted from REN, 2019)

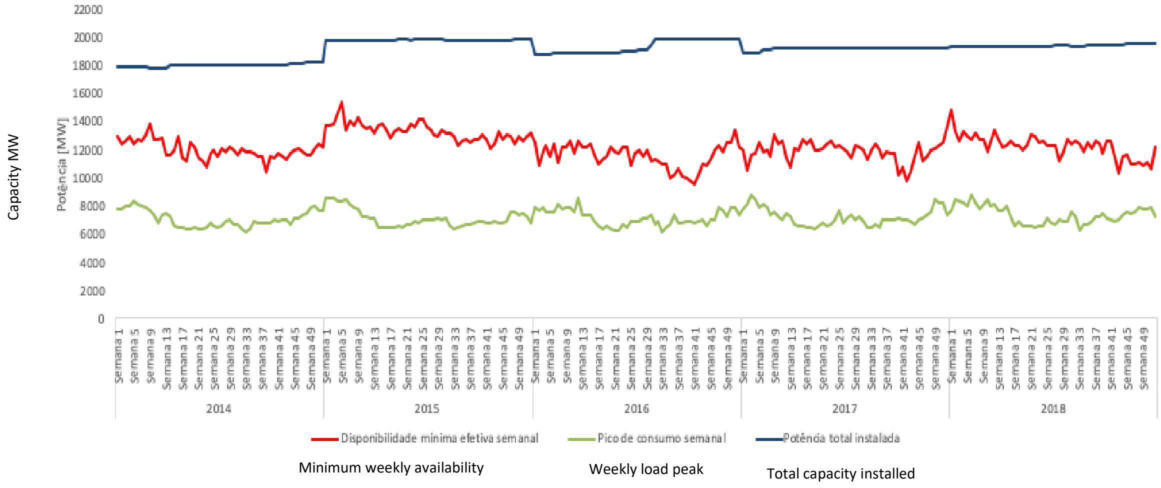
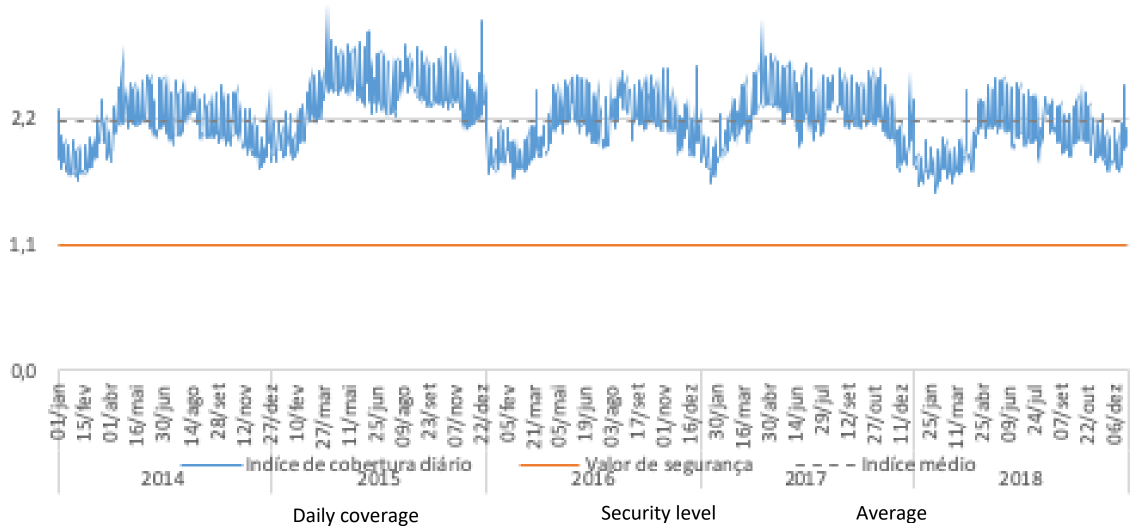


Figure 4.4 — Electric grid coverage index (available power/peak consumption) on a daily basis, 2014-2018 (Source: Ribeiro et al., 2019, adapted from REN 2019)



The reinforcement of interconnections could be better supported. The interconnection capacity between Portugal and Spain is double the official indicators (whose calculation does not have a transparent methodology). The reinforcement of the network should be fully justified. The network organisation should be thought for the prosumer and support itself in smart networks. As it is not addressed in the PNEC, it would be worthwhile to introduce the issue of low voltage distribution network management, at a time when this problem is being addressed with contradictory solutions that deserve more public scrutiny.

