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Energy Efficiency Trends and Policies in SPAIN

ODYSSEE- MURE

"A decision support tool for energy efficiency policy evaluation"

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0. EXECUTIVE SUMMARY

This report presents the national case of Spain for the *"ODYSSEE-MURE, a decision support tool for energy efficiency policy evaluation (ODYSSEE-MURE)"* project in the HORIZON 2020 programme. Follow-up on progress in energy efficiency of countries in the European Union, Norway, Serbia and Switzerland is carried out within the framework of the aforementioned project by studying energy efficiency trends and policies.

Energy efficiency plays a key role in energy planning policies owing to its strategic importance in the transition towards a more competitive and sustainable economy. Throughout the last few years, Spain has been carrying out significant efforts to improve its energy efficiency, as can be seen in the four chapters in which this report is structured.

Chapter 1 offers a general overview of the energy-related and economic situation of Spain, as well as the main policies currently in force in what concerns energy planning.

Chapters 2, 3, and 4 are geared towards sector-based analysis, including two sections within each chapter that display a differentiated analysis for the most significant energy efficiency trends and actions for each sector, paying special attention to measures geared towards the fulfilment of the targets set by Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency.

Throughout the last few decades, Spain has evolved towards an increased level of energy diversification that is characterised by a growing share of renewable energies and natural gas. This has been followed by a sustained growth in the demand for energy that reached a tipping point in 2007. It was followed by a downward trend from that point onwards, mainly owing to the fall in demand for oil products and coal and reinforced by the effects of the financial crisis. This situation ended in 2015, in a context of economic recovery in which demand increased by 4.0%. This change in trends remained by 2016, with a slight increase of 0.4%.

As with demand, energy intensity displayed a downward trend from 2004 to the beginning of the crisis in 2008. Ever since then, it maintained this trend at a slower rhythm throughout the first few years of the crisis. Although this downward trend can still be observed to this day, the improvements that can be seen from 2014 onwards seem to have been stimulated by the recovery in economic activity that allowed for increased levels of production and, therefore, a better use of productive capacity. In this context, improvements of 2.9% and 0.6% were observed in what concerns primary and final intensity, respectively. The higher level of improvement in primary intensity is due to an increased availability of renewable resources for electric power generation in 2016, which in turn leads to greater efficiency in transformation, thus reducing the amount of energy required to generate electricity and, hence, primary intensity.

In what concerns the final energy demand by sectors, the transport sector still holds first place with a 42.3% share of overall consumption. It is followed by the industrial sector, with a 23.0% share of demand. These two sectors largely determine the evolution of global energy intensity, owing to their significance within the overall demand structure.

Practically all sectors display a trend towards improvement in their intensity, which was accentuated in the context of the financial crisis. The service and industrial sectors display a somewhat erratic behaviour largely owing to the economic downturn, which led to the equipment to run below optimal levels, thus affecting their efficiency. To this we must add, in what concerns the industrial sector, the downturn in the construction sector. In the context of a more favourable economic situation, this sector displayed a significant 8% improvement in energy intensity by 2016, in contrast with other sectors, which displayed a slight deterioration in intensity.

According to the global energy efficiency index (ODEX), which is best suited to analyse energy efficiency, Spain has displayed continuous progress in energy efficiency over the 2000-2016 period, with an average annual improvement of 1.44%.

The need to consolidate the advance towards increased energy efficiency in Spain has taken shape in a number of actions, many of which respond to requirements established by Community guidelines on energy efficiency that are currently in force. You may find some of these measures in the MURE (Mesures d'Utilisation Rationelle de l'Énergie) database (http://www.measures-odyssee-mure.eu/).

The 2017-2020 National Energy Efficiency Action Plan is the general framework for energy efficiency policies in Spain. This plan is the second Action Plan required by Directive 2012/27/EU and the fourth (NEEAP4) pursuant to article 14 of Directive 2006/32/EC, of 5 April 2006 on energy end-use efficiency and energy services. This provides continuity to the Action Plans of the *2004-2012 Energy Saving and Efficiency Strategy (E4)*, as well as the Action Plans that followed, 2011-2020 (NEEAP2) and 2014-2020 (NEEAP3). The Plan integrates a vast array of instruments and measures to fulfil the energy targets undertaken by Spain concerning articles 3 and 7 of the aforementioned Directive.

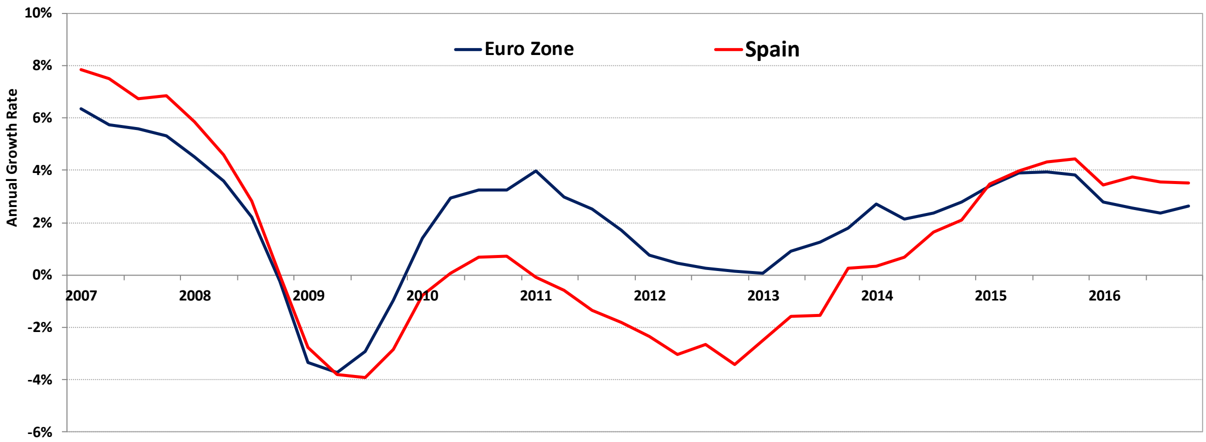
At the sector level, transport and buildings stand out as the recipients of the largest number of measures. In what concerns the transport section, actions geared towards sustainable and alternative mobility stand out in particular. In what concerns buildings, beyond the legislative measures developed in response to Directive 2010/31/EU on the energy performance of buildings, there are a number of programmes and measures intended to renovate buildings for the purpose of improving energy efficiency, focusing especially on buildings belonging to the public administration owing to their exemplary role.

1. ECONOMIC AND ENERGY EFFICIENCY CONTEXT

1.1. ECONOMIC CONTEXT

The Spanish economy has shown signs of recovery since 2014. In 2016, its Gross Domestic Product (GDP) maintained an average growth rate of 3.2%, identical to that of the previous year, and almost twice as much as the Euro zone average, *Figure 1.1*. This improvement, both in Spain and in the Euro zone, has been stimulated by the drop in oil prices and by the accommodative monetary policy of the European Central Bank (ECB).

Figure 1.1: Evolution of GDP in Spain and EMU



Source: Eurostat. Note: GDP in current prices.

The main driver for growth in the Spanish economy is still national demand, which has yielded year-on-year increases in GDP since 2014. Nevertheless, the contribution of internal demand abated somewhat in 2016, and this abatement was partially compensated for by an improvement in external demand, which positively contributed to GDP growth for the first time since 2013. As a result, advances in the correction of macroeconomic imbalances were achieved in 2016, as well as a consolidation of economic recovery.

Dynamism in **private consumption** expenses and **productive investments** stand out among the **components of national demand**. In 2016, private consumption increased by 3.2%, stimulated by positive developments in the gross disposable household income, job creation as well as the suppression of prices and improvements in financing terms. **Public expenditure** increased by 0.8% in 2016, less than in 2015. This deceleration is consistent with the process of budgetary consolidation that has been carried out and which contributed to a reduction in public deficit.

The boost provided by **investments** has also contributed to the expansion in national demand**.** Investments grew by 3.1% in 2016 under the impulse of national and external demand, as well as favourable financial conditions, a stabilisation in corporate balance sheets and improvements in business expectations. Investments associated to capital assets (+5%) and, to a lesser extent, construction (+1.9%), especially in what concerns the housing segment, are particularly worthy of note.

With regard to **net external demand**, the positive developments that took place in 2016 are chiefly the result of the dynamism displayed by exports in goods and services (+4.4%), especially tourism services (+8.8%). In addition to this there is a certain downturn in imports, which increased (+3.3%) 0.5% less than in 2015. In what concerns foreign trade in goods, the trade gap has decreased by 22.4%. A 37.8%

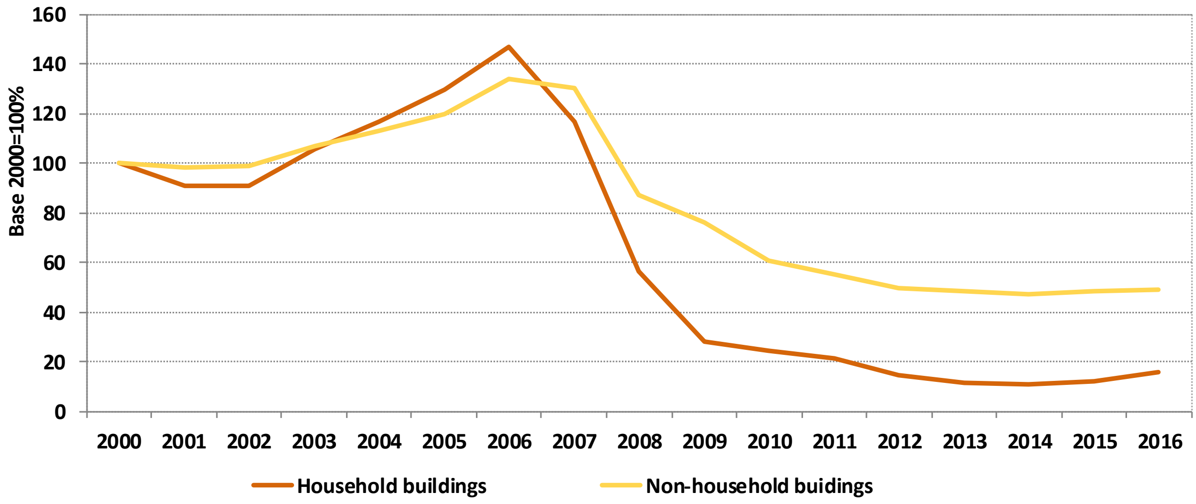
decrease in energy deficit, which makes up for 86% of the trade gap, stands out in particular among its components. This improvement has been boosted by the drop in oil prices.

In what concerns **supply**, all branches of production have displayed a positive performance in 2016, the service sector being particularly dynamic, with a recovery in activity to pre-financial crisis levels.

Within the service sector, the progress made by activities such as *trade, transport and hospitality, information and communications* and *professional activities,* which have the highest recorded increases in added value in this sector in 2016, stands out. In aggregate, these branches represent nearly 50% of the gross added value in the service sector.

Industry as a whole[1] has displayed an upward trend since 2014, even though the level of industrial activity remains below that of 2008. The industrial sector's performance was due, among other factors, to the adjustment in the construction sector and the real estate crisis, which lasted until the end of 2014. This is explained by the locomotive effect the construction sector has on demand for manufactured industrial products. This upward trend in industry, which is partially due to the dynamism of the manufacturing and extractive branches, as well as construction, can still be observed in 2016. After a constant downturn over the 2000-2009 period, the construction sector displays some signs of recovery in 2016, *Figure 1.2*, chiefly due to an upturn in residential building and, to a lesser extent, in civil works, which has allowed for a 2.5% increase in added value for this sector.

Figure 1.2: Trends in Total Floor Area of New Buildings in Spain, 2000-2016

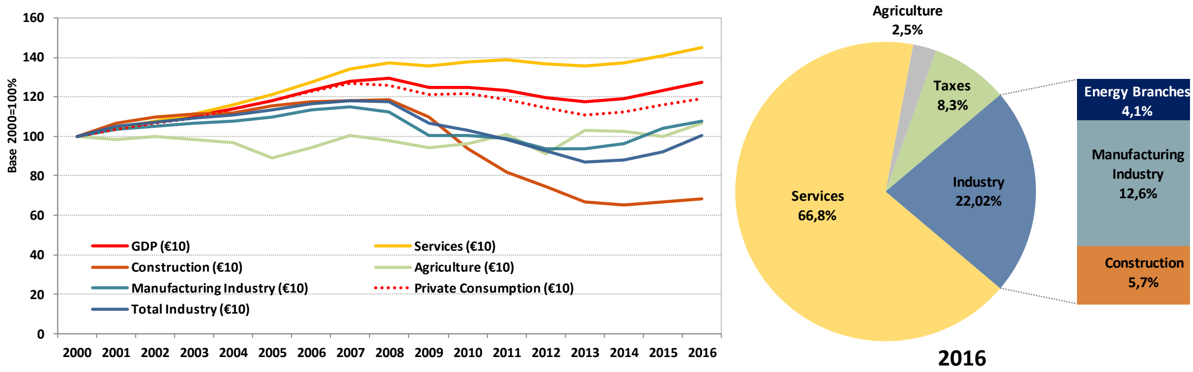


Source: MFom/INE/IDAE. Note: Data based on building permits.

Of all the EU Member States, Spain is the country where the construction industry has lost most ground and where the sector has been slowest to show signs of recovery. The adjustment measures implemented and their impact on consumption and investment have greatly conditioned the development of industrial activity, whose contribution to the economy as a whole has been declining, currently holding steady at around 22 %. This development is not exclusive to Spain's economy; it is linked to tertiarisation of the economy and, in the case of Spain, it is combined with the increasing significance of the service sector, which has increased its share of GDP since the beginning of the 2008 crisis, having reached 66% in 2016, *Figure 1.3*.

[1] *Manufacturing, energy and construction industries.*

Figure 1.3: GDP and Sectoral Contributions in Spain



Source: INE/IDAE

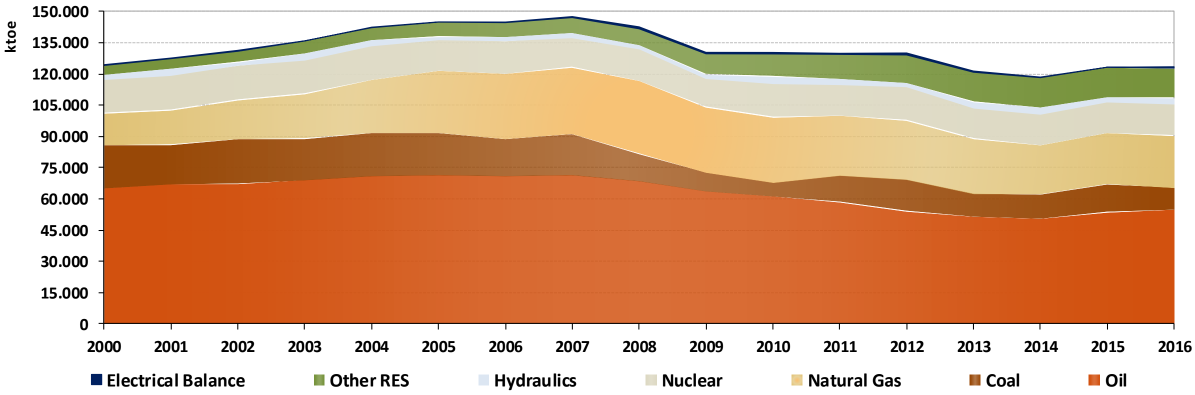
1.2. TOTAL ENERGY CONSUMPTION AND INTENSITIES

1.2.1. ENERGY CONSUMPTION TRENDS: BY FUEL AND BY SECTOR

During the last few decades, primary energy consumption in Spain has become more diversified, with renewable energy sources and natural gas accounting for a larger share, *Figure 1.4*. After a long upward trend in energy demand, total primary energy consumption peaked in 2007, followed by a downturn that was chiefly due to the drop in demand for coal and oil products. Demand for primary energy continued to fall throughout the economic crisis, but this downward trend was reversed in 2015 by a 4.0 % increase in consumption, after seven consecutive years of shrinking energy demand.

In 2016, in a context of economic recovery, with a 3.2% increase in the Gross Domestic Product (GDP), total primary energy demand amounted to 123,498 ktoe, 0.4% more than demand in 2015.

Figure 1.4: Evolution of Primary Energy Consumption by sources in Spain, 2000-2016

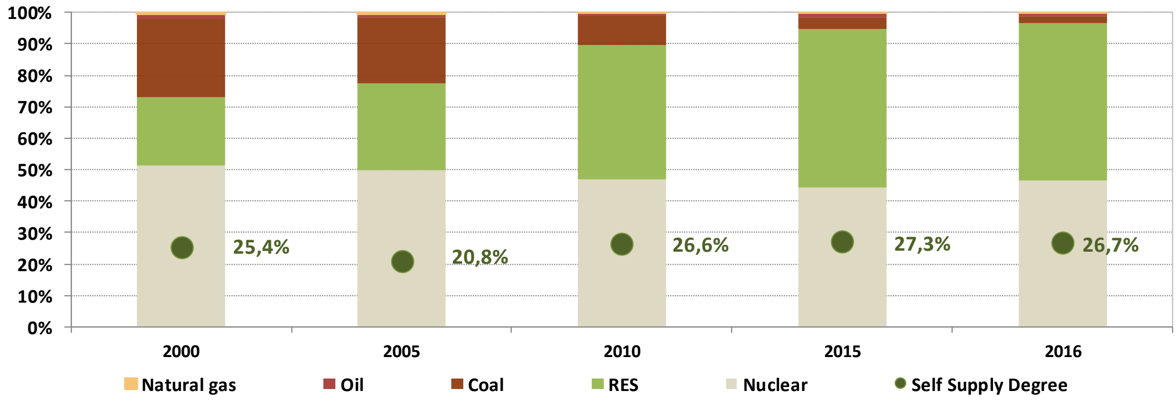


Source: MITECO/IDAE. Note: Non- renewable wastes included in petrol; small Hydro in Hydraulic.

Renewable energy sources have spearheaded this growth, with a 3.4% increase in consumption, ahead of oil (+2.7%), nuclear power (+2.2%) and natural gas (+2%). Hydro-electric energy stands out in relative terms, with a 29.3% increase in demand, stimulated by a greater availability of this resource. Other renewable technologies that have experienced an increase in demand in 2016 were biofuels (+4.7%), geothermal energy (+3.1%) and solar thermal energy (+5.8%). All of these contributions have given rise to a slight improvement in renewable energy coverage of primary energy demand, from 13.5% in 2015 to 13.9% in 2016.

Progressive penetration of renewable energy sources in the energy system, whose domestic production is currently greater than that of nuclear power, *Figure 1.5*, along with energy efficiency improvements have allowed for a significant improvement in the degree of self-supply since 2005. In 2016, despite the increased share taken up by hydro-electric energy, the level of self-supply has decreased slightly owing to the decline in biomass production, which accounts for a third of production with renewable energy sources.

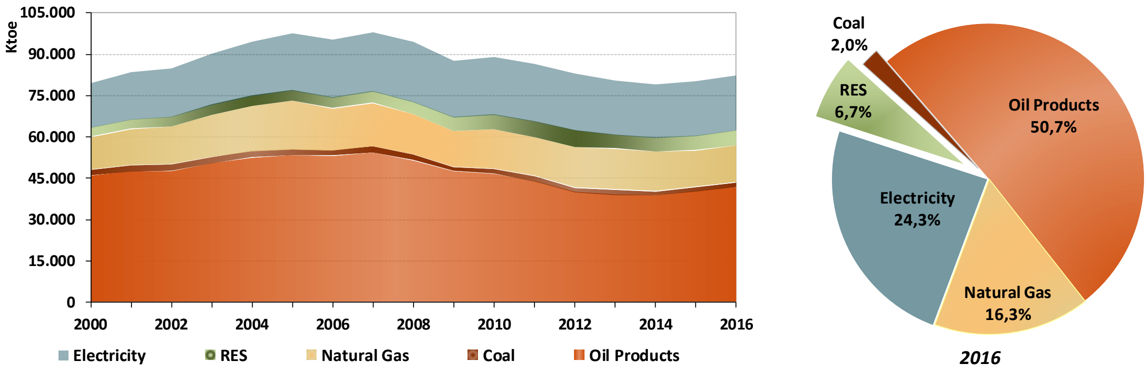
Figure 1.5: Trends of Domestic Energy and Degree of Self Supply, 2000-2016



Source: MITECO/IDAE. Note: Non- renewable wastes included in petrol.

Energy dependence remains high, around 73.3% in 2016, although its financial impact has been softened somewhat by the steady fall in oil prices since 2014, which has also implied a reduction in the energy deficit, estimated at €16,237 M in 2016 – 1.5% of GDP–. In what concerns of final energy, demand by energy sources displays a similar profile to that of primary energy. In 2016, final energy consumption, excluding non-energy uses, amounted to 82,333 ktoe, a 2.6% increase compared to the previous year. This implies a strengthening of the change in trends that began in 2014, after seven consecutive years of downturn in demand.

Figure 1.6: Trends of Final Energy Consumption by Sources, 2000-2016

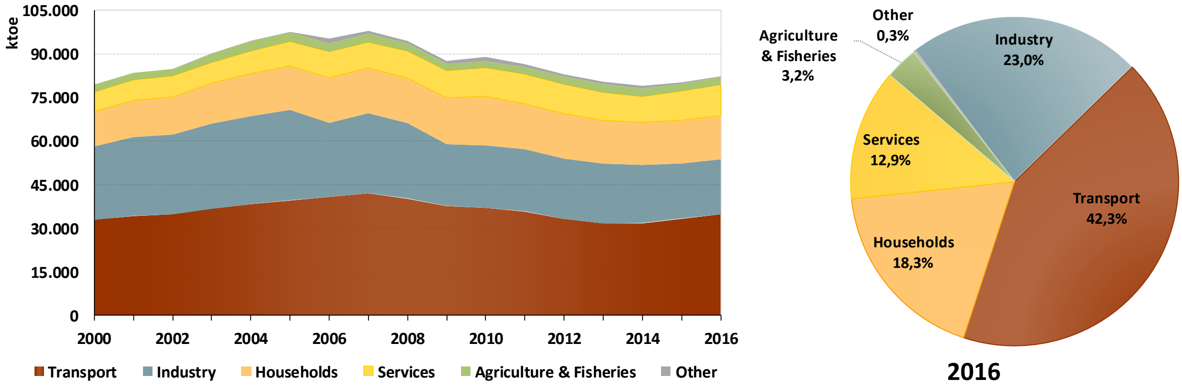


Source: MITECO/IDAE. Note: Non-energy uses excluded.

The increase in 2016 is mainly due to the increased consumption of oil products (+3.6%) and natural gas (2.3%), which jointly account for 67.1% of overall demand.

The structure of energy demand by sources in 2016 is concordant with sector-specific demand, *Figure 1.7,* in which transport stands out with a 42.3% share of demand. It is followed by the industrial sector, with 23.0% of demand, although this sector has been progressively declining as regards its significance within the overall demand structure. The opposite occurred with the sectors grouped together under the 'Mixed use' category,[2] which accounts for 34.4 % of demand and has exceeded the share held by industry since 2006.

Figure 1.7: Trends of Final Energy Demand by Sectors, 2000-2016



Source: MITECO/IDAE. Note: Non-energy uses excluded.

This evolution corresponds to the increasing tertiarisation of the economy, *Figure 1.3*, which has been accentuated in the context of the financial crisis, in which industry as a whole – the manufacturing, energy and construction industries – has declined, and this is especially the case for construction.

The significance of the transport sector and its impacts on the environment and energy dependence justify the need to promote energy efficiency policies in this sector. This explains the large number of incentives programmes managed by the IDAE through which it has strived to promote the use of efficient vehicles and sustainable mobility. These programs focus on energy efficiency as a key element to improve competitiveness and, in doing so, to ensure the fulfilment of the targets[3] undertaken in the context of the 2017-2020 National Energy Efficiency Action Plan, pursuant to article 3 of Directive 2012/27/EU of 25 October 2012, on energy efficiency.

Spain holds fifth place among EU-28 countries in terms of primary and final energy consumption, although it holds a much lower position in terms of per capita consumption, to wit, nineteenth place.

1.2.2. OVERALL TRENDS IN ENERGY INTENSITY

The evolution of the **primary energy intensity indicator** in Spain, *Figure 1.8,* displays a trend reversal between the years 2004 and 2009 when, owing to the financial crisis, the declining trend began to level off. As in other neighbouring countries, the downward trend later began anew, largely due to the effects related to structural changes and changes in activity.

Ever since the beginning of the financial crisis, energy intensity has been improving at an annual rate of 1.5%, below the improvement (2.3%) recorded over the 2004-2008 period. This slowdown is related to, among other factors, the evolution of the energy supply structure from 2008 onwards.

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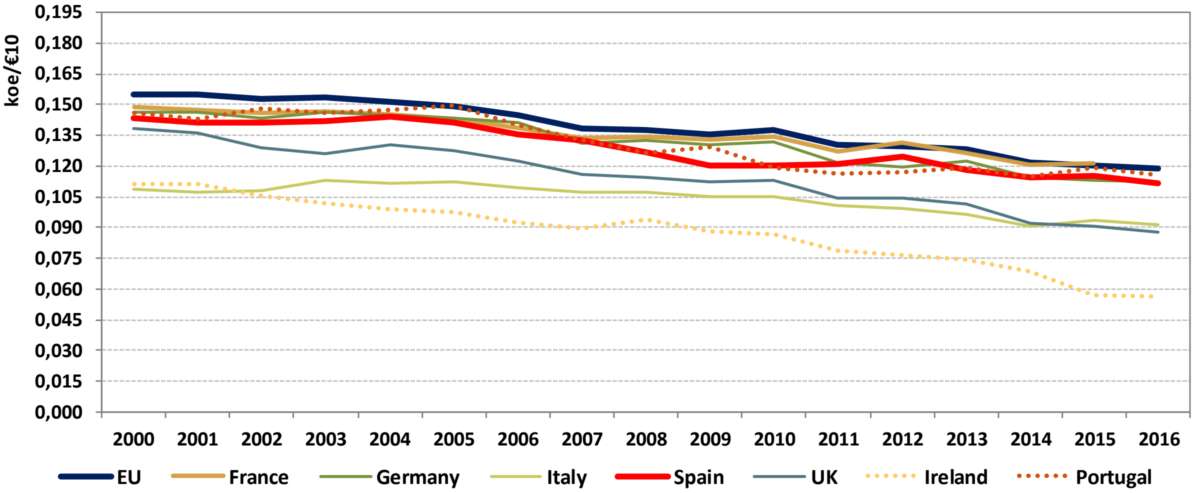
[2] *The "mixed use" category integrates the residential, service, agriculture and other sectors.*

[3] *Spain has undertaken national targets for primary and final energy consumption (excluding non-energy uses) of 122.6 Mtoe and 87.24 Mtoe, respectively. These energy consumption forecasts may be reviewed to adapt to other macro-economic scenarios.*

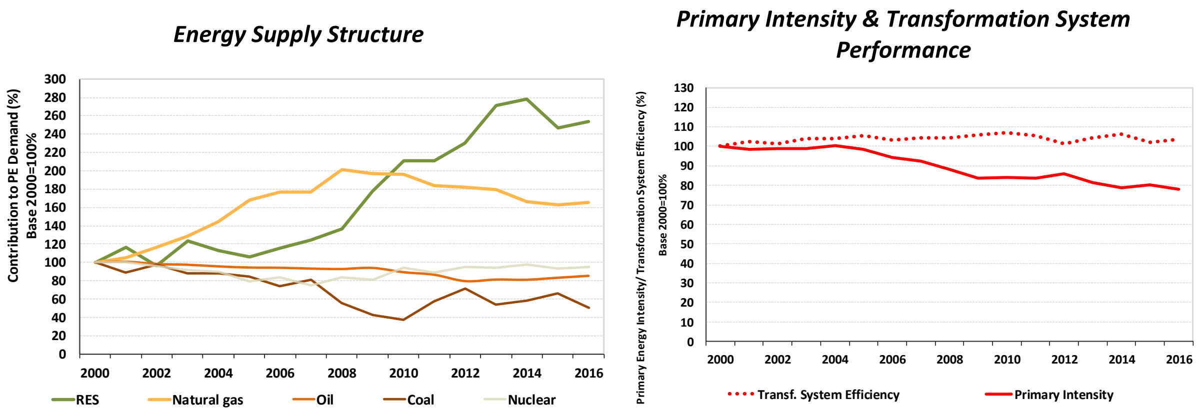
Figure 1.8: Trends of Primary Energy Intensity in Spain and EU, 2000-2016



Source: EnR/IDAE

Specifically, the adverse climatic conditions recorded in 2012 and 2015 decreased the share of renewable energy sources in electric demand which had to be compensated for by pressing coal-firing power plants into service, thus countering the positive effect associated to electric generation technology based on renewable energy sources that had been recorded since 2005, *Figure 1.9.*

Figure 1.9: Energy Mix vs Primary Intensity/ Transformation System Performance, 2000-2016



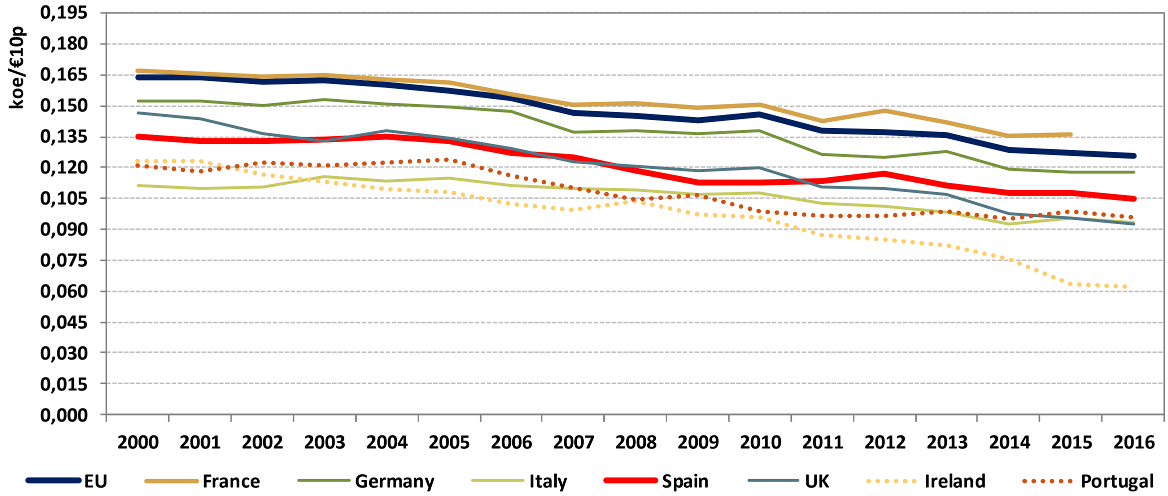
Source: MITECO/IDAE.

Other decisive factors in primary energy intensity are the effects of the structural changes in our economy, reinforced by the context of the financial crisis, to which we must add the positive impact of actions promoted within the context of the Energy Efficiency Action Plans that have been approved since 2004.

In 2016, primary energy intensity experienced a 2.9% drop. This improvement is due to the positive evolution of the economy during this year, with a 3.2% growth in the gross domestic product (GDP), which implied a recovery in levels of activity. In addition to this there is an improvement in the efficiency of transformation systems that has been brought about by an increased share held by the most efficient technologies, thus reducing the energy required for power generation, which has remained practically stable compared to the previous year.

Adjusting intensities to purchasing power parity, *Figure 1.10*, allows for a more realistic comparison at the international level owing to the fact that differences between countries concerning price levels and purchasing power are thus corrected, leading to a vertical displacement of nominal intensities. In what concerns Spain, the adjusted intensity improves its relative position, moving further below the EU average.

Figure 1.10: Trends of Primary Energy Intensity at PPP in Spain and EU, 2000-2016

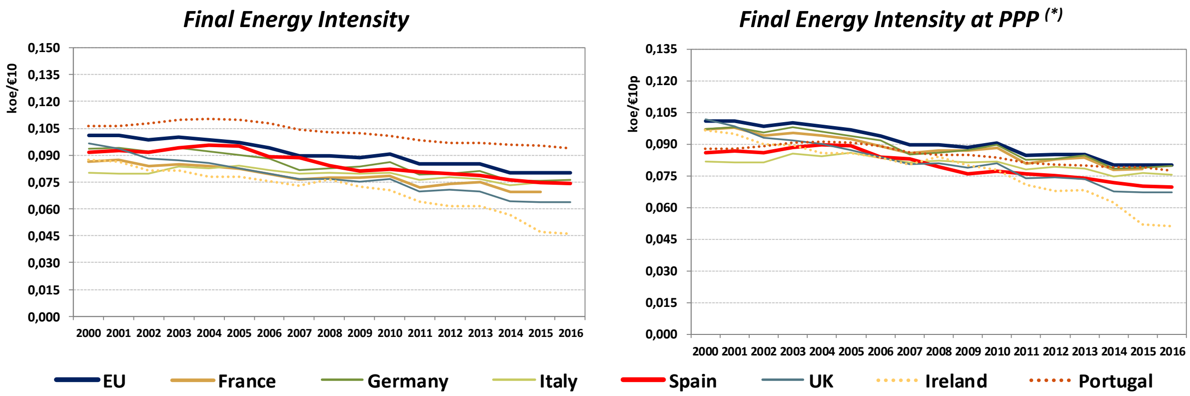


Source: EnR/IDAE. Reference: EU28.

The growth in final energy demand (2.6%) at a slower rate than GDP (3.2%) also entails a reduction in **final energy intensity** in 2016 of about 0.6%, below the improvement recorded in primary intensity, due to the greater share held by renewable technologies in the power generation system.

A comparative analysis with our neighbouring countries, *Figure 1.11*, also reveals that the evolution of this indicator is in tune with the average EU value. Adjustment to purchasing power parity of the final intensity indicator, as with primary intensity, yields a better position for Spain compared to the EU average.

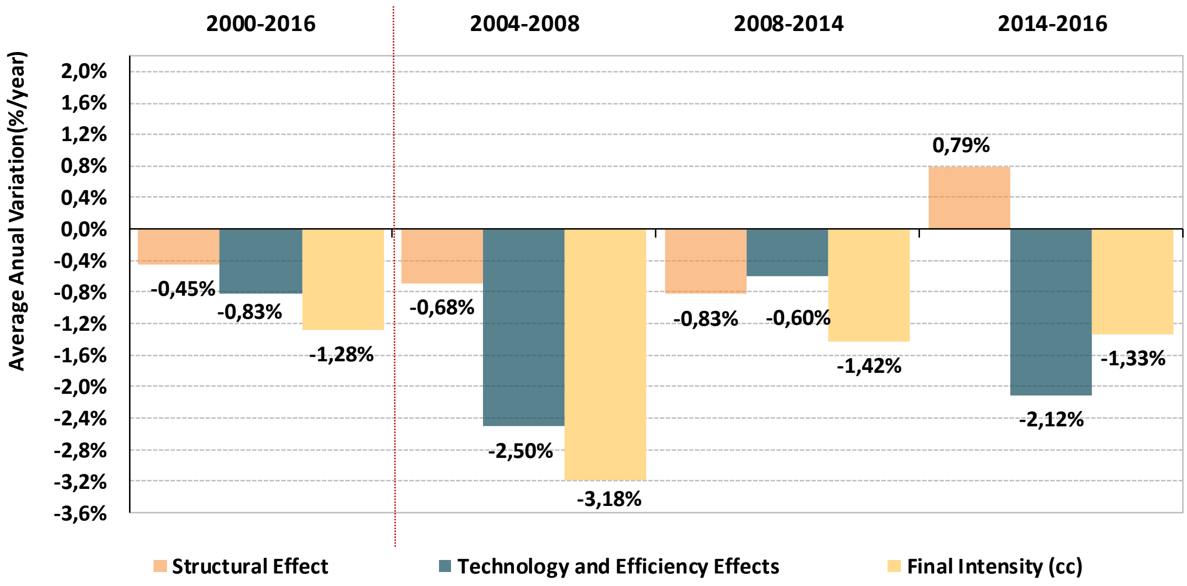
Figure 1.11: Trends of Final Energy Intensity in Spain and EU, 2000-2016



Source: EnR/IDAE. (*) Reference: EU28. Note: Non-energy uses excluded.

Under the impact of the financial crisis in Spain, final intensity displayed an average annual improvement of 1.5% over the 2008-2016 period, below the figure for the previous period. This difference is largely due to the lower level of observable activity in many sectors of the economy which, in turn, affects the performance of equipment and processes, which are made to run below their optimal productive capacity. This diagnosis is confirmed by an analysis of the evolution of actual final energy intensity against the 2005 constant structure intensity, *Figure 1.12*, shows the increasing relevance of the structural factor in final intensity in the period immediately following the financial crisis.

Figure 1.12: Impact of Structure Effect on Final Energy Intensity in Spain, 2000-2016

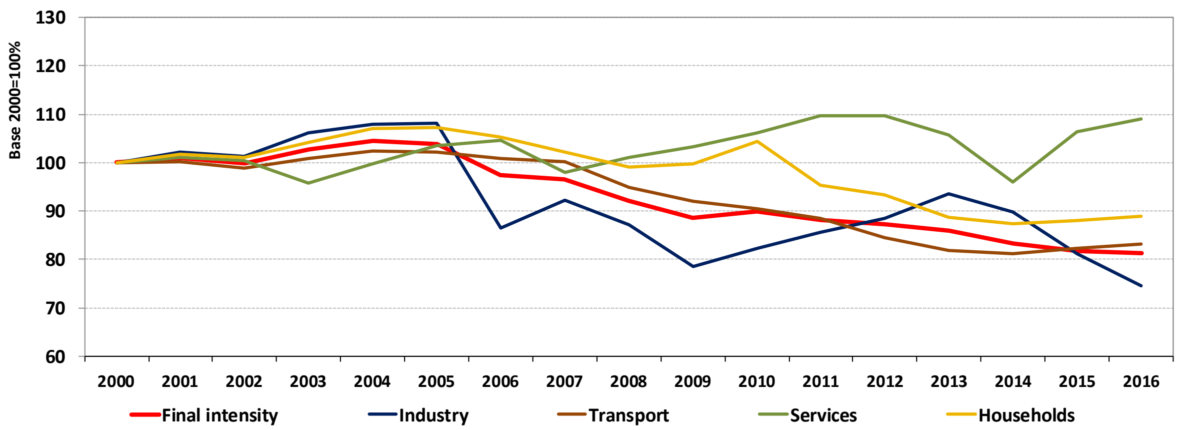


Source: IDAE. Note: Intensities with climate correction.

Economic recovery from the year 2014 onwards has allowed for increased production levels that were more synchronised with productive capacity, which implies that technological factors have played a more significant role in the last two years. On the contrary, the overall effect of structural effects as a whole has been negative.

Comparison of the overall and sector-specific trends in final energy intensity, *Figure 1.13*, reveals the significant influence of the transport sector on overall intensity due to its significance within the demand structure. Also contributing, albeit to a lesser extent, were the service, residential and industrial sectors.

Figure 1.13: Trends of Final Energy Intensity in Spain: Global and by Sectors, 2000-2016

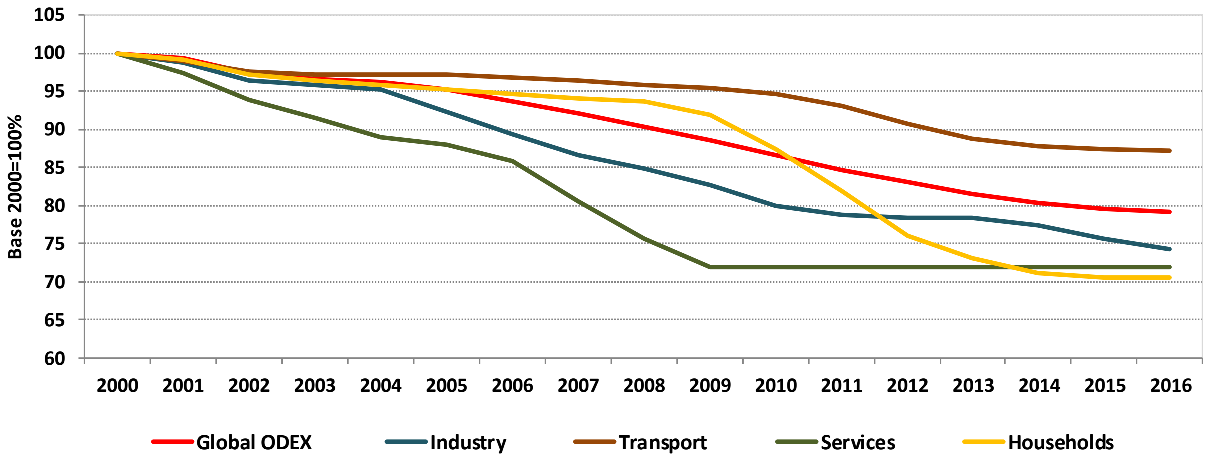


Source: MITECO/IDAE. Note: Non-energy uses excluded.

Progress in energy efficiency is usually assessed based on an analysis of trends in energy intensity, as can be seen above. Nevertheless, the evolution of final energy intensity may be affected by factors other than energy efficiency, such as structural changes in various sectors of the economy, lifestyle changes, etc. In order to make up for this limitation, an alternative indicator, the ODEX index, which allows for an improved understanding of the progress achieved by energy efficiency in each sector, was developed within the framework of the ODYSSEE project.

This indicator combines the trends of the indexes for each sub-sector or final use, calculating these indexes based on unit consumption concerning activity variables expressed in physical rather than monetary units. According to this index, Spain displays constant improvements over the 2000-2016 period, *Figure 1.14*, at an average annual rate of 1.44%. The most significant improvements in efficiency have taken place in the residential[4] and industrial sectors.

Figure 1.14: Energy Efficiency Progress by Sectors in Spain



Source: IDAE/ ODYSSEE.

Note: Progress in the ODEX index for the residential sector is slightly understated due to the lack of detailed on information on power consumption by household appliances.

Most of the improvements observed in the ODEX index for industry took place prior to the financial crisis owing to the impact the recession had on the efficiency of productive processes, as can be seen below in *section 4.1.*

1.3. ENERGY EFFICIENCY POLICY BACKGROUND

Spain's energy policy seeks a transition towards a more sustainable and competitive energy model in which renewable energies play an increasingly important role in covering for a more moderate demand for energy achieved through the implementation of energy savings and efficiency measures. Extant planning is in accordance with the directives issued by European policies on energy and climate change, among which the *2013-2020 climate and energy package* and, more recently, the *Clean energy for all Europeans* package or the "winter package". The following plans, in which priorities in questions of energy policy are defined, stand out on the 2020 horizon:

[4] The ODEX for the residential sector may have been affected by the methodological change applied to the calculation of consumption for residential sector uses since 2010. From that point onwards, consumption has been modelled based on the SECH-SPAHOUSEC I study and the manual for statistics on energy consumption in households (MESH).

- 2011-2020 Renewable Energy Action Plan.
- 2017-2020 Energy Saving and Efficiency Action Plan.
- Planning energy transport infrastructure:
    - Electricity: 2015-2020 Electric Energy Transport Network Development Plan.
    - Natural gas: 2008-2016 Gas and Electricity Sector Planning.