4.4 Dimension of the internal energy market (electricity infrastructures, energy transport infrastructures, market integration)

The Iberian electricity market is already a reality today. However, there is a lack of transparency towards consumers, along with a legal and commercial framework that facilitates the emergence of new business models: prosumer, cooperatives, smart grids, ESCO, among others. These issues are raised in the PNEC, but there is no clear strategy to promote alternative models; it seems that incumbents always deserve priority.

The strengthening of interconnections is poorly grounded in the PNEC. According to REN, the average interconnection capacity between Portugal and Spain amounts to 2 221 MW in imports and 3 096 MW in exports; the minimum values indicated in the PNEC for comparison terms are not the most appropriate. Apparently, we have already met the interconnection target for 2030 today. Network reinforcements should be fully justified. The future organisation of the network should be thought for the prosumer and for the intelligent networks. The Spain-France interconnections should be promoted, as they are important links to reduce costs and improve the complementarity of the Iberian Peninsula with the rest of Europe.

4.5 Dimension of Research, Innovation and Competitiveness

The research and innovation dimension is addressed in a very general way using recent indicators and their evolution. The evolution of the level of investment in science in relation to GDP is mentioned. The weight of the business sector reaches almost half of what is invested in science, with total amounts approaching 1.3% of GDP (2016).

Within the framework of the PNEC, it would be more interesting to define the main lines of possible financing of research & innovation projects, involving companies and R&D units. Some of these lines could be the various modalities of energy efficiency, hydrogen, the power storage (batteries) technology or the exploitation of the ocean energy potential. Also, the evidence of the efficiency of energy communities, the deployment of smart grids in urban or rural spaces, the better organisation of collective transportation, the improvement of the energy behaviour of collective equipment, the integrated and collective management of urban condominiums, or the adhesion of the various social groups to the proposed measures and technologies.

In the business sector, the latitude of aspects to study, to experiment and to spread is equally immense. The possible establishment of a cluster in those areas, naturally with strong public leverage, could anticipate some of the PNEC objectives (and also of the RNC2050) and create, in the country, innovative competencies and skills as well as a new business in this area.

A chapter on Research and Innovation is expected to define a methodology for structuring R&D lines, projects or contracts in order to incorporate new levels of interdisciplinary knowledge, that take into account energy efficiency, the exploration of new resources and the decarbonisation of the community.

Structuring a Development Programme, coupled with the new programming period for Community funds (2021-2027), could be useful but partial support for promoting R&D in energy and decarbonisation.

While acknowledging that the national scope is fundamental, the RD&D strategy could also lead to regional contracts, managed with the support of the CCDRs, similarly to what was recently launched in the Circular Economy, pointing to the main intervention axes and measures in the energy sector, but adapted to the diversity of regions.

5. Energy poverty[2]

Energy poverty is one of the aspects included in the PNEC, although an almost negligible emphasis is given. It is a barely recognised problem in Portugal, which began to be investigated in the United Kingdom in the early 1990s. At the time, it was termed fuel poverty and referred to households' inability to access adequate energy services (heating, hot water, lighting, etc.), with associated costs that could not exceed a maximum of 10% of their income. Since then, recognising the extent and severity of this problem in Europe has been slow, although it has led to the notion of energy poverty finally gaining more political attention. It is already on the European Union agenda, as shown by its inclusion in the energy transition package, which obliges Member States to monitor energy poverty. The recent creation of the European Energy Poverty Observatory shows the interest this problem has aroused.

In the context of the recent economic crisis, energy poverty in the EU has increased and is estimated to affect more than 50 million households, with serious implications for their health and well-being, as well as negative consequences for the economy. Energy poverty has been linked to cardiovascular and respiratory diseases, as well as mental and other health problems such as colds, flu, arthritis and rheumatism. The impacts of climate change - heat waves and cold waves - have already exponentially increased health problems that affect mostly fragile groups such as the elderly, children and citizens with less economic and educational resources.