On the long-term, for the period after 2020, the draft for the *Climate Change and Energy Transition Law* and the *Integrated National Energy and Climate Plan (NECP))* are currently in development, and they will lay down the guiding principles that will direct the actions of public powers to assist in the fulfilment of the targets undertaken in matters of energy and climate change and to advance towards a low-carbon economy in accordance with the Paris Agreement.

In the field of renewable energy sources, the *2011-2020 Renewable Energy National Action Plan (PANER)*[5], lays down the national targets with regard to renewable energy sources pursuant to Directive 2009/28/EC, of 23 April 2009, on the promotion of the use of energy from renewable sources. The attainment of these objectives by 2020 will require a 20.8% share of gross final energy consumption to be accounted for by renewable energy sources, as well as 17.3%, 39.0%, and 11.3%, respectively, of energy consumption in the heating/refrigeration, electricity and transport sectors. For this purpose, PANER 2011-2020 features a package of over 80 measures, both horizontal and sector-specific as well as technology-specific.

Over the course of the last decade, Spain has practically doubled its contribution of renewable energies to gross final energy consumption, reaching the figure of 17.3% in 2016. Should this trend continue, Spain should be able to fulfil the target set by Directive 2009/28/EC for Spain in what concerns the contribution of renewable energies to gross final energy consumption.

In the field of energy efficiency, the ***2017-2020 Energy Efficiency National Action Plan*** responds to the requirement of Directive 2012/27/EU of the European Parliament and of the Council, of 25 October 2012, on energy efficiency (DEE), whereby all member states of the European Union are bound to submit plans of this nature, the first by 30 April 2014 at the latest and, following that, every three years.

This action plan is the second Action Plan required by Directive 2012/27/EU and the fourth (NEEAP4) pursuant to article 14 of Directive 2006/32/EC, of 5 April 2006 on energy end-use efficiency and energy services. This plan provides continuity to the plans that were previously approved within the framework of the *2004-2012 Energy Saving and Efficiency Strategy (E4)*, as well as the Action Plans that followed, 2011-2020 (NEEAP2) and 2014-2020 (NEEAP3).

Within the framework of this action plan, the savings have been assessed in conformity with Directive 2006/32/EC, which established a target of 9% savings in final energy by 2016. Savings estimated for 2016 amount to 15.8%, which once again[6] confirms the fulfilment and overcoming of the aforementioned target by Spain in 2016.

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[5] *This plan was subsequently updated and replaced by a new PANER dated 20 December 2011, which was delivered to the European Commission on 5 January 2012.*

[6] *Within the context of the 2011-2020 Energy Efficiency National Action Plan, Spain stated that it had fulfilled this target in 2010. It reasserted this fulfilment in 2013, in the context of the 2013-2020 Energy Efficiency National Action Plan.*

The approval of Directive 2012/27/EU has implied the adoption of two targets for energy savings and efficiency by all member states: the first one, which is indicative and is established by each member state, in conformity with article 3 of the aforementioned Directive, and the second one, which is binding and calculated pursuant to article 7 thereof.

Having regard to the **indicative target**, considering the latest evolutions of the macroeconomic scene, Spain has provided the European Commission with a new target for primary energy consumption by 2020 equivalent to 122.6 Mtoe, which implies a 24.7% cut in primary energy consumption compared to the trending scenario. This target is concordant with that which was established by the EU for the 2020 horizon —1,483[7] Mtoe of primary energy —.

Including non-energy final consumption, the primary energy consumption target for 2020 is estimated at 127.4 Mtoe. In terms of final energy, the consumption target for 2020 is 87.2 Mtoe. *Table 1.1* displays the forecast for primary and final energy consumption by energy sources in 2020, whereas *Table 1.2* displays the final energy consumption forecast by sectors.

Table 1.1: Indicative Target for Energy Consumption (ktoe) by Energy Sources, 2020

Primary Energy (ktoe)		Final Energy (ktoe)	
Coal	8,066	**Coal**	1,413
Oil	55,441	**Petroleum products**	43,777
Natural gas	28,032	**Natural gas**	13,900
Nuclear	14,927	**Electricity**	20,750
Renewables	20,891	**Renewables**	7,395
Elec. balance (Imp. - Exp.)	0	**TOTAL**	**87,236**
TOTAL	**127,357**		
TOTAL excluding non-energy uses	**122,580**		

Source: MITECO. Note: Non-energy uses excluded.

Table 1.2: Indicative Target for Final Energy Consumption (ktoe) by Sectors, 2020

Sectors	2020
Industry	20,508
Transport	36,424
Mixed Use	30,306
Residential	*16,129*
Services	*10,882*
Agriculture and fisheries	*2,701*
Other unspecified	*594*
TOTAL	**87,236**

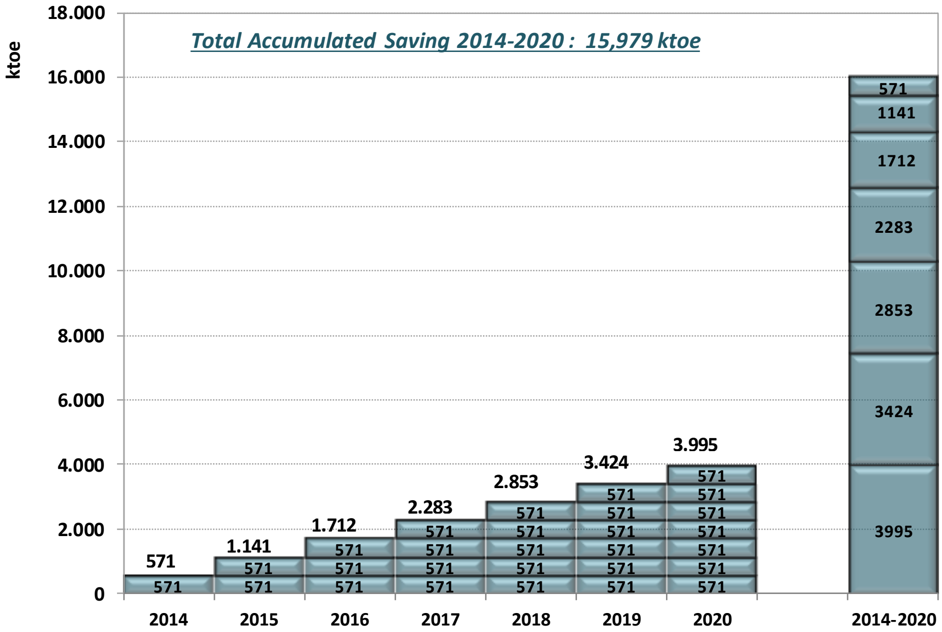
Source: MITECO. Note: Non-energy uses excluded.

These forecasts may be reviewed in order to be adapted to other macroeconomic scenarios that may be officially adopted by Spain in view of the next yearly report, which should be submitted before late April 2018, pursuant to article 3 of Directive 2012/27/EU, or of the Energy and Climate National Integrated Plan (PNIEC) which is currently in development.

[7] *Article 3 of Directive 2012/27/EU has been amended by article 1 of Council Directive 2013/12/EU of 13 May 2013 adapting Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency, by reason of the accession of the Republic of Croatia. The previous primary energy consumption target for the EU-2020 by 2020 was increased from 1,474 Mtoe to 1,483 Mtoe.*

With regard to the **binding target**, pursuant to article 7 of the DEE, Spain has established a target of accumulated final energy savings of 15,979 ktoe for the 2014-2020 period, which is equivalent to yearly savings of 571 ktoe—assuming a linear distribution over the entire period of the commitment–.

Figure 1.15: Time Distribution of Final Cumulative Savings Target



Source: IDAE.

This target may be achieved through a combination of **alternative measures**, defined in section 9 of article 7 of the EED, and an **energy savings obligation scheme** for energy retailers and energy distributors. To that end, Royal Decree-Law 8/2014 of 4 July 2014 approving urgent measures for growth, competitiveness and efficiency, a revised version of which was later published as Law 18/2014 of 15 October 2014, introduced an energy savings obligation scheme and, in accordance with Article 20 of Directive 2012/27/EU, set up a National Energy Efficiency Fund administered by the Secretariat of State for Energy under what is currently the Ministry for the Ecological Transition (MITECO) and which is administered by the IDAE. It was likewise established that the obligated parties would be required to make an annual financial contribution to the Fund in order to fulfil the savings obligation imposed on them.

Alternatively, and under the terms laid down by government regulation, Law 18/2014 indicates that a mechanism based on the submission of Energy Saving Certificates may be established that allows the obligated parties to comply with the saving obligation imposed on them. However, it should be noted that, at present, the regulations that would allow for the introduction of such a mechanism have not yet been implemented. Therefore, the only way to comply with the saving obligations is to make a contribution to the fund based on the financial equivalence set for each year.

In addition to the energy efficiency obligation scheme, Spain is considering the possibility of accessing Community funding for the National Energy Efficiency Fund from the funds envisaged under Thematic Objective 4 ('Low-carbon economy') of the 2014-2020 ERDF Sustainable Growth Operative Programme (POCS).

Savings calculated in Spain as a consequence of measures implemented within the framework of savings obligations established pursuant to article 7 of Directive 2012/27/EU amount to 555.75 ktoe and 522.87 ktoe in 2014 and 2015, respectively. *Table 1.3* displays a detailed breakdown of these savings by measures in force during the 2014-2015 period, as well as cumulative savings on the 2020 horizon as a consequence of the aforementioned annual savings.

Table 1.3: Final Energy Savings - (ktoe) 2014-2020

Measures	Sector	Final Energy Savings (ktoe/year		Cumulative final energy savings, 2020 (ktoe)
		2014	2015	
Alternative Measures		**555.74**	**392**	**5,810.61**
Law 15/2012 on fiscal measures for energy sustainability	Cross-cutting	276.37	47.97	2222.43
2014 MOVELE Programme	Transport	0.51	0.41	6.01
2015 MOVELE Programme	Transport		0.43	2.55
PIVE 3	Transport	2.8		19.6
PIVE 4	Transport	14.31		100.19
PIVE 5	Transport	42		293.99
PIVE 6	Transport	34.92	42.48	499.36
PIVE 7	Transport		7.96	47.74
PIVE 8	Transport		22.83	136.99
PAREER-CRECE Plan	Buildings	2.02	4.34	40.23
JESSICA- FIDAE Fund	Cross-cutting	0.43	5.44	35.65
'You control your energy' communication campaign	--	13.05		26.1
PIMA Aire	Transport	6.92	2.71	64.72
PIMA Sol	Buildings/ Services	0.8		5.6
PIMA Tierra (tractors)	Agriculture	0.7		4.9
PIMA Transport	Transport		4.5	27
CLIMA residential, non-ETS industry and transport sectors	Transversal	40.49	80.21	764.72
Industrial competitiveness incentive programme	Industry		47.52	285.09
State Plan to promote building refurbishment (3R)	Buildings	N.D	N.D	N.D
ICO loans for building refurbishment	Buildings	N.D	N.D	N.D
Eco driving-Driving License	Transport	42.67	47.93	181.2
Programmes Carried Out By Regional Governments	--	77.75	77.27	1.046.54
Energy Efficiency Obligation Scheme. National Energy Efficiency Fund			**130.87**	**710.47**
EENF: Energy efficiency programme for municipal street lighting	Services		5.59	33.52
EENF: Energy efficiency programme for SMEs and large industrial enterprises	Industry		75.95	455.72
EENF: Programme for modal shift and more efficient use of transport modes	Transport		30.64	183.85
EENF: Communication campaign	--		18.69	37.38
TOTAL		**555.75**	**522.87**	**6,482.40**

Source: MITECO

Further details on this and other energy efficiency measures can be found in the sector-by-sector chapters in this report. Most measures have been reported within the latest 2017-2020 Action Plan, which was delivered to the European Commission in April 2017.

All of the above is completed with the planning of energy transport infrastructure, whereby the safety and quality of the energy supply is guaranteed on the mid- and long-term. With regard to the electric system, its current planning is governed by the *2015-2020 Plan for the Development of the Electric Energy Transport Network,* approved by the Council of Ministers on 16 October 2015. This planning is binding for the next six years, including the lines, substations and devices that must be built to ensure supply in accordance with the expected evolution of demand and the estimated increase in capacity for international networking on the 2015-2020 horizon. The estimated cost of the investments planned for electric infrastructure amounts to €4,554 M.

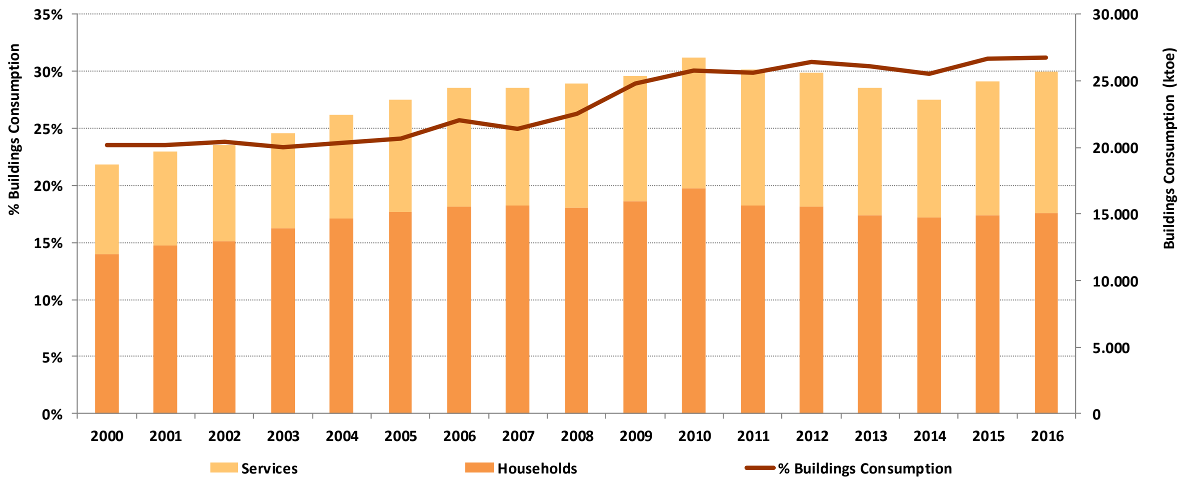
With regard to gas infrastructure, the planning currently in force is the *2008-2016 Planning for the Gas and Electricity Sectors* approved by the Council of Ministers on 30 May 2008.

2. ENERGY EFFICIENCY IN BUILDINGS

2.1. ENERGY EFFICIENCY TRENDS

The buildings sector in Spain accounts for a growing share of overall energy demand, in contrast with the industrial sector, whose relative weight has been decreasing, *Figure 2.1*. In the last few years, in the context of the recession, buildings' energy consumption has gradually dropped, at a rate similar to neighbouring countries, and a change in trend can be observed starting in 2014, which is concordant with the increasing dynamism displayed by the Spanish economy from that point onwards.

Figure 2.1: Share of Buildings in Final Energy Consumption in Spain, 2000-2016



Source: MITECO/IDAE

In 2016, buildings' energy consumption represented 31.2% of total final energy demand and 60.9% of total electricity demand. These figures are slightly above the EU average for total consumption (39.0%) and for electricity demand (59.5%).

Average per capita consumption by buildings in Spain stands at 0.53 toe/year, one third below average EU Member State consumption. The difference can be explained in part by Spain's more favourable climate.

According to the estimates of the Ministry of Development based on information from the land registry, the total constructed surface area of buildings exceeds 5,000 million m^2. 62% of this surface area corresponds to buildings in the residential sector, in which housing blocks make up for 67% of dwellings, according to available information from the INE.

The rhythm of construction has been progressively slowing since the beginning of the financial crisis, *Figure 1.2*, even though construction activity seems to have recovered somewhat since 2016, as it has been pointed out in *Chapter 1*. The slowing of activity in recent years affects the energy demand of buildings as a whole, limiting the favourable impact on efficiency from the inclusion of new buildings with a higher energy rating in accordance with more demanding building standards. Considering the useful surface of both types of buildings, the estimated average consumption in 2016 amounts to 145 kWh/m^2, 25% lower than the average figure for buildings in the EU.

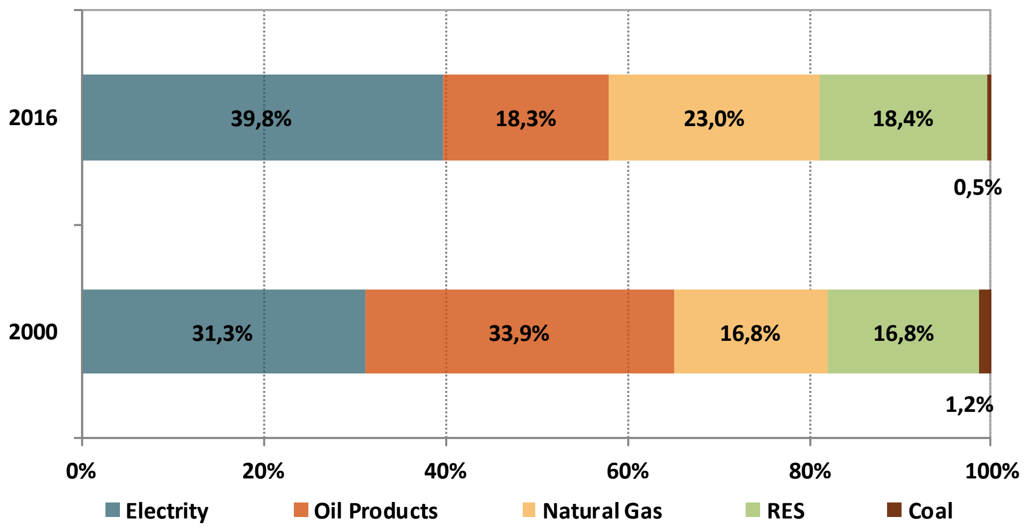
2.1.1 HOUSEHOLD SECTOR

Demand in the household sector in 2016 increased by 1.2% to 15,067 ktoe, i.e. 18.3% of total final energy consumption. This increase was driven by the demand associated to natural gas (+14.9%) and renewable energies (+0.8%), which jointly cover 41.4% of demand. Demand for other energy products has dropped, especially in what concerns oil products (-8.0%) and, to a lesser extent, in electricity (-0.6%), considering its significance in overall demand, *Figure 2.2.*

With regard to energy sources, most energy demand in the residential sector (60.2%) is met using both fossil fuels and renewable energies, although electricity has progressively gained ground to cover 39.8% of demand in 2016. This increase has occurred at the expense of oil products.

The predominance of fuels reflects the significance that thermal uses, among them heating, have in this sector. This use represents over 43.1% of total demand in Spanish households, *Figure 2.8*, primarily covered by fossil fuels and renewable resources.

Figure 2.2: Energy Consumption by Energy Sources in the Household Sector in Spain, 2000-2016

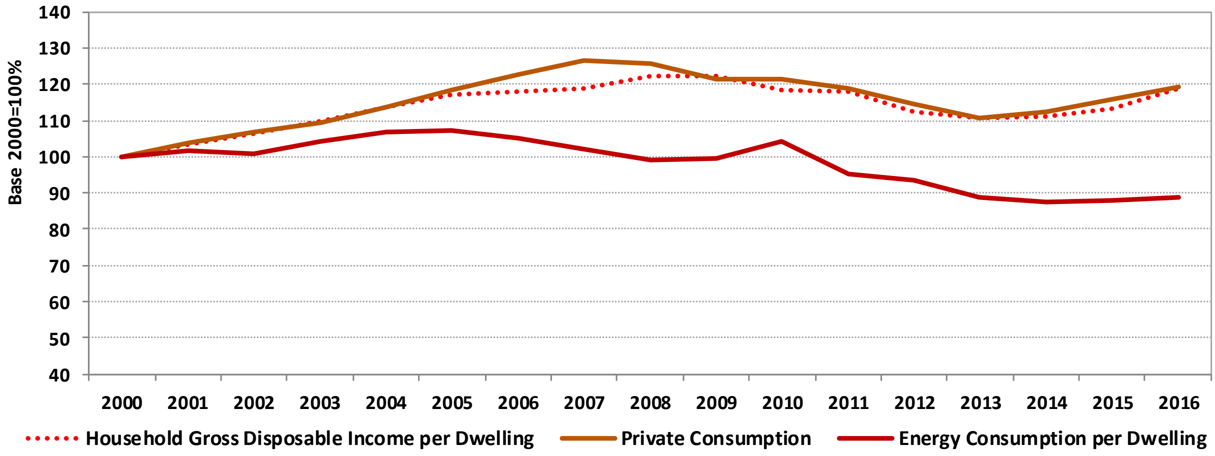


Source: MITECO/IDAE

The average energy demand of households has followed a downward trend since 2005, and this was reinforced by the changes in the economic environment that began in 2008 and the loss in purchasing power of households, *Figure 2.3.* It was in this context that the lower spending power of households, as well as the effect induced by technological improvements in household equipment and facilities, contributed to decrease the level of power consumption per household.

There have been a number of signs of recovery since 2014, and these remain in 2016. This, along with the drop in oil prices, job creation and favourable financing conditions, has allowed for an increase in the gross disposable income of households and their spending capacity. This may therefore explain the increase in energy demand from the aforementioned households in 2016, which has given rise to a 0.9% increase in energy intensity in the residential sector. This increase is mainly associated to household heating uses, in which energy demand has grown by 2.2%.

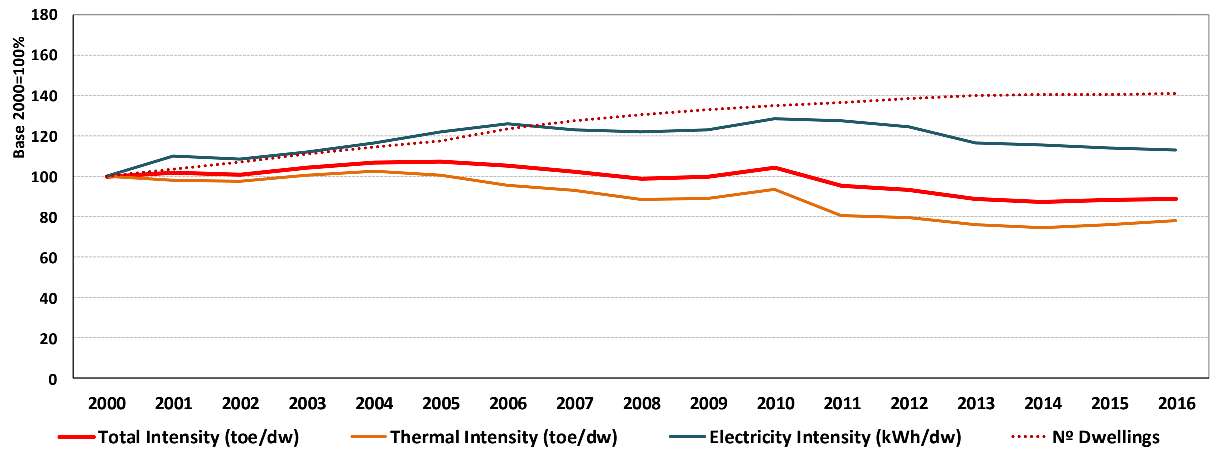
Figure 2.3: Trends of Income and Energy Consumption per Dwelling in Spain, 2000-2016



Source: INE/MITECO/IDAE

Technological and legislative improvements in the household building and equipment have had a positive impact on energy intensity in this sector, as can be seen in *Figure 2.4.* This has been accompanied by changes in the economic environment since 2008, which gave rise to more conservative consumption habits, as well as by the rise in energy prices. Heating intensity has grown slightly since 2015, whereas electricity intensity has maintained a downward trend, with a 0.9% drop recorded in 2016.

Figure 2.4: Main Indicators of the Household Sector in Spain, 2000-2016

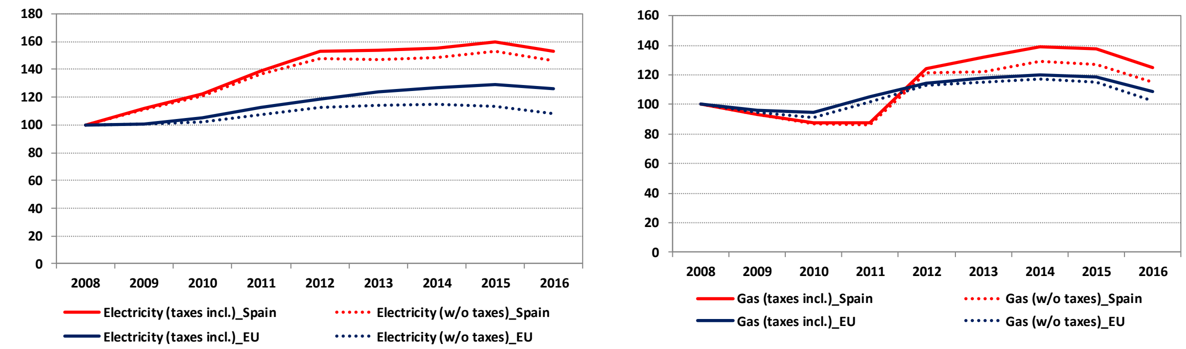


Source: INE/MITECO/IDAE

Considering that technological progress affects both household electrical and heating devices, it can be assumed that the spike in heating intensity is due to, on the one hand, an increased use of fossil fuels to cover demand for heating and, on the other, the steep increase in electricity prices, *Figure 2.5*, at a rate of approximately 5% per year, above the EU average, which has contributed to restraint in the use of household appliances.

Figure 2.5: Trends in Energy Prices for Households in Spain and the EU, 2008-2016

Electricity ***Natural Gas***

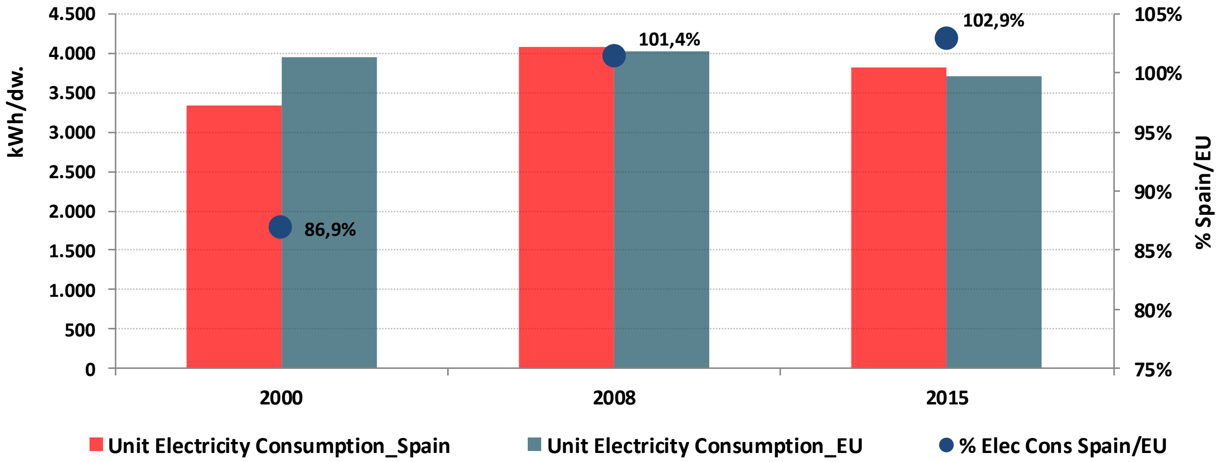


Source: EUROSTAT

Note: prices related to average household prices –2.500–5.000 kWh/year (electricity consumption); 20 GJ - 200 GJ/year (gas consumption).

As mentioned above, electricity has been gaining ground in coverage for the energy demand of Spanish households, *Figure 2.2.* This dynamic is correlated to the gradual penetration of electric appliances in Spanish households, approaching the average consumption figures for EU households, *Figure 2.6.* Throughout the last few years both indicators - Spanish and European - have displayed a downward trend in which the effects of the crisis, electricity prices, as well as technological improvements in lighting and household appliances have superimposed, not to mention certain saturation in the level of equipment.

Figure 2.6: Trends in Electricity Consumption per Dwelling in Spain and the EU

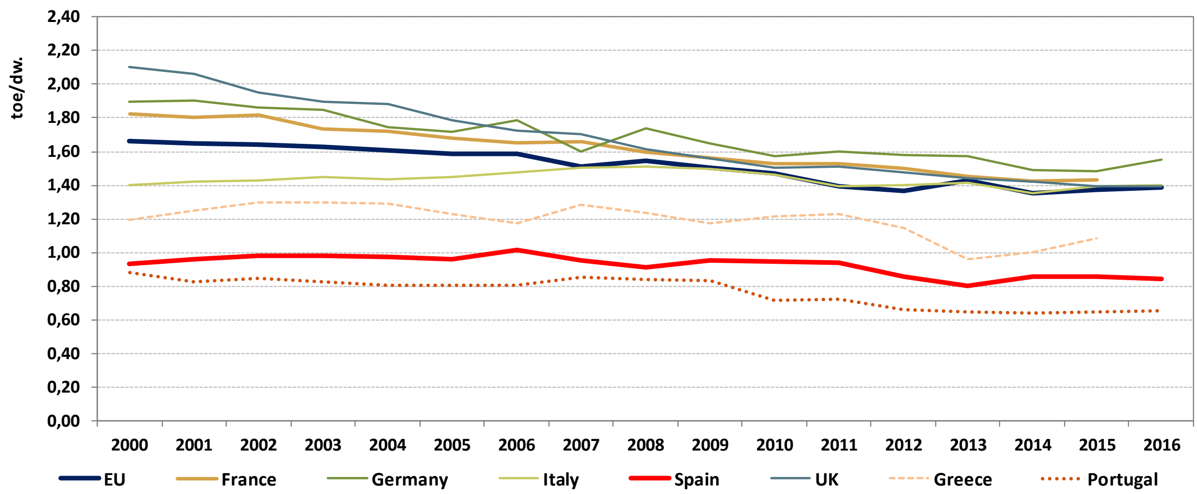


Source: EnR/MITECO/IDAE

In what concerns Spain, electricity consumption is affected by the use of air conditioning during the summer months. Even though energy demand associated to air condition does not surpass 1% of the total figure, *Figure 2.9,* being a seasonal service, it may cause spikes in demand that can be hard to manage.

Comparative analysis of the evolution of global energy intensity in the residential sector in the scope of the EU, *Figure 2.7,* reveals a difference of around 40% between the national indicator and the European average. This difference can be explained by the influence of the warmer climate in Spain as well as in other southern European countries such as Italy, Greece and Portugal in which lower values in this indicator can also be observed.

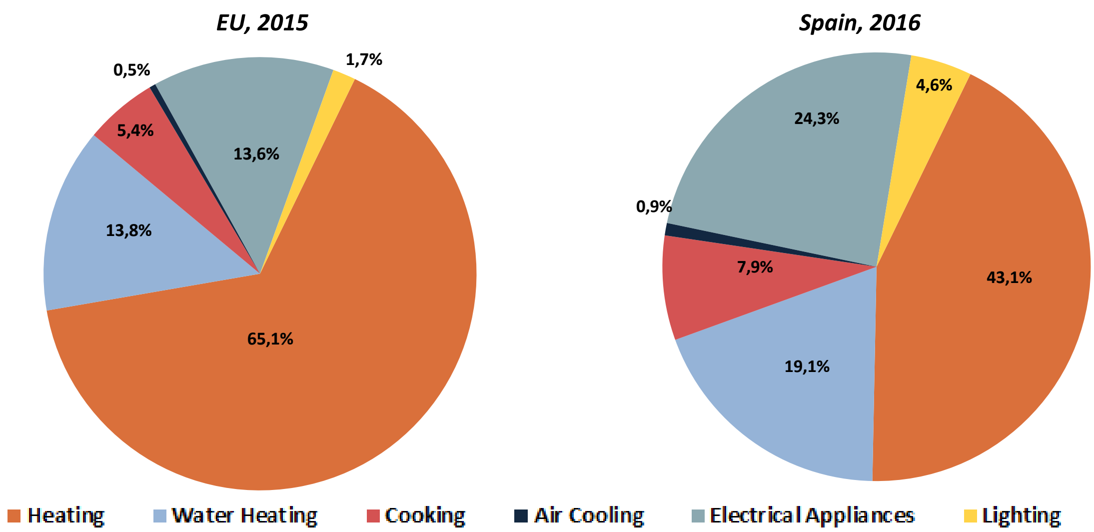
Figure 2.7: Trends of Energy Intensity in the Household Sector in Spain and the EU, 2000-2016



Source: EnR/IDAE/INE. Note: Intensities with climate correction.

The warmer climate justifies the lower demand for heating in Spain, which lies around 43%, 20 percentage points below the EU, *Figure 2.8.* This difference in the relative importance of heating largely conditions the energy intensity of the residential sector. With regard to remaining uses, the next largest position is held by electric household appliances, with approximately a quarter of total consumption, among which refrigerators, washing machines and television sets stand out with over 50% of consumption for household appliances.

Figure 2.8: Energy Consumption by Uses in the Household Sector in Spain and the EU

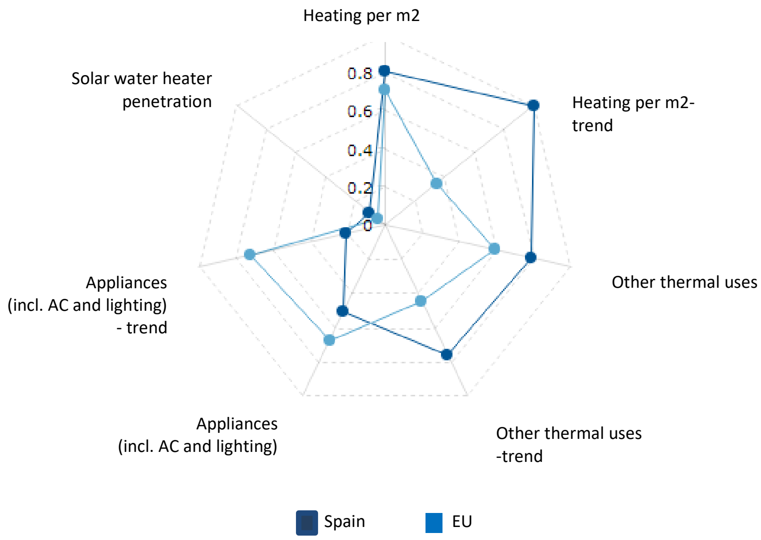


Source: EnR/IDAE.
Note: The consumption by uses has been modelled on the basis of the SECH-SPAHOUSEC I study and the Manual for statistics on energy consumption in households (MESH).

In the context of the ODYSSEE project, a scoring methodology for indicators in different sectors, based on a series of representative indicators for each sector, has been developed. The OECD composite indicator methodology has been adopted for this purpose. According to this methodology, it is possible to know the position and trend of a country within a range of normalised values in which "0" and "1" stand for the worst and best positions for the indicator in question. This rating is determined based on an assessment of the three highest and lowest values for EU countries for each of the sector-based indicators.

In view of the above, the following comparison between Spain and the EU average for the residential sector, *Figure 2.9*, has been obtained where both the current situation and the trend followed since the year 2000 are shown. The indicators related to thermal uses in Spain display better relative positions.

Figure 2.9: Comparison of Energy Efficiency in the Household Sector in Spain and the EU (ODYSSEE Scoreboard Methodology)



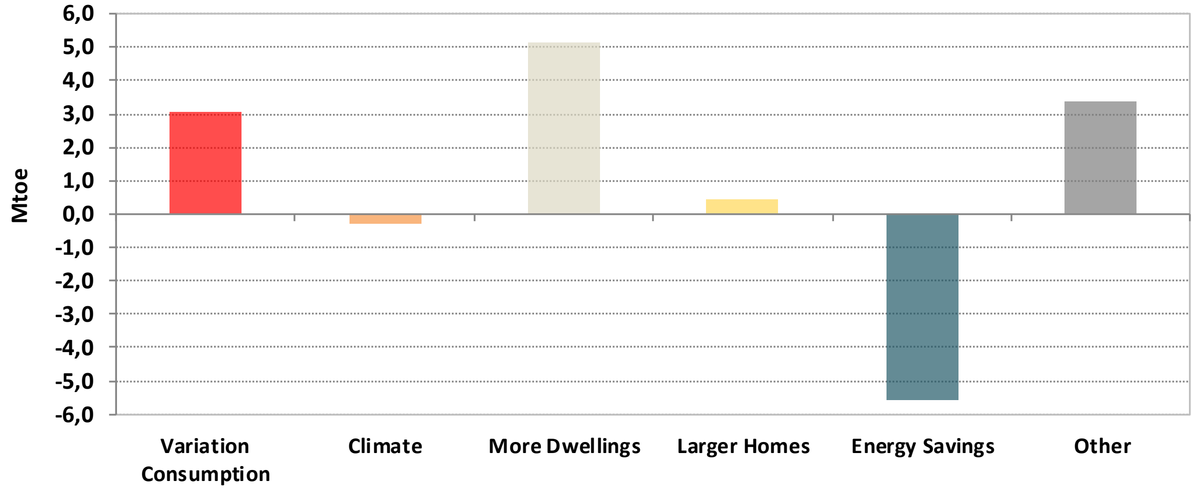
Source: ODYSSEE http://www.indicators.odyssee-mure.eu/php/odyssee-scoreboard/documents/methodology-odyssee-scoreboard.pdf
Notes:
Heating per m^2: Space heating consumption per m2 scaled to EU climate and equivalent to central heating in koe/m^2
Other thermal uses: Cooking and water heating consumption in toe/dwelling
Appliances (incl. AC and lighting): Specific electricity consumption including air-conditioning in toe/dwelling
Solar water heater penetration: Percentage of households with solar water heating

Further analysis of the household sector can be obtained from a breakdown of the variation in energy consumption for the sector, *Figure 2.10,* taking into account its decisive factors, among which the following stand out:

- Climate.
- Number of occupied dwellings.
- Size of dwellings.
- Energy savings.
- Other effects, such as household equipment and heating behaviours.

Over the course of the 2000-2016 period, energy consumption in the household sector in Spain has increased by 3.1 Mtoe, mainly as a result of the effect arising from the increase in the number of occupied dwellings, especially during the first half of the aforementioned period. Other effects that have contributed to the increase in consumption refer to the increase in comfort, associated to a move towards larger dwellings, increased levels of equipment in dwellings and behavioural patterns. These contributions have been partially counteracted, mainly by the effects associated to technological improvements in dwellings and equipment and, to a lesser extent, by climate, which have jointly led to a 5.9 Mtoe decrease in consumption over the course of the aforementioned period.

Figure 2.10: Decomposition of Households Consumption Variation in Spain, 2000-2016

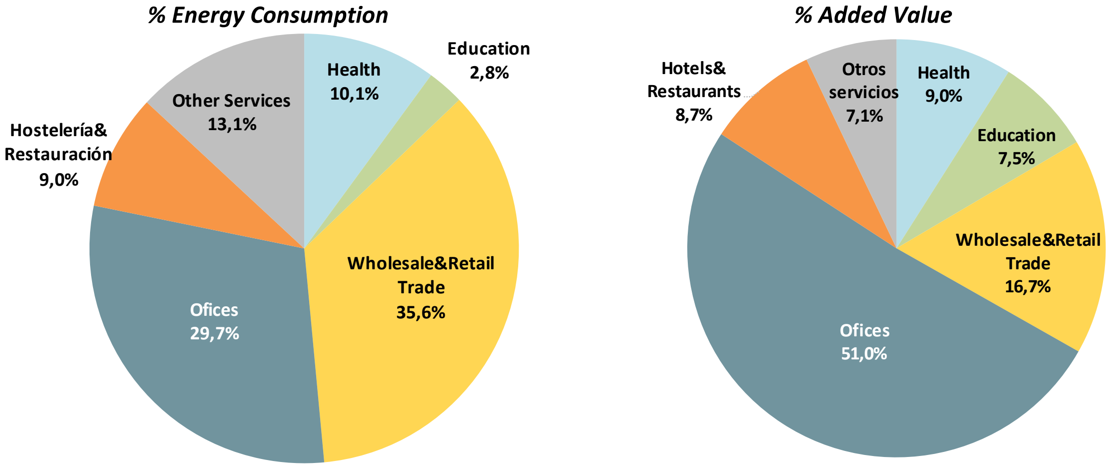


Source: IDAE/ ODYSSEE

2.1.2 SERVICES SECTOR

The services sector covers a mixed package of activities, chiefly related to offices, trade (wholesale and retail trade), hotels and restaurants, health and education. As a whole, these activities make up for 67% of GDP and 13% of final energy demand. Breaking it down by branches of activity, *Figure 2.11,* the offices and trade sub-sectors stand out in particular with a 65.3% share of energy demand and 67.5% of sector Gross Added Value (GAV). This explains the decisive role played by these two branches in the evolution of the energy intensity of the sector.

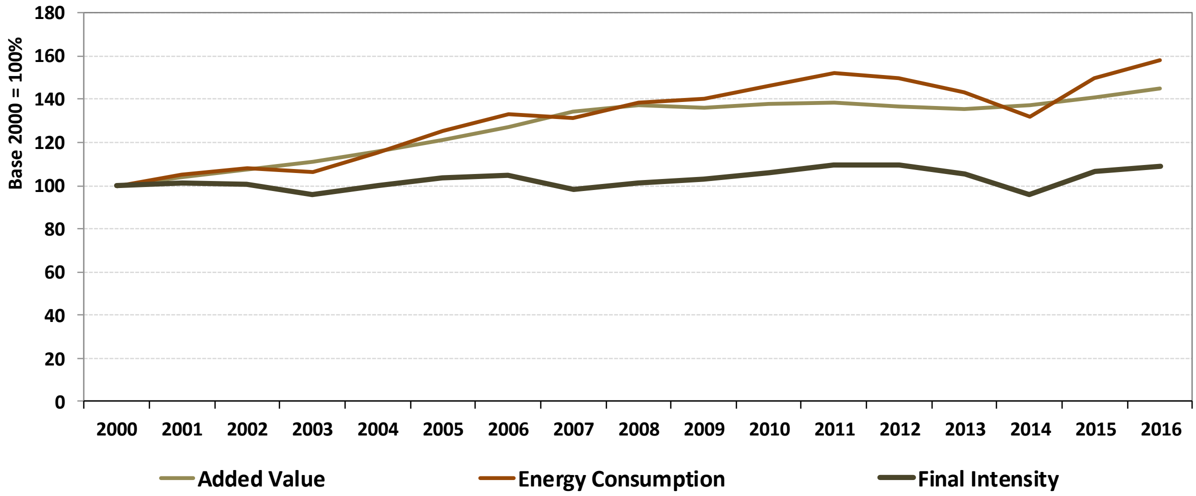
Figure 2.11: Consumption and Added Value of the Services Sector by Sub sectors in Spain, 2016



Source: INE/MITECO/IDAE. Note: Other services included services related to recreational activities and personal and social services.