International studies have identified Portugal as one of the European countries that is most exposed to energy poverty. Vulnerability to energy poverty is reflected, for example, in excess winter mortality. In Portugal (2014) a coefficient of 24.9% was registered, while the average of the 28 countries of the European Union was 11.7% (EPOV, 2019). The apparent paradox of having a country with a mild climate and, at the same time, an excess of deaths during the winter, far superior to that of countries with cold climates, has been explained by the combination of factors that tend to be the basis of energy poverty: low incomes, low quality housing construction and high energy prices.

Energy poverty is not limited to the population below the poverty line and can affect a substantially larger segment of the population. Available statistics (Eurostat, European Union Annual Survey of Income and Living Conditions (EU-SILC)) show that in Portugal, between 2010 and 2017, the proportion of individuals who declared that they were unable to keep the house adequately warm was between 20.4% and 30.1%, while the EU average was between 10.4% and 11.3%. For households in Portugal with problems of roof infiltrations, humidity on walls, floors or foundations and even rotting in windows and floors, the proportion was between 21.3 and 32.8%, while in the EU it varied between 13.3 and 16.1%. With regard to the price of electricity for domestic consumers in Portugal, there has been a gradual increase between 2008 and 2016, including the adoption of the maximum VAT rate. In 2016, the price of electricity in Portugal became the fifth highest in the 28 EU countries. In 2018, electricity and gas prices, with all taxes included, were respectively 12% and 28% higher than the European average (Eurostat, 2019).

[2] The analysis of the issues of energy poverty benefited from the collaboration of Ana Horta, from the Institute of Social Sciences of the University of Lisbon and João Pedro Gouveia, from the Faculty of Science and Technology of the New University of Lisbon.

The inadequacy of the majority of Portuguese households to protect the population from the cold is also evidenced by data from the Energy Consumption Survey in the Domestic Sector (INE/DGEG, 2010). It should be noted that 69.8% of residential buildings were constructed before 1990, i.e. before the first regulation with indications regarding the thermal comfort of households. Only 21.1% of households have external insulation on the walls and more than 70% have single glazed windows. In addition, data on the energy certificates for residential buildings issued so far (over 855,000) show that the majority (74.1%) received a low rating (between C and F) (Energy Observatory, 2019).

Combined analyses of various indicators place Portugal as one of the three EU countries with the highest risk of energy poverty, mainly due to the inability to maintain temperatures of thermal comfort in households. However, in view of the large social and geographical differences associated with the distribution of energy poverty in the European Union and within each Member State, the policies aimed at mitigating them must be implemented at regional level, and hence the need to study the problem within each country in its different geographical scales (regions, municipalities, parishes).

Considering the data in regional terms, resulting from a methodology developed for the classification and mapping of vulnerability to energy poverty in the national territory at parish level, it is verified that the problem of energy poverty is identified in practically all counties of the country, with different regional variabilities, through vulnerability in winter and summer (Gouveia et al., 2019).

So far, there are few measures to address the problem. The social energy tariffs, launched in 2010 and 2011 (respectively, electricity and natural gas), comprised 13.84% and 2.57% of families in the third quarter of 2018 (Martins et al., 2019).

The fact that the problem is pressing, due to the impact it has on thermal comfort, indoor air quality and Portuguese population’s health implies the adoption of short and medium-term strategic measures that the PNEC should contemplate more clearly, starting with the most consistent identification and characterisation of energy poverty in Portugal.

Local Authorities, due to their proximity, could play a fundamental role in the detection, analysis and solution of these cases.

6. Recommendations

Analysing the National Integrated Energy and Climate Plan (PNEC), and bearing in mind the strategy that has been developed with a long-term horizon proposed by the National Road Map for Decarbonisation, the National Council for Environment and Sustainable Development (CNADS) **advises that further reflection on the PNEC should be made, taking advantage of the period that is still available until the final version of the Plan is presented and addressing the issues that the CNADS suggests as Recommendations:**

Recommendation 1 – Adoption of building rehabilitation policies, primarily through tax benefits and local support models for families (eventually with the responsibility of local authorities), aimed at improving the buildings thermal behaviour, including insulation, solar thermal and solar photovoltaic equipment, reaching families, companies and institutions;