In a context of economic recovery, in 2016, the Gross Added Value (GAV) of this sector increased by 3.4% owing to the push provided by branches related to trade and hospitality. This is accompanied by a 5.6% increase in energy demand associated to this sector, which reached a value of 10,627 ktoe in 2016. This growth in demand above the growth in GAV has led to a worsening in the services sector energy intensity in 2016 with a 2.5% increase, *Figure 2.12.*

Figure 2.12: Main Indicators in the Services Sector in Spain, 2000-2016

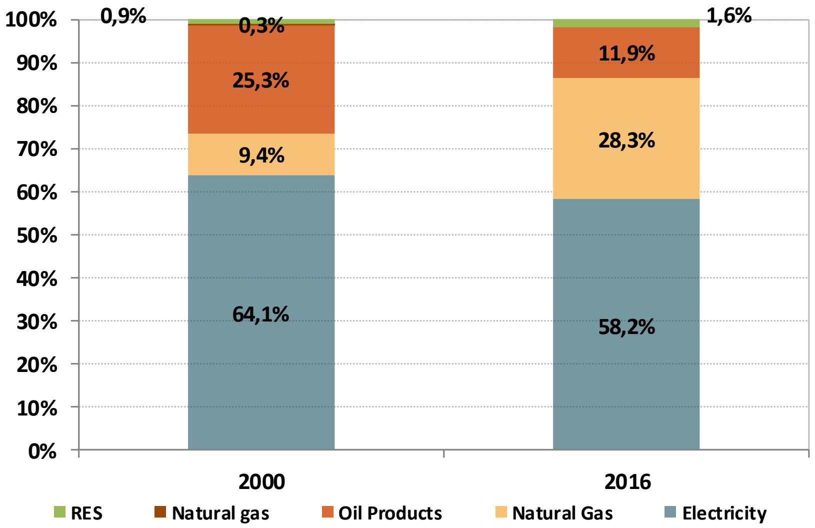


Source: INE/MITECO/IDAE

The evolution in intensity is related to the demand structure, *Figure 2.13*, in which electricity covers a high proportion of the sector's needs with a 60% share of consumption. This demand is chiefly due to the needs of the offices and trade sectors in what concerns lighting, air conditioning, office appliances and ITC technology.

Demand for nearly all energy sources excepting electricity increased in 2016. Among them, oil products (+20.3%) and natural gas (+14.8%) stand out with a joint contribution of 40.2% of demand. Renewable energies contributed to a lesser extent, although they still play a limited role in the overall demand structure. It can be concluded that heating uses in this sector drove the evolution in intensity in 2016.

Figure 2.13: Energy Consumption by Energy Sources in the Services Sector in Spain, 2000-2016

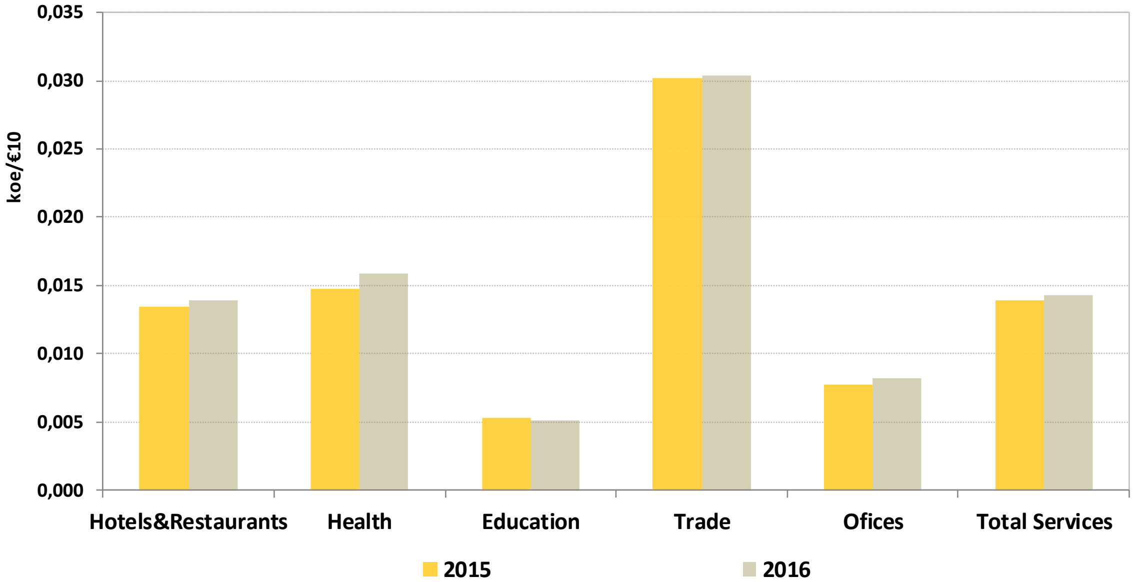


Source: MITECO/IDAE

Over half of the increase in overall energy demand in this sector in 2016 was due to offices and trade. Nevertheless, these branches have displayed a different behaviour in what concerns their economic production, with certain stagnation in the former that stands in stark contrast with the 3.2% increase in GAV in the latter. This has led to a greater increase in intensity in the offices sector (+6.2%) compared to the wholesale and retail sector (+0.8%).

It could be said that the evolution in intensity in the services sector has been mainly marked by these two branches, owing to their importance in what concerns energy and activity. Nevertheless, the remaining branches of the service sector, with the exception of education, also display a worsening in intensity, *Figure 2.14*, which contributed to the global increase in intensity in the sector, albeit to a lesser extent.

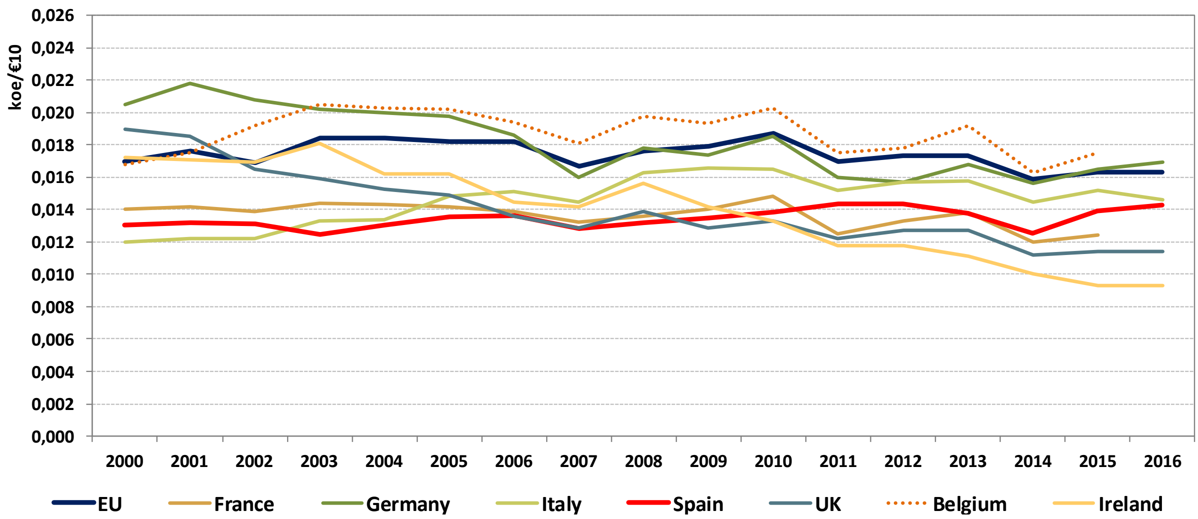
Figure 2.14: Energy Intensity in the Services Sector by sub sectors in Spain, 2015-2016



Source: INE/ MITECO/IDAE

Energy intensity in the services sector in Spain has followed an upward trend, evolving below the European average, *Figure 2.*15, although the gap between both of these indicators has narrowed. A change in trend in the indicator for Spain can be observed between 2011 and 2015, as a result of the recovery in the economic activity of the sector as a whole. This has been accompanied by an increase in energy demand at a rate above that of the GAV, which explains the increase in intensity in 2015 and 2016.

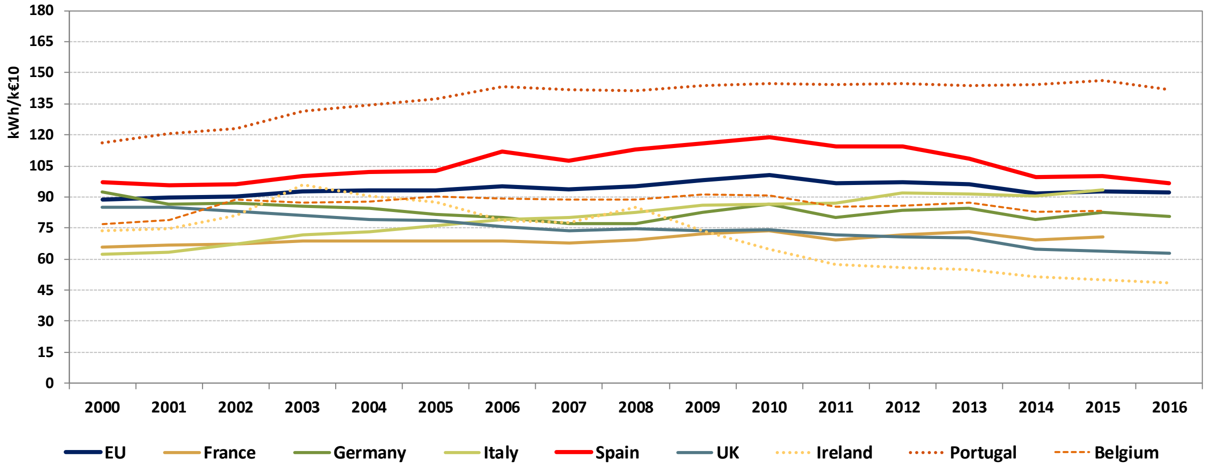
Figure 2.15: Trends of Energy Intensity of the Services Sector in Spain and the EU, 2000-2016



Source: EnR/IDAE

In contrast with the above, the electricity intensity of the services sector in Spain has evolved above the average value for the EU, *Figure 2.16*, with a gradual increase compared to the European indicator until 2010. A change in trend can be seen from that point onwards in which the national indicator drops to an average yearly rate of 3.4%, above the European indicator (-1.4%), which has led to a narrowing of the gap between both indicators. This change in behaviour can be explained by the increase in electricity prices and the financial crisis. In 2016, electricity intensity had decreased by 3.7% due to the drop in electricity demand in the sector.

Figure 2.16: Trends of Electricity Intensity of the Services Sector in Spain and the EU, 2000-2016



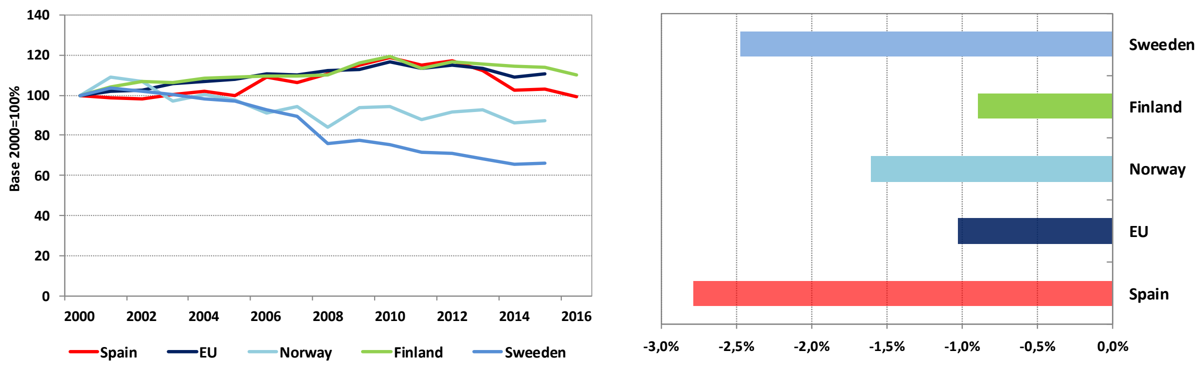
Source: EnR/IDAE

The high figure for electricity intensity in Spain is due to the importance of electricity when it comes to covering the needs of this sector and it stands at roughly thirteen percentage points above the European average. Lower consumption rates in central European countries are largely due to cogeneration and district networks.

Electricity consumption per employee in Spain amounts to roughly 5,193 kWh in 2016, 5% above average consumption in the EU, and between 40 to 60% below the average consumption for countries such as Norway, Finland and Sweden, which boast high rates for electricity consumption owing to their greater hydraulicity and the corresponding electricity production, which leads to a greater use of this energy source to meet their heating needs. A downward trend has been observed since 2010, declining at a rhythm greater than that of average EU consumption, *Figure 2.17*.

Figure 2.17: Trends of Unit Electricity Consumption (kWh/imp) in the Services Sector in Spain and the EU, 2000-2016

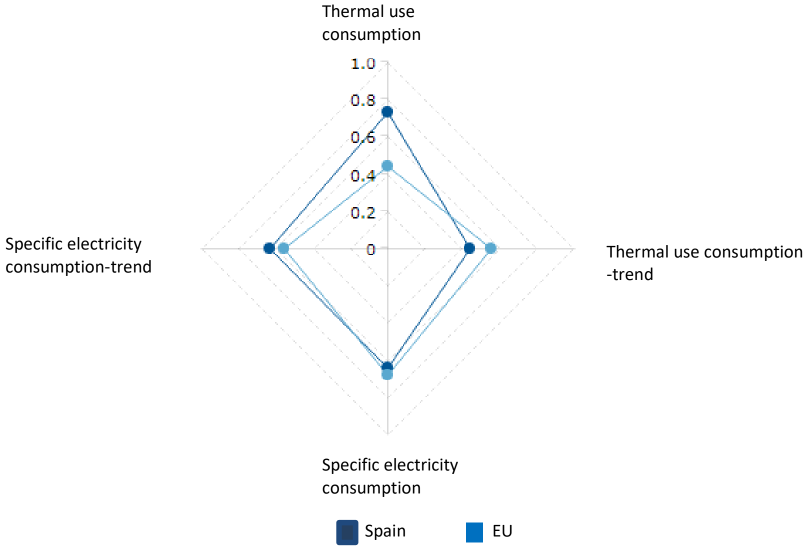
Trends, 2000-2016 ***Yearly Variation (%/year)***



Source: EnR/IDAE

The aforementioned indicator scoring methodology has yielded the following comparison between Spain and the EU average for the services sector, *Figure 2.18*, both in what concerns the current situation and the trend that has been followed since the year 2000. A similarity between Spain and the EU average can be observed in what concerns the positioning and trend of the indicator for electricity consumption per employee, in accordance with what has been stated before. With regard to heating consumption, even though Spain has a better relative position, it would seem that the trend towards improvement in this sector is somewhat more favourable in the EU.

Figure 2.18: Comparison of Energy Efficiency in the Services Sector in Spain and the EU (ODYSSEE Scoreboard Methodology)



Source: ODYSSEE http://www.indicators.odyssee-mure.eu/php/odyssee-scoreboard/documents/methodology-odyssee-scoreboard.pdf
Notes:
Thermal use consumption: Fuel consumption per employee scaled to EU climate in toe/employee
Specific electricity consumption: Electricity consumption per employee in kWh/employee

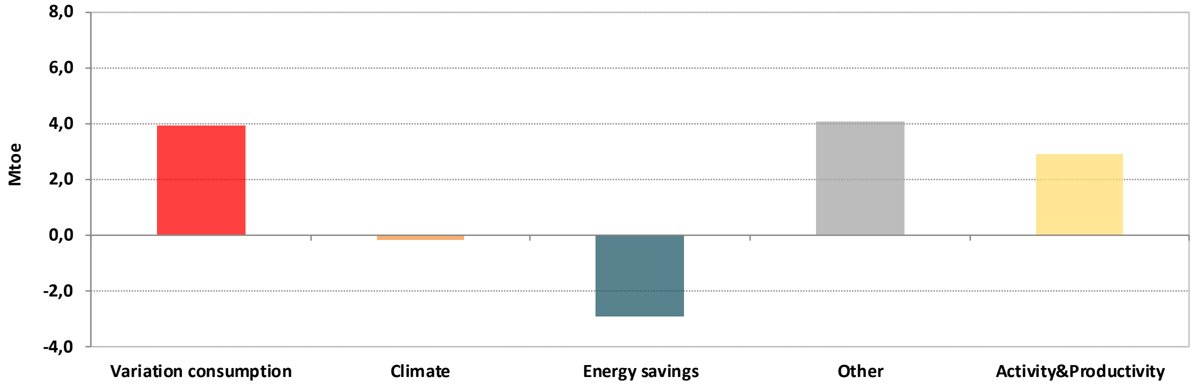
Further analysis of the services sector can likewise be obtained from a breakdown of the variation in energy consumption into different factors or effects, *Figure 2.19*. For this purpose, a number of variables concerning energy, technology and socio-economic factors are taken into account, including the following:

- Activity effect, measuring the effect of a change in the added value for the sector.
- Productivity effect, measured through the change in the added value per employee ratio.
- Climate.
- Energy savings due to changes in the use of energy by employees.
- Other effects chiefly associated to behaviour and "negative" savings caused by inefficient operations due to a low use of productive capacity.

Over the course of the 2000-2016 period, energy consumption in the services sector in Spain has increased by 3.9 Mtoe. This increase is due to, on the one hand, the greater energy demand induced during the crisis due to inefficiency in the use of equipment and facilities, which was particularly manifest during the 2008-2014 period. From 2014 onwards, this effect became mitigated due to the recovery in economic activity which led to a better use of productive capacity and, as a result, increased efficiency in the use of equipment.

Moreover, activity in the sector, excepting those years in which the impact of the crisis was more acute, likewise contributed to the aforementioned increase in demand. These two effects have been partially compensated for by contributions related to climate and energy savings, which led to a reduction in energy demand.

Figure 2.19: Decomposition of Services Consumption Variation in Spain*, *2000-2016



Source: IDAE/ ODYSSEE

2.2. ENERGY EFFICIENCY POLICIES

The first reference to energy efficiency in the building sector in Spain goes back to 1979, with the approval of the NBE-CT-79 basic building code, on thermal conditions in buildings, through Royal Decree 2429/1979, of 6 July. From that point onwards, legislation concerning buildings has evolved according to the dictates of European guidelines applicable to this sector, specifically Directive 2010/31/EC of 19 May 2010 of the European Parliament and of the Council on the energy performance of buildings and Directive 2012/27/EU, on energy efficiency, and Directive 2009/28/EC, in what concerns renewable coverage for energy demand from buildings. This legislative dynamic has been accompanied by a number of energy efficiency measures geared towards this sector, which have been implemented in Spain within the framework of successive Action Plans since the launch of the 2004-2012 Energy Saving and Efficiency Strategy (E4).

With regard to **Directive 2010/31/EU,** over the last few years a series of regulatory measures that tightened the requirements for efficiency in buildings have been adopted. These have taken form in the **Technical Building Code**, the **Regulation on Thermal Installations in Buildings (RITE)** and **building energy certifications**.

The TBC, which was updated through Order FOM/1635/2013, of 10 September, increases the energy efficiency requirements for newly constructed buildings and for expansions and renovations of extant buildings that have requested a building license from March 2014 onwards. This update is the first phase in the progress towards the target of Directive 2010/31/EU, namely to obtain nearly-zero energy buildings.

The RITE, which was updated through Royal Decree 238/2013, of 5 April, amending certain articles and technical instructions, lays down, among other aspects, the minimum energy performance requirements applicable to heating, cooling, ventilation and domestic hot water systems and periodic energy efficiency audits. The higher efficiency standards take shape in an increased thermal systems performance, improved insulation for devices and for thermal fluid conduits, the use of renewable energy sources and energy recovery systems, as well as the inclusion of compulsory consumption accounting systems in collective facilities.

The basic procedure to certify building energy efficiency, approved through Royal Decree 235/2013 of 5 April lays down the obligation to provide the buyers or users of buildings with an energy efficiency certificate that must include objective information on the energy efficiency of the building and reference values, such as minimum energy-efficiency requirements. It likewise establishes the basic procedure to be followed in calculating the energy efficiency rating. In order to assist in the fulfilment of the provisions of Royal Decree 235/2013, software with which to calculate the energy rating of new and existing buildings has been made available to the public (HULC for new buildings, CE3 and CE3X for existing buildings).

In late 2016, since the entry into force of the aforementioned Royal Decree, over 1,600,000 certificates concerning new and existing buildings, both for individual dwellings and residential and tertiary sector buildings are available.

The above is reinforced by the approval of the consolidated text of Law 8/2013 of 26 June 2013 on urban renovation, regeneration and renewal, amended by Royal Legislative Decree 7/2015 of 30 October 2015 adopting the consolidated text of the law on land use and urban renewal. This text includes the obligation for buildings to have an evaluation report consisting of three documents, one of which must be the building's energy certificate. This obligation applies to residential buildings which are near 50 years old and buildings whose owners intend to apply for public aid. Therefore, and as a result of this legislation, a significant portion of the existing building stock will be required to obtain energy certification between 2014 and 2020, which will require some of those buildings to implement the energy-efficiency improvement measures recommended in the energy certificate.

With regard to **Directive 2012/27/EU**, its transposition into the Spanish legal system is still in process through the adoption of a series of measures. Below is a list of some of those that affect the building sector.

In pursuance of article 4, the Ministry of Development drafted the Long-term strategy for improving energy efficiency in Spain's buildings sector*, ERESEE 2014*, which was updated -ERESEE 2017- in 2017. ERESEE 2014 was a significant starting point for the promotion of energy renovation in Spain, as well as a roadmap to guide the various agents that intervene in renovation processes.