Recommendation 2 – Further define regulations capable of improving the energy efficiency of buildings, ensuring the adoption of passive solutions in the various construction modalities;

Recommendation 3 – Recognising that the energy transition requires considerable investment, in particular from the private sector, it is recommended to adopt policies to support the conversion of production systems and processes, encouraging the replacement of equipment, valuing the readjustments of production processes, ensuring the support to energy audits, defining incentives for the acquisition of equipment and services of high energy efficiency, supporting the creation, in its internal structure, of the figure of an energy manager with a transversal role of intervention in all the sectors of a company;

Recommendation 4 – Focusing on energy efficiency, extend the energy labelling rules for office and household equipment and sensitize the general public as well as companies to opt for equipment that has maximum efficiency in their energy performance;

Recommendation 5 – Promoting as wide a decarbonisation as possible in the transport sector, discouraging individual transportation, promoting collective transportation, and developing and electrifying the railroad;

Recommendation 6 – Ensure the creation of incentives for light mobility (bicycles and other light vehicles), including electric versions, as well as the installation of dedicated lanes for these modes of transport;

Recommendation 7 – Taxation should be restructured and reformed, making it user-friendly with the various initiatives geared towards energy transition and decarbonisation, avoiding double taxation and eliminating fiscal burdens with contradictory meaning;

Recommendation 8 – Establish an appropriate value for the carbon ratio that reflects the environmental costs of GHG emissions, in activities not covered by the European Union Emission Trading Scheme, for the benefit of energy efficiency and sustainable mobility;

Recommendation 9 – Structure a programme to support the decentralised generation of energy by modifying the Small Production Unit (UPP) and Production Units for Self-consumption (UPAC) legal framework, making them more transparent, flexible and attractive, covering the acquisition of photovoltaic panels and adjusting them to the various target audiences that have to be mobilised for these changes (households, SMEs, Municipalities, Associations, Administrations);

Recommendation 10 – Simplify the licensing, accreditation, installation and operation mechanisms of equipment for the generation of renewable energy of low environmental impact, facilitating and promoting its adoption, without offending the rules of competition;

Recommendation 11 – Consistent planning and structuring of electricity distribution networks that respond to the increasing needs of electric mobility and, in particular, facilitate the access of this service to families;

Recommendation 12 – Promote the installation of forests, based on native species, also valuing them as a carbon sink, with impact on the soil, and structured in the framework of appropriate planning, so as to minimize rural fires;

Recommendation 13 – Promote and defend the various agrosilvopastoral systems, namely the montane farming systems (in the south) and the loam systems (in the north);

Recommendation 14 – Promote agricultural production, using mainly methods that adopt a minimisation of farming, as a means of increasing carbon sink, and valuing biological crops, integrated protection practices and cultural associations that preserve biodiversity;

Recommendation 15 – Particular attention should be given to professional training and requalification by linking appropriate and specific measures to the various stages of the energy transition and decarbonisation, which are conducive to a just transition;

Recommendation 16 – Define lines, measures and concrete actions to foster research/demonstration projects aimed at adopting renewable energies in real estate, favouring residential buildings, encompassing families and encouraging the creation of energy communities, intelligent condominiums or autonomous energy generation structures;

Recommendation 17 – Ensure a qualified intervention in the field of education and training that responds to the breadth the options adopted at the PNEC and covers the various levels of the education system, acknowledging the school, at its various levels, as a privileged instrument in supporting the implementation of the various PNEC measures;

Recommendation 18 – Carry out information and awareness campaigns regarding the causes and consequences of energy poverty among the general population, but also of specific sectors such as mayors, managers and technicians in the area of social housing, architects, civil constructors, health professionals, teachers, social assistants and agents of solidarity institutions, among others;

Recommendation 19 – Promoting public culture on energy that provides citizens with basic knowledge and skills on how to deal with everyday issues related to energy. Studies and surveys show very low levels of energy literacy by the Portuguese population, which generates serious deficiencies and distortions of knowledge in this area, from notions of spending, control of consumption and the exercise of best practices. To meet these needs, and given the complexity of the theme, it is recommended to invest seriously in communication processes, through direct interaction by proximity agents (Town Councils, Regional Agencies or Local Energy Agencies, Local Development Associations, etc.);

Recommendation 20 – Strengthen monitoring mechanisms for energy efficiency, focused on families and SMEs, with a special focus on energy poverty, to monitor the PNEC implementation, identify best international practices to mitigate the problem, promote sources of financing and disseminate low-cost measures to improve the thermal comfort of the population;

Recommendation 21 – Define a new type of Governance model to accompany the execution of the PNEC in order to overcome traditional institutional segmentations and ensure the design of transversal public policies oriented towards energy transition and decarbonisation;

Recommendation 22 – As part of the changes in the Governance model, it is important to understand that the PNEC will have to dialogue with the various programmes with intervention in the territory, with the financing programmes and with the public policies that have an impact on the territory, evoking the PNPOT (National Program of Territorial Planning Policy), the

National Strategy for Active Mobility, and the POEM (Maritime Spatial Planning Program), which did not deserve due attention in the reflection that led to the PNEC.

7. Final Note

The PNEC is moving ahead with a set of guidelines for the energy transition, decarbonisation of society and mitigation of the effects of climate change. All these lines compromise, with different degrees of intensity, the various agents that compose the communities: families, companies, municipalities, administrations and other entities with expression in our social order.

However, it is recognised that this whole complex structure cannot function effectively without an appropriate governance model. The fluidity of information, the qualified decision-making capacity at the various levels corresponding to the various interventions, the establishment of simple and clear rules that facilitate not only relations between entities but also the Administration's position (as a driver, creator and regulator of the institutional structure) encompassing the various initiatives included in the decarbonisation strategy and the promotion of the energy transition are decisive factors in ensuring the success of this strategy. The survival of our communities depends on the collective ability to adopt another model of lifestyle and a different attitude towards the everyday mechanisms that characterise our socio-economic organisation.

The PNEC is part of the long-term strategy for the decarbonisation of the economy and society, as reflected in the National Roadmap for Carbon Neutrality. Being a Roadmap (and not a Plan), its execution over the next 30 years is conditioned by the dynamics of society as a whole, recognising the enormous difficulty in defining its execution timings before a set of agents with different perceptions, with different financial capacities, with outdated priorities or with sensitivities to the problems of energy and climate that may be inconsistent, but also with policies that may generate transient discontinuities. The inevitability of achieving, by 2050, full compliance with the carbon neutrality goals has to be collectively assumed. In the politico-social balance that conditions the evolution of our society, the course will not be linear; therefore, it needs a solid navigational instrument that will alert to the difficulties faced, which will identify the goals reached, that will mobilise the different agents differently and that will give public notice of the situation to which it is progressively reaching.

As mentioned in the epigraph: "**There is no Planet B**".

[Approved at the 1st Extraordinary Meeting of the CNADS in 2019, held on April 15]

The President

Filipe Duarte Santos

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ANNEX

Presented below, are some profiles of consumption of sectors of the society (agriculture and fisheries, industry, public works, transport, services and domestic sector). In the end, the results of the manufacturing industry are disaggregated into three subsectors, also defining their profiles of energy consumption. Some explanatory notes are also included. The source of this information is the National Energy Balance (provisional) for 2017 (DGEG).

1. The consumption profile by activity sector

1.1. Agriculture and Fisheries

Type of energy	2005		2010		2017		*Var. 2017/05*
	toe	%	toe	%	toe	%	*%*
Coal	-	-	-	-	-	-	
Oil and Derivatives	407 817	80	360 462	79.3	359 230	78.3	*-12*
Natural Gas	3 824	0.8	3 511	0.8	5 773	1.3	*+51*
Electricity	85 054	16.7	88 164	19.4	90 651	19.8	*+7*
Heat	12 759	2.5	2 399	0.5	1 793	0.4	*-86*
Waste and other renewable	-	-	65	0.01	1 422	0.3	-
TOTAL	509 454	100	454 601	100	458 869	100	*-10*

1.2. Mining Industry

Type of Energy	2005		2010		2017		Var. 2017/05
	toe	%	toe	%	toe	%	*%*
Coal	-	-	-	-	24	-	-
Oil and Derivatives	53 972	50.5	46 001	34.1	33 806	42.4	*-37*
Natural Gas	6 863	6.4	7 951	5.9	1 629	1.8	*-76*
Electricity	37 350	34.9	47 271	35.1	36 707	46	*-2*
Heat	8 774	8.2	33 517	24.9	7 799	9.8	*-11*
Waste and other renewable	-	-	91	0.07	-	-	-
TOTAL	106 959	100	137 831	100	79 965	100	*-25.2*

Notes:

- Selective reduction of activity with different incidence in the various origins of energy consumed.