With regard to article 5, which highlights the exemplary role of public bodies' buildings, Member States are bound to establish and make publicly available an energy inventory of buildings belonging to central administrations[8] that shall include information on the floor area and energy performance of each building. All of this implies a continuation of the path that began with the *Plan for Energy Saving and Efficiency in Central Government Buildings (PAEE-AGE)*, which established a series of minimum energy savings targets for all government buildings. This set a precedent in what concerns the introduction of energy efficiency criteria for public contracting of equipment, energy management, etc., thus highlighting the exemplary role of the Administration.

In order to assist in the compilation of the inventory of buildings belonging to the Central Government and its dependent bodies, the IDAE has designed and developed an online platform, **SIGEE-AGE (Energy Management System for Central Government Buildings)**. Since 2013, all the ministries

[8] Prior to 31/12/2013 for buildings with a total useful floor area over 500 m² and, as of 9/7/2015, over 250 m².

concerned have cooperated in the compilation of the inventory using the SIGEE-AGE software. The inventory, updated in 2016, with a total of 2,142 public buildings, determines the renovation target for 2017 in order to ensure compliance with the requirements established in article 4 of Directive 2012/27/EU. Moreover, the renovation of 248,695 m^2 of surface corresponding to buildings equipped with heating and/or cooling systems, that is to say, over 3% of all surface in the inventory (11 Mm^2), was carried out in 2016.

Despite the fact that article 5 only requires the compilation of the inventory of buildings belonging to the Central Government, Spanish legislation extends this obligation to all buildings of local and regional governments. All autonomous regions are currently carrying out or intend to carry out energy efficiency plans in their public buildings, considering the **energy service contracting** model as an instrument for the management and improvement of energy efficiency in buildings. The application of this contract model has received a substantial boost in order to promote the energy services market in the buildings sector, especially in what concerns public buildings.

For this purpose it was necessary to adapt the legal framework through the approval of Royal-Decree Law 6/2010, of 9 April on measures to stimulate economic recovery and employment, pursuant to which the figure of Energy Services Companies (ESE) were recognised under Spanish law, in compliance with the provisions of Directive 2006/32/EC. Law 8/2013 of 26 June 2013 on urban renovation, regeneration and renewal has gone one step further by providing for participation by energy service companies in programmes to improve energy efficiency in buildings.

Returning to article 5, in September 2017 the **Aid programme for the energy renovation of existing buildings and infrastructures belonging to the Central Government**, endowed with a budget of €95 M from the 2014-2020 ERDF Operational Programme for Sustainable Growth (OPSG). This is intended to allow the Central Government and its affiliate organisms to carry out exemplary renovation actions in its buildings in order to make them reach near-zero levels of energy consumption. Actions on **buildings** must attain an energy rating of A or B in what concerns integral actions or to improve the rating by one letter, in what concerns partial actions. Actions on **infrastructure other than buildings** shall have to justify a minimum of 20% savings in non-renewable final energy and 30% savings for outdoor lighting, compared to their initial situation.

In addition to the above, a €253 M budget from the *Integrated Sustainable Urban Development Strategies (DUSI)* is available for energy efficiency and renewable energy actions by local bodies for functional urban areas with a population of over 20,000 inhabitants. Eligible energy efficiency actions include the energy-related renovation of buildings and the execution of zero-consumption demonstration projects. These Strategies are funded by the Integrated and Sustainable Urban Development axis of the OPSG programme, which has been allocated €1,012 M in ERDF aid for the period. Along this same line, the Low-carbon economy axis in the OPSG programme also considers the financing of measures implemented by local authorities in towns with less than 20 000 inhabitants. The budget considered amounts to €480 M. Measures eligible for assistance include the energy-related renovation of buildings.

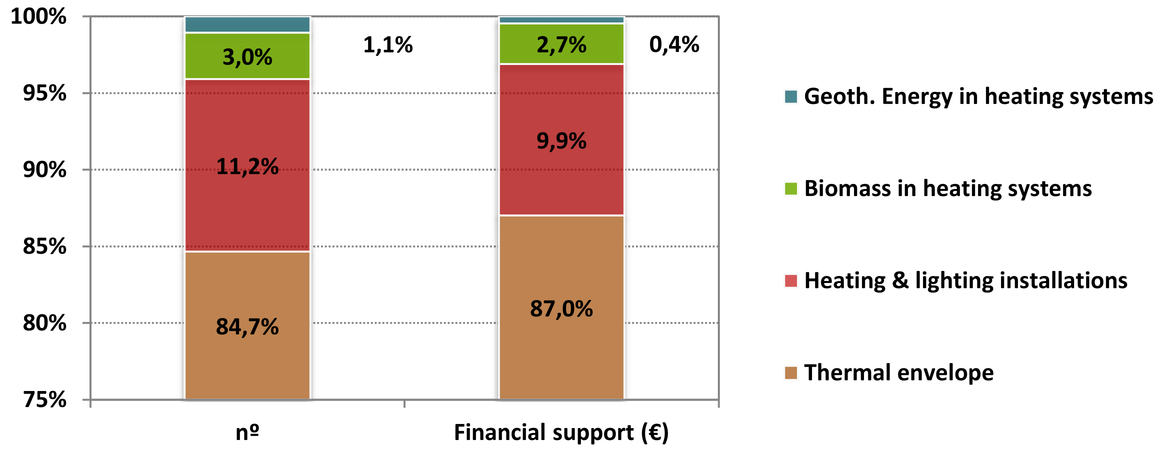
Likewise, in the field of the public sector, Law 15/2014 of 16 September 2014 on rationalisation of the public sector and other administrative reform measures complies with article 6 of Directive 2012/27/EU. This law is intended to intensify the acquisition of high-energy-performance buildings by the public administrations which pertain to the state sector. This obligation is likewise extended to contracts the result whereof is the construction of a building in those cases established by the Public Sector Contracting Law in which the cost of the contracts surpasses the established threshold values. In what concerns the purchase or rental of buildings for administrative uses, the minimum required energy rating shall be class C for the heating, cooling and primary non-renewable energy consumption indicators.

The buildings sector likewise benefits from a series of financial support measures, described as **alternative methods**[9] according to the definition contained in article 7.9 of Directive 2012/27/EU. These measures are: The Aid Programme to Improve the Energy Efficiency of Existing Buildings (PAREER-CRECE Programme); the Environmental Promotion Plan in the hotel sector (PIMA SOL); the 2013-2016 State Plan to promote housing rental, building refurbishment and urban regeneration and renewal; and the JESSICA-FIDAE fund.

The **PAREER Programme,** which is endowed with a total budget of €200 M, was launched in late 2013 by what is currently the Ministry for the Ecological Transition (MITECO) through the IDAE in order to promote integral measures to promote energy efficiency and the use of renewable energy sources in existing buildings, thus contributing to achieve the targets established in Directive 2012/27/EU. In 2015, and based on acquired experience, it was deemed fit to expand the object of the programme to the greatest possible number of extant buildings, extending its period of application in accordance with the OPSG programme.

Measures for which support is provided fall into the following categories: improvement of the energy efficiency of the thermal envelope; improvement of the energy efficiency of heating and lighting systems; replacement of conventional energy with geothermal and biomass in heating systems. Most of the requested assistance refers to the building envelope, *Figure 2.20.*

Figure 2.20: Aid Granted (%) per Type of Measures under PAREER-CRECE Programme



Source: IDAE

The success of this programme, which was jointly funded with ERDF funds from the OPSG programme, has led to the exhaustion of the funds in May 2016, when 2,488 requests were received, 35% more than the planned budget. The total assistance committed to by late 2017 amounts to €180 M. It is expected that this assistance will mobilise investments for a value of € 300 M. Approved requests imply improvements in energy efficiency for 42,358 dwellings with 8,398 rooms and 4,500,000 m^2 of total prepared floor area.

[9] *These measures, which are in effect throughout the period of application of the Directive, between 1 January 2014 and 31 December 2020, will contribute to the fulfilment of the binding energy savings target.*

In view of the success of this programme, a second call for the **Aid Programme to Improve the Energy Efficiency of Existing Buildings (PAREER II)** has been launched in order to continue to incentivise the execution of measures promoting energy efficiency and renewable energy sources in extant buildings. The available budget amounts to €125 M.

The PIMA Sol plan, which was approved in August 2013 and promoted by the Ministry of Agriculture, Food and the Environment (currently the Ministry for the Ecological Transition (MITECO), was an initiative designed to reduce greenhouse gas (GHG) in the tourism sector, endowed with a budget of €5.21 M. The energy renovation of hotels has been one of the measures considered, requiring an energy improvement equivalent to at least two letters in its energy rating or a B rating.

The **2013-2016 State Plan to promote housing rental, building refurbishment and urban regeneration** was approved by the Ministry of Development in April 2013 with a total budget of €2,421 M. The Plan included several programs among which the ***Stimulus program for building refurbishment*** stands out. The Plan, which was extended in 2017, has found continuity through the recent approval of the **2018-2012 State Housing Plan** which likewise includes a programme geared towards building efficiency - the ***Plan for the promotion of improvements in energy efficiency and sustainability in dwellings*** -. The granting of assistance is subject to obtaining a reduction in yearly energy demand in heating and cooling for the building, referring to the energy certificate. In the new Plan, this requirement for reduction[10] varies from 20% to 35% between climatic areas. The assistance of the first of these programmes has allowed for the refurbishment of 80,709 dwellings.

The **JESSICA-FIDAE Fund**, with an endowment of €123 M, is a joint initiative developed by the IDAE and the European Investment Bank (EIB) which was active throughout the 2013-2016 period. Its goal was to finance urban energy efficiency and renewable energy use projects. The buildings sector was among the sectors considered for the execution of the aforementioned projects, as well as industry, transport and public service infrastructure.

With regard to **Directive 2009/28/EC**, apart from the forecasts established in legislation concerning building on the subject of building energy coverage with renewable energy sources, nowadays there are several programmes to support the incorporation of renewable energies in buildings. Among them, the **Biomcasa, Geotcasa, Solcasa and GIT** programmes, which are intended to promote the use of efficient hot water and air conditioning systems based on biomass, geothermal energy, solar energy or a combination of these technologies through energy service companies, stand out in particular.

2.2.1. HOUSEHOLD SECTOR

Along with measures geared towards buildings, the Renove Plan for electrical appliances, intended to improve the energy efficiency of house appliances by replacing them with more efficient models, stands out. This plan was successfully carried out in the context of the action plans of the E4 Strategy. Nowadays, these Plans are maintained in a number of autonomous regions as a part of their energy policies. Likewise, with respect to equipment, the provisions of the Eco-design and Eco-Labelling Directives apply and have been transposed into Spanish law through Royal Decree 187/2011, of 18 February and Royal Decree 1390/2011, of 14 October, respectively.

Added to this is the informative activity carried out by the IDAE in the context of the E4 Action Plans, aimed at citizens through communications campaigns on energy savings and efficiency. Three new

[10] *In the 2013-2016 Housing Plan, the requirement to obtain assistance was set to 30% in all climatic areas.*

campaigns have been held since 2014, the latest two having been funded with the National Energy Efficiency Fund.

2.2.2. SERVICES SECTOR

Apart from the measures shared by the household sector, such as those geared towards buildings and equipment, other actions specific to this sector are considered. In the public service sector there are a number of measures geared towards the purchase of efficient equipment by public bodies as well as the improvement of final use energy efficiency, mainly in what concerns public lighting and water processing.

In what concerns equipment, the Green Public Procurement Plan (PCPV) of the Central Government was approved in 2008. This Plan laid down a number of measures and guidelines to incorporate environmental criteria in the various phases of contracting, including prescriptions concerning energy savings and efficiency. The second PCPV Plan, which was carried out in 2011 and 2015, confirms the adoption of a series of habits in the public management and consumption of goods and services. Following the same line, Law 15/2014, of 16 September, on the rationalisation of the public sector implied an additional push for energy efficiency in acquisitions (office equipment, tyres, etc.) by the public administrations. This requirement was extended to the awarding of contracts to service providers. In the future, a new Environmental Public Procurement Plan will be drafted.

With regard to public lighting, significant advances have been made owing to a combination of technological progress (LED technology, etc.) and legislative progress (regulation of energy efficiency in outdoor lighting facilities). Based on these improvements, considerable potential for savings linked to the renovation of the national outdoor lighting stock can be expected for approximately 8 million lighting points. It is in this context that the **Aid programme for the renovation of municipal street lighting** was approved, with a total budget of €113,791 M[11] from the National Energy Efficiency Fund. One requirement to obtain assistance is that the energy rating of the renovated facilities must be A or B. Implemented renovations lead to an average annual electricity consumption saving of 65%.

In addition to this Programme, the aforementioned *DUSI Strategies* are endowed with a budget to carry out a street lighting energy improvement plan.

In what concerns water treatment, in view of the high energy consumption of desalination plants and their energy potential, the **Aid programme for energy efficiency measures in desalination plants,** which is currently in force, was approved in December 2015. It has been allocated a €12 M budget which is likewise from the Energy Efficiency Fund. Eligible measures must fall into one or more of the following categories: improvement of desalination equipment and process technology, and implementation of energy management systems. It is required that eligible investments must have a financial/energy ratio[12] equal to or less than 19,186 €/toe for the first category and 14,501 €/toe in the second.

Moreover, the approval of Royal Decree 56/2016, of 12 February, whereby article 8 of Directive 2012/27/EU, on energy audits, was transposed, is an incentive to improve energy efficiency in large companies in the services sector.

[11] This budget is divided into € 65 M, for the first call for aid, and € 48.791 M for the second one. The two calls were approved in May 2015 and April 2017, respectively.
[12] Eligible investment / final energy savings

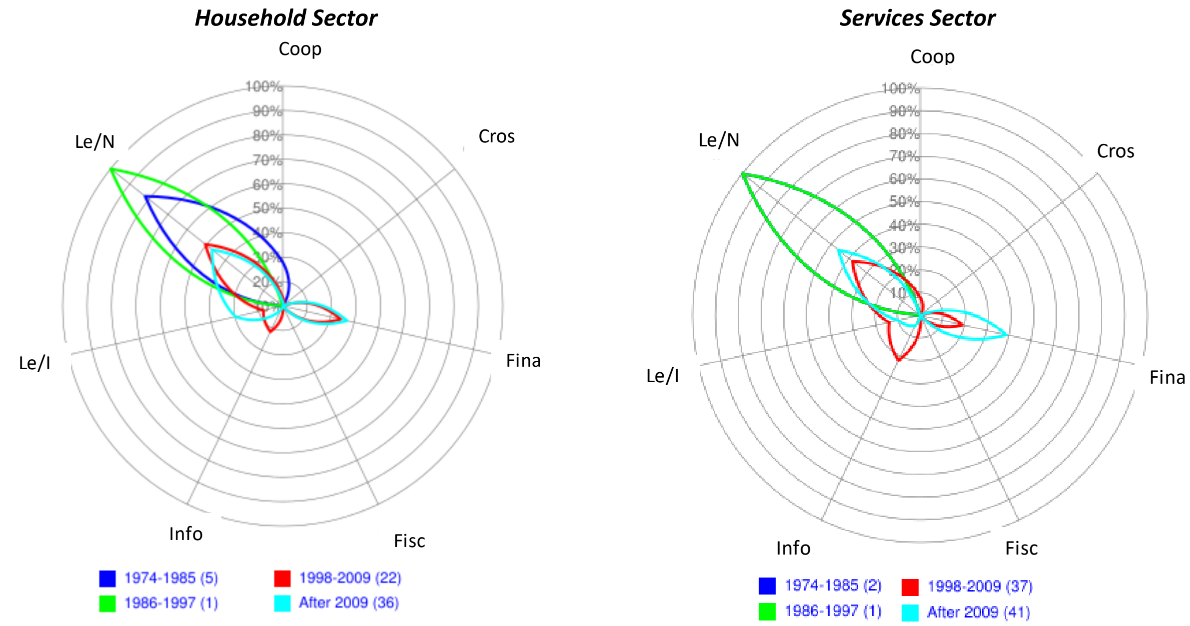
Patterns and Dynamics of Energy Efficiency Measures

Figure 2.21 below displays the evolution of energy efficiency measures implemented in the buildings sector in Spain over the course of different time periods and which fall into seven different categories:

- Coop: Cooperative measures.
- Cros: Cross-cutting measures with sector-specific characteristics.
- Fina: Financial.
- Fisc: Fiscal/Tariffs.
- Info: Information/Education/Training.
- Le/I: Legislative/Informative.
- Le/N: Legislative/Regulatory.

The graphs display as many axes as there are categories[13] for different time periods. Measures that were implemented both in the residential and in the services sector fall into diverse categories, with a predominance of financial, informative and legislative measures. Over the last few years, legislative activity related to building, energy efficiency, eco-design and labelling directives stand out in particular. This is accompanied by financial measures that were mostly approved within the context of Energy Savings and Efficiency Action Plans.

Figure 2.21: Development of Energy Efficiency Measures by Types over time in the Buildings Sector



Source: MURE. Note: Ongoing and completed measures.

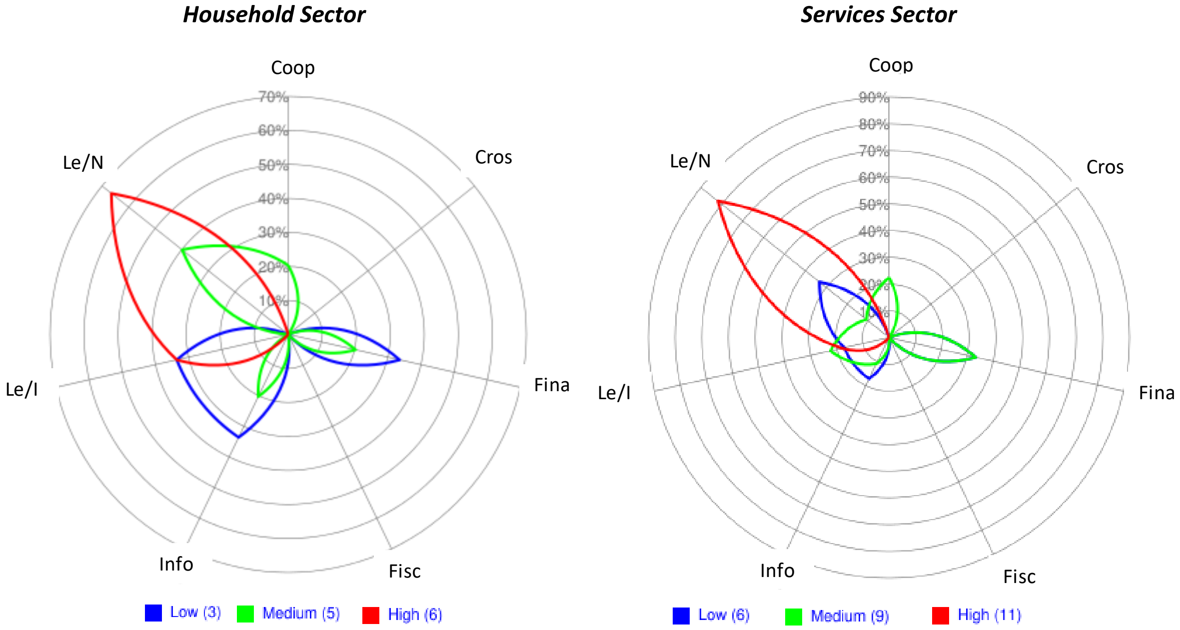
[13] The distribution of measures on each axis is related to their categorisation, which, in some cases, may be of a multi-dimensional nature. Therefore, the number on the caption does not necessarily correspond to the total number of real measures, as it considers all types of measures in their different dimensions.

Evaluation of Energy Efficiency Measures: Impact Assessment

The impact assessment of the measures was carried out taking into account the expected impact as well as the impact based on the ***"Ex-ante"*** assessment criterion established in the framework of the ODYSSEE-MURE project. In accordance with the latter, based on the relationship between the expected energy savings derived from the application of the measure in a given sector and the forecast energy consumption in said sector, three energy efficiency impact categories can be obtained: low: < 0.1%; average: 0.1-0.5%; and high: ≥ 0.5%. A qualitative assessment of the possible impact was carried out in those cases in which there is no quantitative evaluation.

There are currently a total of 29 measures applicable to the buildings sector in the MURE database, 10 of which are common to the services and residential sectors. Average-high impact measures, which are mostly legislative and financial, predominate. Most measures in the first category arise from the aforementioned Directives, among which Directive 2010/31/EU stands out on the basis of which a large number of legislative regulations intended to increase the standards of design and energy efficiency of buildings were approved.

Figure 2.22: Impact of Energy Efficiency Measures in the Buildings Sector by Types



Source: MURE. Note: Ongoing measures.

Financial measures, on the other hand, are increasingly present under the framework of aid programmes such as that approved with contributions from the National Efficiency Fund and the 2014-2020 ERDF Funds (OPSG) whereby it is expected to contribute to the fulfilment of the target established by Article 7 of the Energy Efficiency Directive. The aforementioned PAREER-CRECE Program stands out among financial measures due to the success of its implementation and its potential for replicability.

Among measures with low impact, level equipment labelling, of an informative and educational nature, stands out. It is expected that the impact will increase as market experience is acquired with this type of measures.

3. ENERGY EFFICIENCY IN TRANSPORT

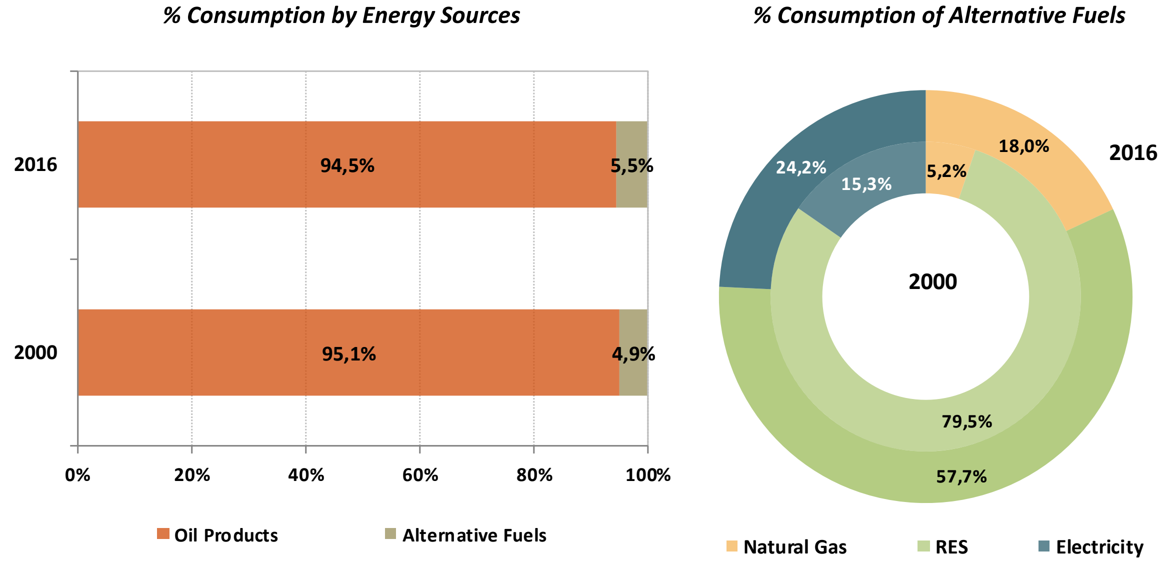
3.1. ENERGY EFFICIENCY TRENDS

Transport maintains its relevance in the sectoral distribution of final energy demand in Spain with a 42.3% share in 2016. During that year its consumption increased by 4.2%, reaching a value of 34,821 ktoe. This implies a consolidation in the change in trend that began in 2014 after a six-year period of continuous recession in demand at an annual rate of 4.7%.

This increase in consumption can be explained by the rise in demand for oil products (+4.0%) which makes up for 94.5% of consumption in this sector. Likewise, demand associated to natural gas (+5.3%) and biofuels (+13.7%) has increased, whereas demand for electricity has decreased by 3.5%, although electricity only covers 1.3% of demand in this sector.

There has been a gradual increase in the use of alternative fuels (biofuels, natural gas, electricity) in transport. These sources already make up 5.5% of demand, with biofuels clearly dominating, *Figure 3.1*.

Figure 3.1: Energy Consumption by Energy Sources in the Transport Sector in Spain, 2000-2016

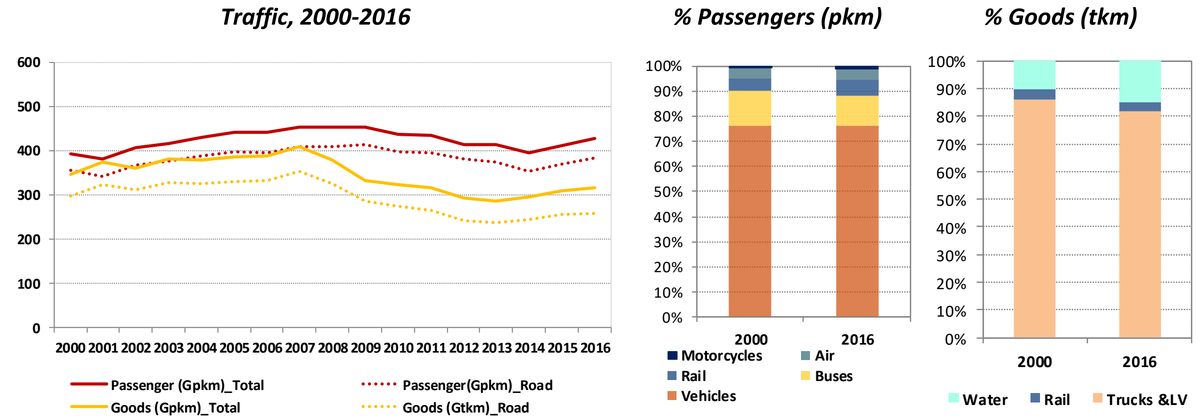


Source: MITECO/IDAE

Further progress is expected for the next few years, promoted by Directive 2014/94/EU on the deployment of alternative fuels infrastructure, transposed into Spanish law through the National Action Framework for alternative fuels infrastructure. This is intended to stimulate the market for alternative vehicles and fuels in Spain, contributing towards the targets set by Directives 2012/27/EU and 2009/28/EU in this sector.

The increase in energy demand in transportation in 2016 can be explained by the recovery of the economy, growth in foreign trade and the drop in fuel prices. All of this has contributed to an increased mobility in all means of transport, *Figure 3.2,* as it emerges from available information on the traffic of passengers and goods, with increases of 4.0% and 2.1%, respectively. This increase in activity, especially in freight transport, mostly took place in road transport.

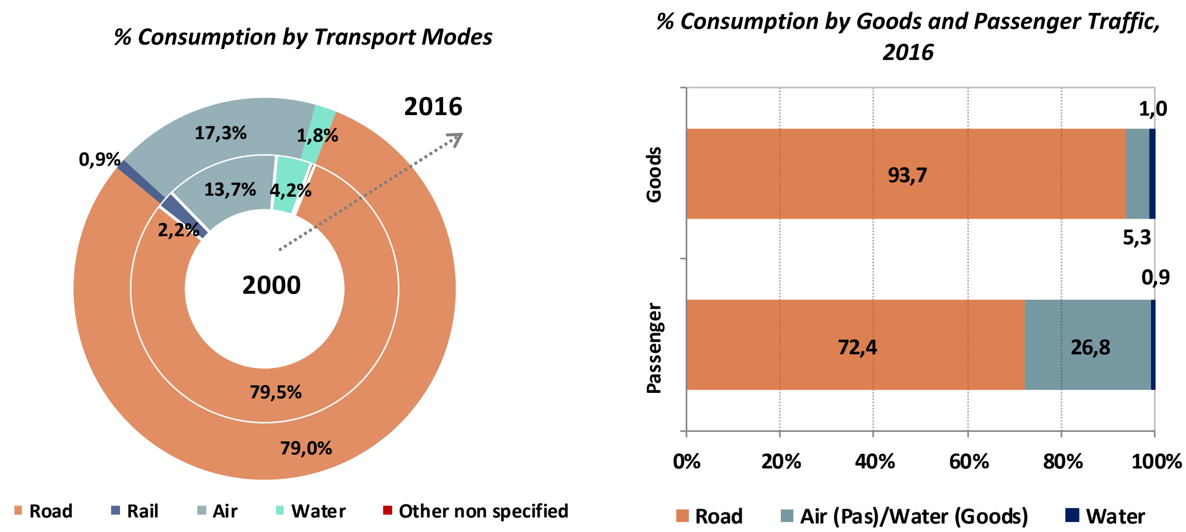
Figure 3.2: Traffic of Goods and Passengers in Spain, 2000-2016



Source: MFOM/MITECO/IDAE/DGT

Road transport is the most relevant transport mode both in terms of overall activity, with a 76% and 82% share of passenger and freight transport, respectively, and energy consumption (79.0% of consumption), *Figure 3.3.* Freight transport was particularly hard-hit by the economic recession of the past few years. This was particularly visible in what concerns internal freight transport, which heavily depends on internal demand and which is mostly carried by road.

Figure 3.3: Energy Consumption by Transport Modes and Types of Activity in the Transport Sector in Spain, 2000-2016

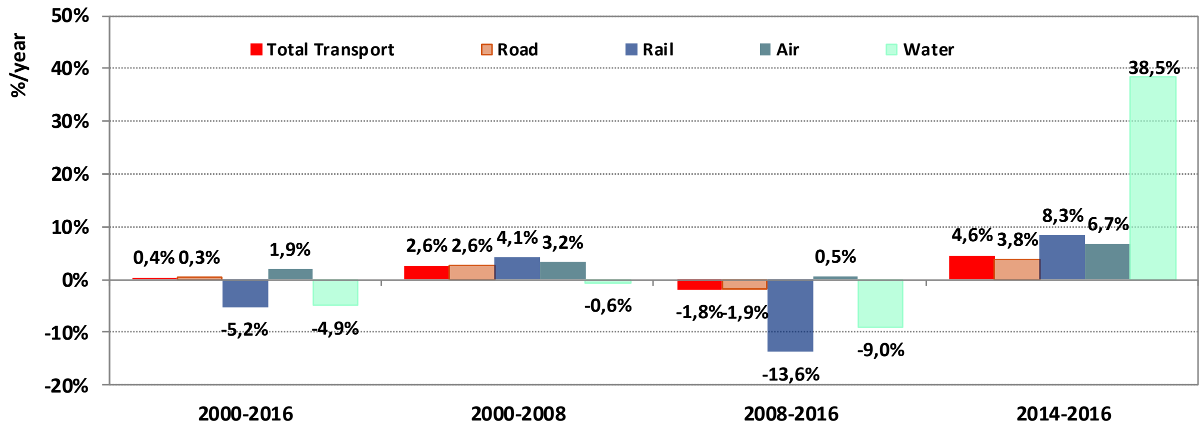


Source: MITECO/IDAE

Generally speaking, the decline in internal freight mobility from 2007 onwards and, to a lesser extent, the slowdown in national passenger transport marked the downward trend in energy demand for road and overall transport. Lower levels of activity associated to water and rail transport also had an influence on the final result despite the fact that their impact is limited due to their low share of demand, *Figure 3.3*, which experienced a slight decline during the financial crisis. Air transport, on the other hand, displayed a more stable evolution.

The situation changed in 2014, with the first signs of economic recovery, which led to an increased mobility and hence an energy demand upturn which yet remains in 2016, *Figure 3.4*. Water transport displayed the greatest increase in consumption in relative terms, although its contribution to the overall increase in consumption in transport barely reaches 10%.

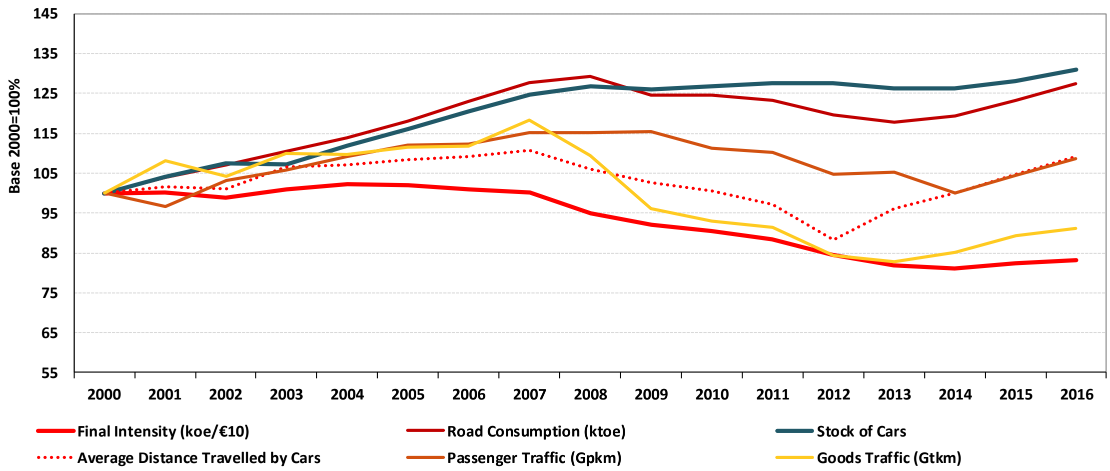
Figure 3.4: Variation of Energy Consumption by Transport Modes in Spain, 2000-2016



Source: MITECO/IDAE

An analysis of the most important determining factors in transport energy consumption —especially by road—, points to the age of the automobile fleet and the high mobility associated to the use of private vehicles and freight transport, *Figure 3.5.*

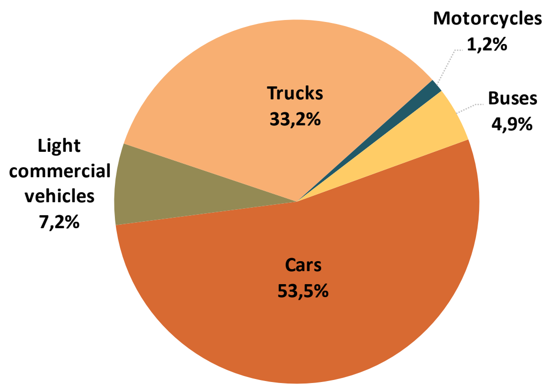
Figure 3.5: Main Indicators in the Transport Sector in Spain, 2000-2016



Source: DGT/MFOM/MITECO/IDAE

Private vehicles, in particular, absorb more than half of consumption for road transport, *Figure 3.6*, which amounts to 42% of transport consumption.

Figure 3.6: Energy Consumption in Road Transport by Vehicle Types in Spain, 2016

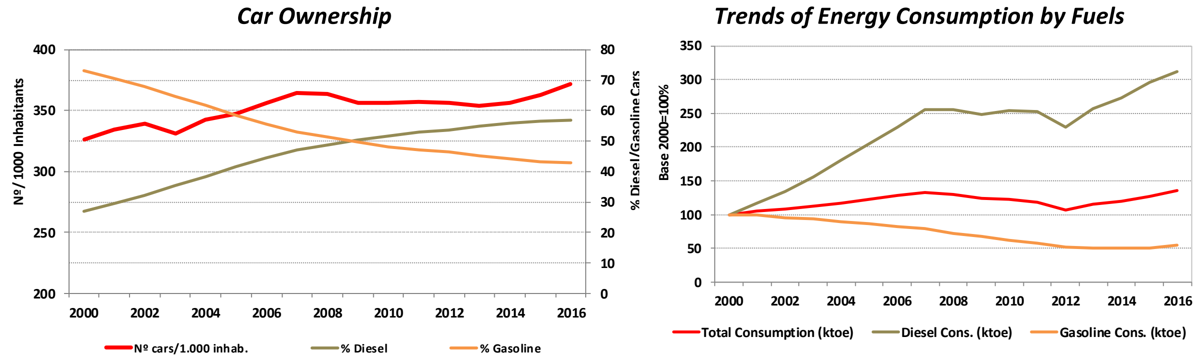


Source: IDAE/DGT

That is why the use of these vehicles, along with a low rate of occupation, has a remarkable impact on transport energy demand and intensity. Throughout the last two decades, the growth in the private vehicle fleet, *Figure 3.7*, has coincided with their dieselisation. The penetration of diesel vehicles—57% of the fleet in 2016— in combination with social factors (longer yearly routes compared to gasoline vehicles) and technical factors (greater cylinder capacity and catalytic converters) inherent to this type of vehicles explains the differential growth in gasoil consumption compared to gasoline consumption in the automobile fleet. This fact has determined the evolution of demand and intensity in road transport.

Nowadays, the gap between these vehicles has narrowed owing to the recent increase in demand for gasoline vehicles which is due to, among other factors, an increase in sales of gasoline hybrid vehicles with the ECO label as well as increased citizen awareness on air quality problems.

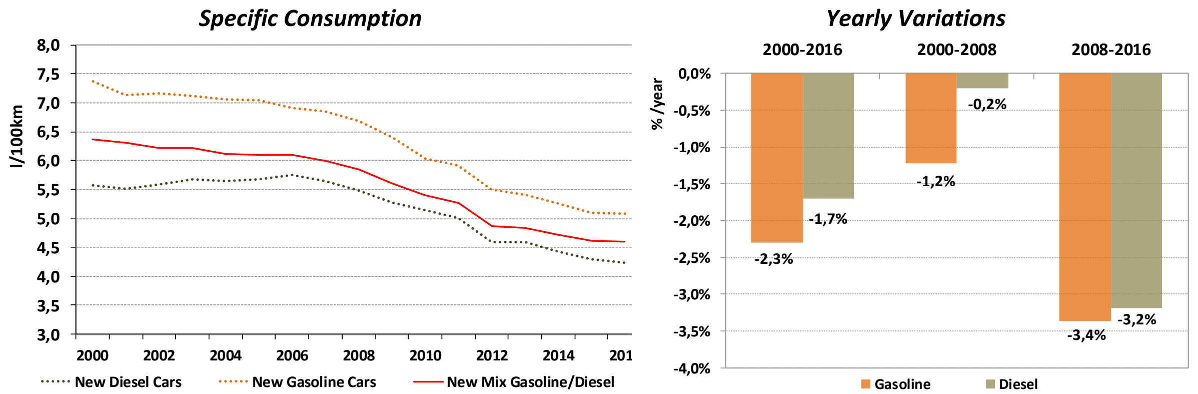
Figure 3.7: Dieselization of the Car Fleet in Spain



Source: IDAE/DGT. Note: The level of car ownership in Spain is base d on the stock of circulating vehicles.

Added to this, there are technological improvements associated to this type of vehicles, which surpass those of diesel vehicles in relative terms, *Figure 3.8*. Generally speaking, the continuous penetration of new technological developments in engines and vehicle designs in the markets contributes to the renewal of the vehicle fleet and to improvements in energy efficiency.

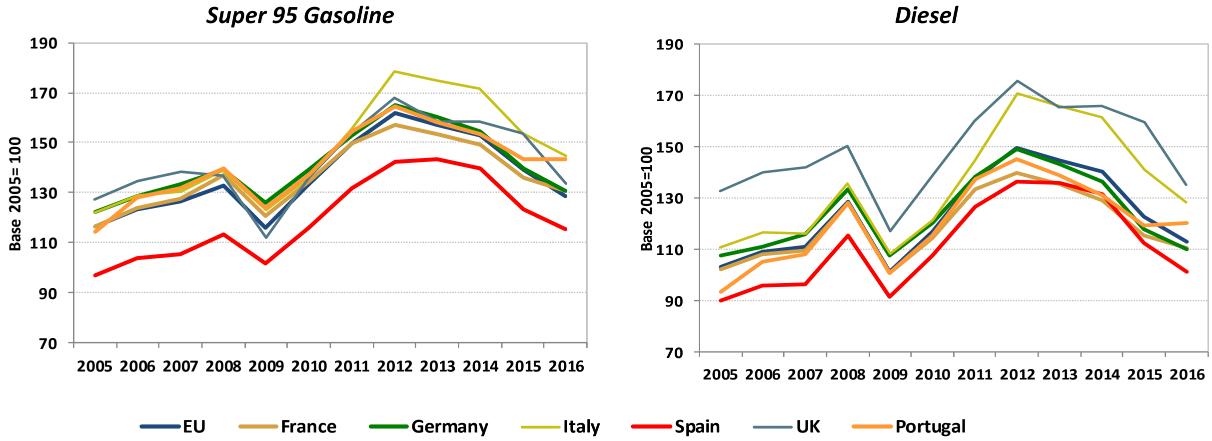
Figure 3.8: Trends of the Specific Consumption of New Cars in Spain, 2000-2016



Source: IDAE/DGT/ACEA, JAMA, KAMA

Another factor is the price of fuel, which is lower in Spain than in neighbouring countries such as Portugal and France, *Figure 3.8.* This encourages long-haul trucks to fill up their tanks in Spain, leading to the so-called "fuel tourism". This consumption is associated to sales in bordering countries in which differences in prices lead consumers to consume outside their country of origin, even though, for statistical purposes, said consumption is computed at the national level, thus having an impact on intensity. This form of consumption can reach up to 20% of road transport consumption in some countries. A survey carried out by the IDAE in 2012 on consumption by the private vehicle fleet concluded that, in Spain, this effect amounts to 6% of gasoline consumption.

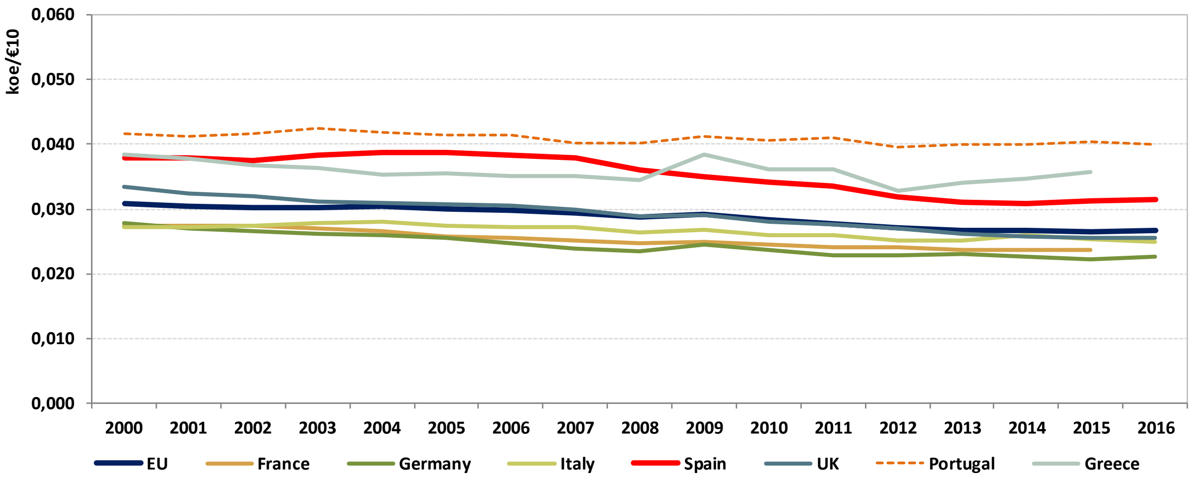
Figure 3.9: Fuel Prices (€/l.) in Spain and the EU, 2005-2016



Source: European Commission's Oil Bulletin. Note: Taxes included.