1.3. Manufacturing Industry

Type of Energy	2005		2010		2017		Var. 2017/05
	toe	%	toe	%	toe	%	*%*
Coal	16 216	0.3	50 200	1	10 980	0.3	*-32*

Oil and Derivatives	1 407 648	26.3	787 171	15.9	478 326	11.2	*-66*
Natural Gas	933 896	17.5	971 726	19.6	1 184 038	27.7	*+27*
Electricity	1 274 317	23.8	1 331 090	26.8	1 320 681	30.9	*+4*
Heat	1 131 803	21.2	1 279 045	25.8	1 099 055	25.7	*-3*
Waste and other renewable	580 706 + 33 925	10.9	590 133	11.9	181 118 + 95 258	4.2	*-50*
TOTAL	5 378 511	100	4 959 165	100	4 369 456	100	*-18.8*

Notes:

- The use of coal in the industry is now residual and confined to the sector of metal smelting (steel and foundries);
- The use of oil derivatives is decreasing and still holds significant importance in the cement sector, where 60% of this consumption is found;
- The use of biomass for heating was significant in the ceramic sector and was greatly reduced due to the decline in the construction sector;
- The renewable component of energy consumption in the industry is 33% (electricity 55% renewable, heat from cogeneration 45% renewable);
- In terms of emissions, the "mix" verified in 2017 suggests even greater reductions of 33% in renewables than in 2005.

1.4. Construction and Public Works

Type of Energy	**2005**		**2010**		**2017**		**Var. 2017/05**
	toe	%	toe	%	toe	%	*%*
Coal	-	-	-	-	-	-	-
Oil and Derivatives	274 947	81.6	179 666	74.5	97 347	61.9	*-65*
Natural Gas	5 837	1.8	9 218	3.8	15 464	9.8	*+165*
Electricity	56 015	16.6	52 436	21.7	44 329	28.2	*-21*
Heat	-	-	-	-	-	-	-
Waste and other renewable	-	-	-	-	91	0.1	-
TOTAL	336 799	100	241 320	100	157 231	100	*-53.3*

Notes:

- The variations are derived from the reduced activity in the sector (fewer large-scale construction works), where the use of electricity or natural gas is often not feasible.

1.5. Transport Sector

Type of Energy	**2005**		**2010**		**2017**		**Var. 2017/05**
	toe	%	toe	%	toe	%	*%*
Coal	-	-	-	-	-	-	-
Oil and Derivatives	6 764 629	99.2	6 068 010	94.1	5 462 402	94.6	*-19*

Natural Gas	10 509	0.2	12 581	0.2	14 735	0.3	*+40*
Electricity	43 613	0.6	40 857	0.6	41 246	0.7	*-5*
Heat	-	-	-	-	-	-	-
Waste and other renewable	-	-	325 706	5.1	255 066	4.4	-
TOTAL	6 818 751	100	6 447 154	100	5 773 449	100	*-15.3*

Notes:

- The reduction in the consumption of oil derivatives in transport is due to:
  - Introduction of biofuels;
  - Reduction of economic activity;
  - Supply outside the country;
  - Reduction of fuel supplies to commercial aviation.

1.6. Domestic Sector

Type of Energy	**2005**		**2010**		**2017**		**Var. 2017/05**
	toe	%	toe	%	toe	%	*%*
Coal	-	-	-	-	-	-	-
Oil and Derivatives	715 656	22.1	679 765	23	420 421	16.4	*-41*
Natural Gas	200 494	6.3	300 266	10.2	251 733	9.8	*+26*
Electricity	1 138 820	35.2	1 248 873	42.3	1 082 712	42.3	*-5*
Heat	-	-	-	-	-	-	-
Waste and other renewable	1 176 309	36.4	724 980	24.5	806 890	31.5	*-31*
TOTAL	3 231 279	100	2 953 884	100	2 561 756	100	*-20.7*

Notes:

- Statistical correction of firewood consumption;
- Decrease in the consumption of LPG fuel and heating oil;
- The effect of energy "poverty" is visible in the comparison between 2010 and 2017.

1.7. Services

Type of Energy	**2005**		**2010**		**2017**		**Var. 2017/05**
	toe	%	toe	%	toe	%	*%*
Coal	-	-	-	-	-	-	-
Oil and Derivatives	933 810	39.2	249 772	12.6	145 749	7.7	*-84*
Natural Gas	138 341	5.8	208 962	10.5	255 272	13.4	*+85*
Electricity	1 297 246	54.5	1 479 924	74.4	1 394 803	73.4	*+8*
Heat	6 537	0.3	21 002	1.1	27 842	1.5	*+326*
Waste and other renewable	5 099	0.2	29 776	1.5	77 352	4.1	*+1,417*
TOTAL	2 381 033	100	1 989 436	100	1 901 018	100	*-20.2*

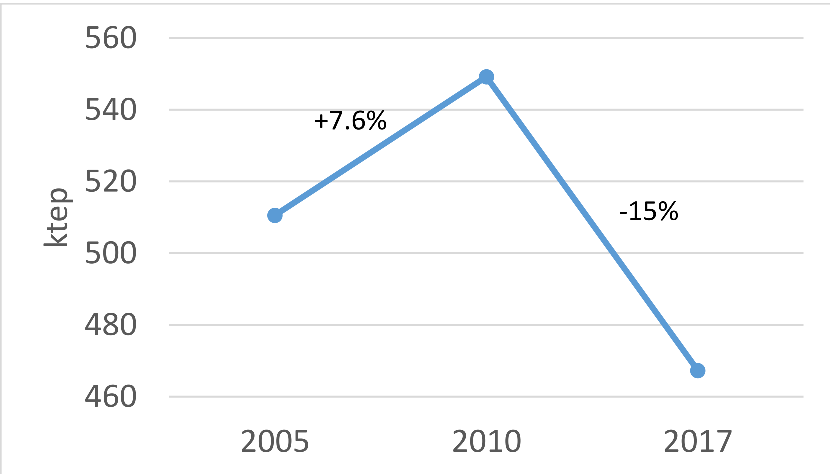
Notes:

- There were changes in the criteria for the consumption of transport;
- The consumption of natural gas was generalised and the solar thermal registered considerable expansion.

2. The evolution verified in key sectors of the manufacturing industry

2.1 Food Industry

Type of Energy	2005		2010		2017	
	toe	%	toe	%	toe	%
Coal	-	-	-	-	-	-
Oil and Derivatives	168 359	33	129 212	23.5	64 284	13.8
Natural Gas	62 850	12.3	94 537	17.2	156 682	33.5
Electricity	145 746	28.5	163 812	29.8	169 906	36.4
Heat	41 468	8.1	68 821	12.6	41 684	8.9
Waste and other renewable	92 143	18.1	92 813	16.9	34 745	7.4
TOTAL	510 566	100	549 195	100	467 301	100

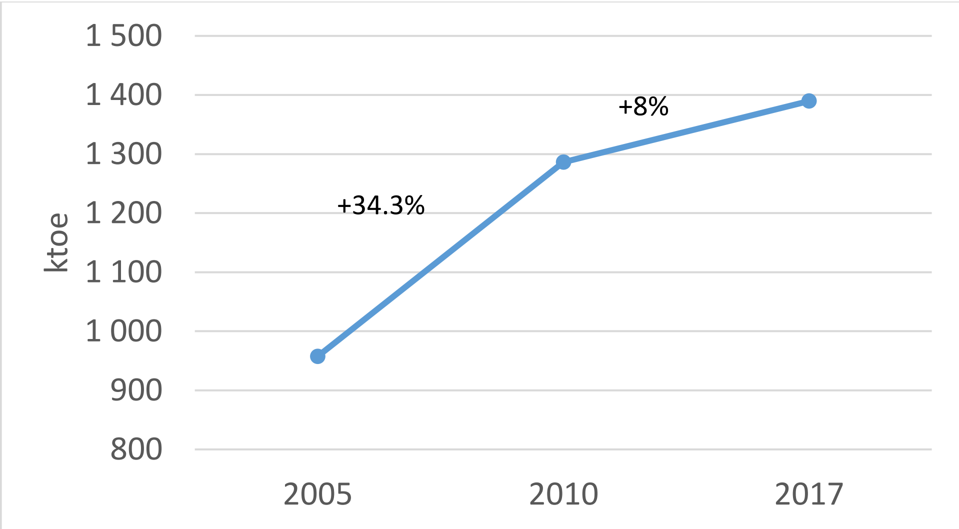


- The effect of the recessive period that the Country has experienced is certainly more significant than that of the improvements in energy efficiency;
- The positions of oil derivatives and natural gas have been reversed;
- The use of cogeneration (heat) is lower today - less attractive electricity tariffs;
- The use of firewood has been drastically reduced for environmental reasons.

2.1 Pulp and Paper Sector

Type of Energy	2005		2010		2017	
	toe	%	toe	%	toe	%

Coal	-	-	-	-	-	-
Oil and Derivatives	28 011	2.9	51 953	4	20 017	1.4
Natural Gas	26 181	2.7	69 885	5.4	152 923	11
Electricity	187 681	19.6	262 849	20.4	265 948	19.2
Heat	715 634	74.8	901 342	70.1	915 633	65.9
Waste and other renewable	-	-	-	-	35 083	2.5
TOTAL	957 507	100	1 286 029	100	1 389 604	100



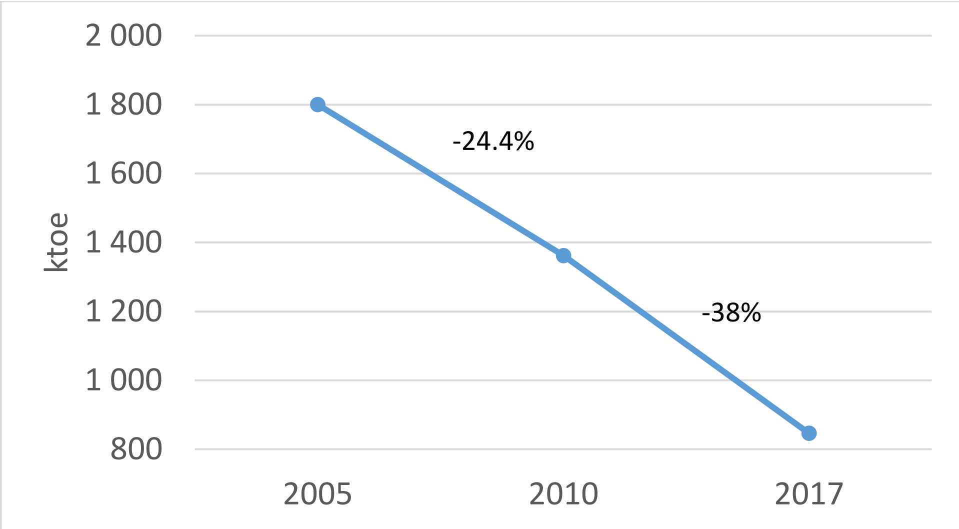
- The positioning of this national sector in the international markets, combined with the investments made in increasing paper production capacity, results in the apparent immunity from the economic contraction in other sectors.

2.2 Sectors with significant dependence of the Construction and Public Works sector (Ceramics and Cements)

Units: toe %

Type of Energy	2005		2010		2017	
	toe	%	toe	%	toe	%
Coal	14 768	0.8	33 965	2.5	-	-
Oil and Derivatives	874 073	48.6	481 336	35.3	314 457	37.1
Natural Gas	351 325	19.5	267 846	19.7	237 401	28.1
Electricity	172 575	9.6	123 792	9.1	99 296	11.7
Heat	13 886	0.8	22 024	1.6	17 326	2.1
Waste and other renewable	373 440	20.7	432 775	31.8	177 708	21

TOTAL	1 800 067	100	1 361 738	100	846 188	100



- The correlation between the decline in investment in the construction and public works sector and the reduction of activity and energy consumption in the ceramics and cement sectors is evident;
- The disappearance of the smaller industrial units in the ceramic sector caused a notable reduction in the use of firewood and other vegetal residues.