All of these factors drive the evolution of transport consumption and intensity in Spain, which is roughly 20% above the EU indicator. The national indicator has followed a downward trend since 2004, *Figure 3.10*, which was initially boosted by measures implemented within the framework of the Energy Saving and Efficiency Action Plans and, later on, reinforced by structural and activity effects caused by the financial crisis in several sectors of the economy. Throughout the last two years, in a context of economic recovery, intensity has worsened somewhat, by 0.9% in 2016. This is partly explained by the increase in energy demand associated to the recovery in mobility and freight traffic.

Figure 3.10: Trends of Energy Intensity in Transport Sector in Spain and the EU, 2000-2016



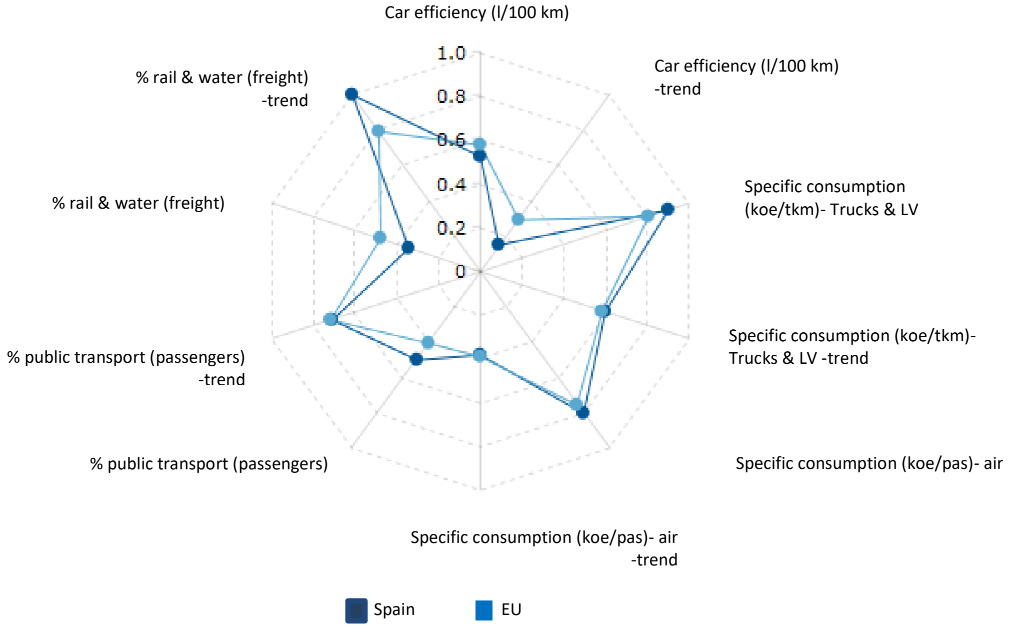
Source: EnR/IDAE

Nowadays, as can be seen in *section 3.2*, there are a number of measures geared towards the transport sector, especially road transport, which are expected to contribute to the reduction in energy intensity.

Using the indicator scoring methodology discussed in *Chapter 2*, there has been obtained a comparison between Spain and the EU average for all representative indicators in the transport sector, *Figure 3.11*, both concerning the current situation and the trend since the year 2000 are shown. The specific consumptions of air and freight transport display similar positioning. Trends vary slightly with regard to the efficiency of private vehicles and the share held by public transport, the former being more positive in the EU and the latter more so in Spain.

The situation in Spain is less favourable with regard to water and rail transport owing to the smaller share held by these two means of transport in overall freight transport, although they display a greater upward trend.

Figure 3.11: Comparison of Energy Efficiency in the Transport Sector in Spain and the EU (ODYSSEE Scoreboard Methodology)



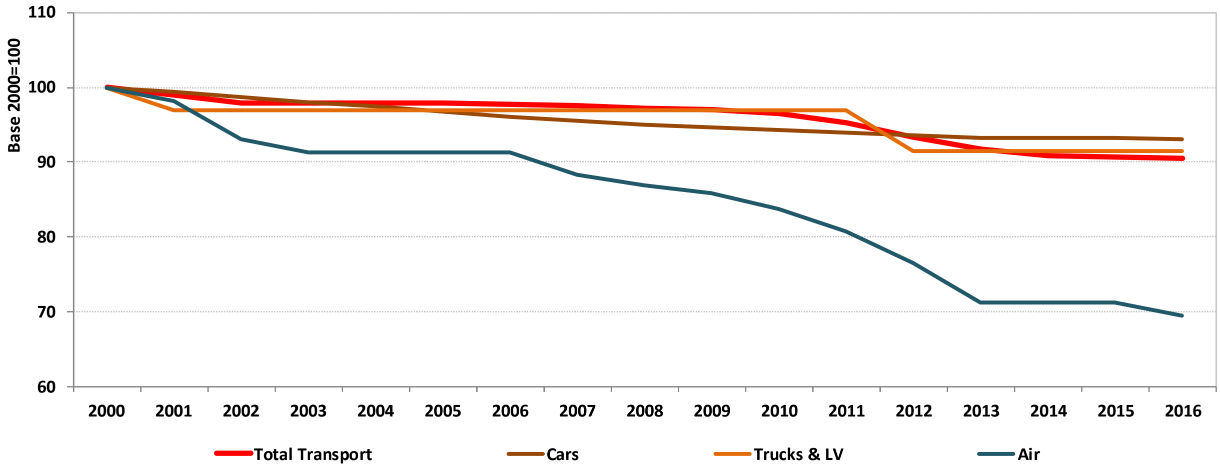
Source: ODYSSEE http://www.indicators.odyssee-mure.eu/php/odyssee-scoreboard/documents/methodology-odyssee-scoreboard.pdf

An additional analysis of efficiency trends in the transport sector can be obtained through the ODEX index. In transport, this index is calculated at the level of 8 means of transport/ vehicle types: private vehicles, trucks and light vehicles, motorcycles, buses, air transport, rail transport, and water transport. The global trend is then obtained by weighting the individual trends of each means of transport based on the relative weight of different means of transport in energy consumption in transport.

Based on the ODEX index, the global efficiency of transport in Spain has experienced an annual improvement of roughly 1% over the 2000-2016 period. All means of transport have participated in this improvement, although the chief contribution comes from road transport owing to its significance in overall demand and, to a lesser extent, air transport.

The ODEX for transport evolves in parallel to the ODEX for private vehicles and lorries, *Figure 3.12*, which make up for the bulk of consumption in road transport. Technological improvements to this type of vehicles have contributed to improvements in transport efficiency, although this progress was dampened in the context of the financial crisis, which had a negative effect on the renovation of the vehicle fleet.

Figure 3.12: Energy Efficiency Progress in Transport in Spain



Source: IDAE/ ODYSSEE

3.2. ENERGY EFFICIENCY POLICIES

Energy efficiency measures implemented in the last few years for transport in Spain are largely integrated in the Energy Saving and Efficiency Action Plans that have been adopted until now, structured around **three lines of action: modal shift** in the mobility of passengers and freight towards more efficient modes; **an efficient use of means of transport; and improvements to the energy efficiency of means of transport**. These three points still define the lines of action to be followed to improve energy efficiency in this sector.

Within the **first line -modal shift-** the Urban Mobility Plans and Transport Plans for Companies and Centres of Activity, which were developed through the Action Plans, especially the 2008-2012 Plan, stand out in particular. These Plans have received additional support since the approval of the Sustainable Economy Law of 4 March 2011 whereby a legal framework for promoting sustainable mobility plans was created. All of this has allowed for mobility plans in nearly all Spanish towns with a population of over 50,000 inhabitants. Added to this there is the inclusion of an energy efficiency criteria assessment mechanism[14] for the granting of state aid to public transport systems.

Nowadays progress continues to be made towards an improvement in the modal shift in order to increase the share held by more efficient means of transport. In May 2015 the **Aid programme for modal shift and more efficient use of transport modes** was launched with an endowment of €8 M, from the Energy Efficiency Fund, in its first call. This programme is one of the alternative measures considered pursuant to article 7.9 of Directive 2012/27/EU. Recipient measures include the development of sustainable workplace travel plans that are required to yield savings of 10% at the very least. Recently, a new line of assistance in this programme, with a budget of €3.7 M, was approved in 2017, thus providing continuity to previous efforts.

In addition to the above, in the context of the 2014-2020 Operational Programme for Sustainable Growth, a budget for the promotion of sustainable urban mobility and the implementation of sustainable urban mobility plans will be assigned both under the "Low-carbon economy" line and the "Integrated and sustainable urban development" line.

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[14] *Measure approved by Law 22/2013 of 23 December 2013 on the general state budget.*

Likewise, in the field of sustainable urban mobility, a positive contribution is expected from the State Strategic Bicycle Plan, which is expected for late 2018 and which is currently under development under the coordination of the Directorate-General for Traffic (DGT).

On the other hand, in order to increase the share held by railroads in the transport of freight and passengers, which were limited to a mere 3.4% and 6.2% in 2016, there are a number of measures geared towards developing infrastructure. Among them are the 2011-2020 Energy Sustainability Plan by RENFE, the main railway transport operating company, and the 2014-2020 general Plan for Energy Saving and Efficiency by ADIF, the manager of public railway infrastructure. In addition to this there is the 2005-2020 Spanish Transport Infrastructure Plan, PEIT, which has currently been superseded by the 2012-2024 Strategic Plan for Infrastructure, Transport and Housing (PITVI). This Plan pays especially close attention to railway freight traffic, thus contributing to inter-modality and global transport efficiency.

Likewise, the improvement in railway transport efficiency promotes a greater use of railway transport by making it more competitive. These measures are preferentially considered within the second line of action, which is described below.

In what concerns the **second line –efficient use–**, there has been progress in **fleet management** through audits, the implementation of digital systems and training in **efficient driving**. Since 1 January 2014, efficient driving techniques are a part of the teaching system to obtain drivers' licenses for private and industrial vehicles. As for professional drivers, over 85,000 professionals have been trained in efficient driving courses over the last few years.

Both fleet management and efficient driving are still being promoted to this day, and they are supported in the context of the aforementioned **Aid programme for modal shift and more efficient use of transport modes**. A minimum of 5% savings is required from measures related to fleet management and a minimum of 200 students are required for efficient driving courses. This programme is expected to allow for the implementation of fleet management systems that will have an impact on the operation of roughly 800 industrial vehicles as well as to train approximately 30 000 professional drivers.

In the same vein, there are a number of other initiatives currently underway in the form of **Collaboration agreements**, both with the Spanish Association of Automotive Fleet Managers (AEGFA[15]) and with the National Confederation of Driving Schools (CNAE[16]), which are meant to promote efficient fleet management and efficient driving. The aim of the former of these agreements is the development of a certification programme for fleet vehicles that wish to distinguish themselves through their improvements in energy efficiency. The latter is intended to promote efficient driving through the instruction provided in driving schools.

With regard to rail transport, one innovative measure intended to improve its use efficiency is the use of energy from regenerative braking in trains, which has been made possible by the modification of Royal Decree 1955/2000, which allows for the remuneration of energy provided to the network. There are currently a number of operating initiatives in commuter train and high-speed rail lines, as well as in the underground lines of certain cities.

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[15] *AEGFA (Asociación Española de Gestores de Flotas de Automóviles*

[16] *CNAE (Confederación Nacional de Autoescuelas*

Such initiatives have received additional support from the **Aid programme to improve energy efficiency in railway systems,** which is deemed to be one of the alternative measures defined in article 7.9 of Directive 2012/27/EU. This Programme, which has been in force since December 2015, is endowed with a budget of €13 M from the Energy Efficiency Fund. Apart from regenerative braking in trains, recipient actions include improvements to energy efficiency in railway facilities and the optimisation of operations. One of the requirements to obtain assistance is the achievement of energy savings.

With regard to the **third line - improvements to the energy efficiency of means of transport -,** a number of measures and programmes geared towards the renovation of fleets and of the automobile fleet have been adopted, with special emphasis on private vehicles, in view of their intense use and impact on energy consumption. These measures have been widely developed within the scope of the Action Plans of the Energy Saving and Efficiency Strategy (E4).

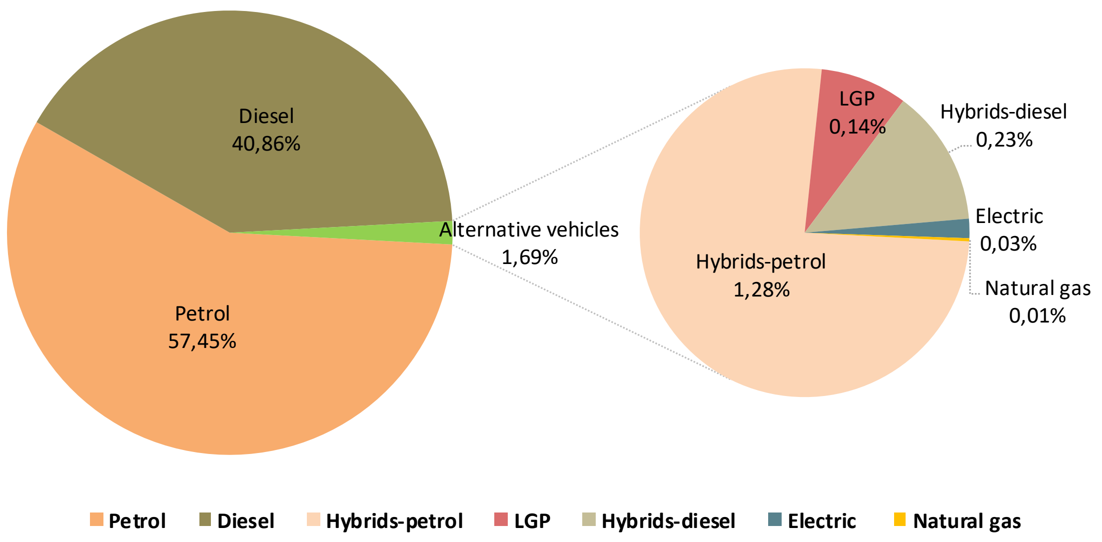
More recently, during the 2012-2016 period, the approval of the **PIVE Plans** (efficient vehicle incentive plan) and the **PIMA Aire Plans** (Environmental Stimulus Plan), which were endowed with budgets of €1,115 M and €53.1 M, respectively, is worth to be mentioned.

Throughout its 8 iterations, the PIVE plan has been a public assistance programme managed by the IDAE and intended to promote the scrapping of private (M1) and commercial (N1) vehicles with minimum ages of 10 and 7 years, to be replaced with high energy efficiency vehicles on the basis of their energy category and CO_2 emissions.

Apart from the promotion of efficient vehicles propelled by conventional fuels, the purchase of electric, plug-in hybrid and extended-range electric vehicles, as well as LPG (autogas) or natural gas-powered vehicles has been incentivised, provided their CO_2 emission levels did not exceed 160 g/km.

Throughout the programme, 1,173,035 vehicles have been replaced by other more energy-efficient models. Of all the replacement vehicles, 57.4 % were diesel-engined, 41 % were petrol-engined, *Figure 3.13.* The remaining difference corresponds to alternative vehicles (diesel/petrol hybrids and LPG, electric and natural gas-powered vehicles).

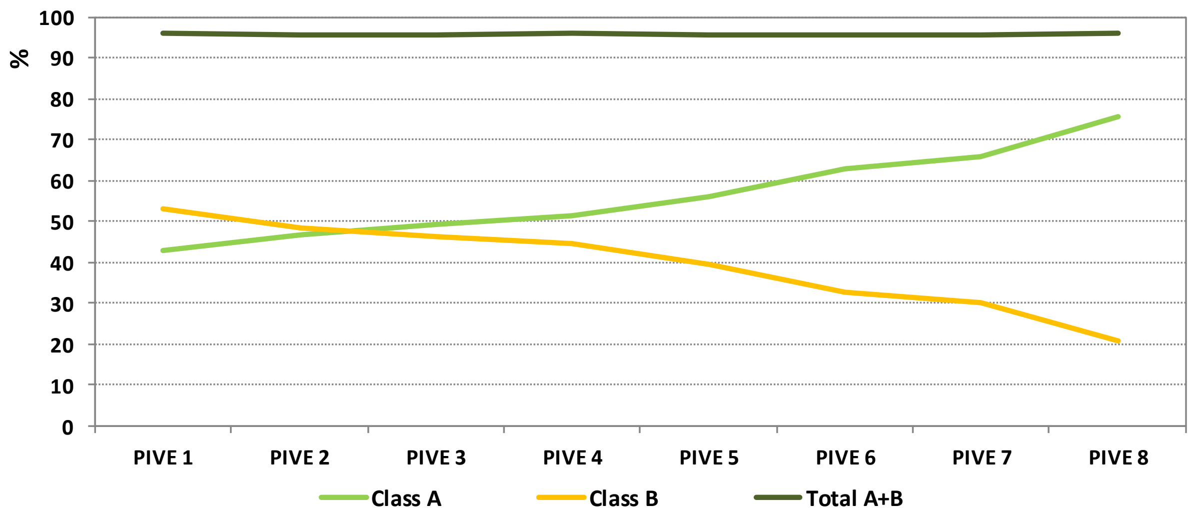
Figure 3.13: Distribution (%) of Vehicles Purchased by Technology under PIVE Programmes



Source: IDAE

The contribution of energy labelling of vehicles has been decisive in the management of these programmes as it has contributed to the displacement of sales towards more efficient class A and B vehicles, *Figure 3.14*. This has led to an improvement in the energy efficiency of the vehicle fleet which, in conjunction with the average age of scrapped vehicles, of roughly 17 years, clearly shows the benefits of the programme in energy and environmental terms.

Figure 3.14: Distribution (%) of Vehicles Purchased by Energy Class under PIVE Programmes



Source: IDAE

Throughout its 4 iterations the PIMA Aire Programme, which was promoted by the Ministry of Agriculture, Fisheries, Food and the Environment (MAPAMA) (currently the Ministry for the Ecological Transition (MITECO), has helped renew more than 50,000 commercial vehicles by replacing them with more efficient models with a lower environmental footprint.

These incentive programmes are completed by two additional plans, the **PIMA Tierra Plan** and the **PIMA Transporte Plan,** which were implemented by the MAPAMA in 2014 and allocated budgets of €5 M and €4.7 M, respectively. The former is geared towards the renovation of the agricultural tractor fleet with more efficient models with a lesser environmental footprint, and the latter is intended to stimulate the withdrawal of old heavy freight transport vehicles and buses.

In what concerns the promotion of vehicles with alternative technologies and fuels, significant efforts have been made in Spain to assist their penetration in the market. Thus, over the 2006-2013 period, the purchase of electric vehicles was incentivised through lines of assistance in the context of the action Plans of the E4 Strategy and the **MOVELE Pilot Project**, managed by the MINETAD (currently MITECO). As a part of this initiative, the **MOVELE 2014**[17] **and 2015 Programmes**, managed by the IDAE with a global budget of €17 M, were approved. These programmes promoted the purchase of 2,529 electric plug-in vehicles. Later on, in the 2016-2017 period, the **Plan to Promote Mobility using Alternative-Fuel Vehicles (MOVEA)**, with a total budget of €30 M, expanded its range to include LPG and natural gas-powered vehicles and electric motorcycles, as well as charging points for electric vehicles in public access areas.

[17] *The MOVELE 2014 Programme was approved within the framework of the "2010-2014 Comprehensive Electric Vehicle Stimulus Strategy".*

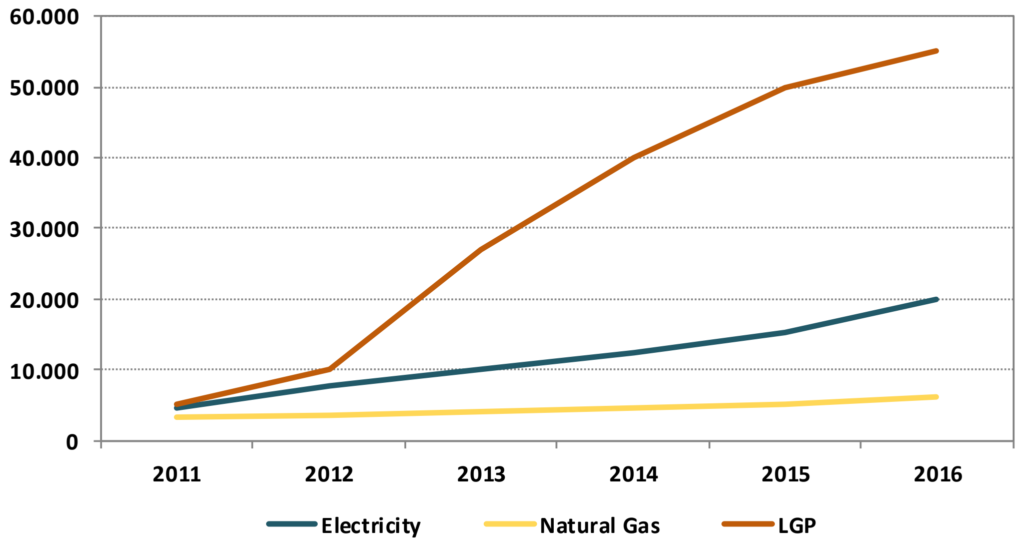
It is in this context that, in late 2017, the MOVALT Vehicles and MOVALT Infrastructure Plans, also managed by the IDAE and endowed with a joint budget of €35 M, were approved. The former is intended to incentivise the purchase of electric, CNG, LNG or LPG vehicles, fuel cell-propelled vehicles and electric motorcycles, and the latter is geared towards the implementation of charging infrastructure for electric vehicles.

This has been reinforced by the transposition of Directive 2014/94/EU on the deployment of alternative fuels infrastructure through Royal Decree 639/2016, of 9 December, on alternative fuels infrastructure and the National Action Framework (MAN), the latter being a continuation of the Spanish Strategy to Promote Alternative-Fuel Vehicles, which was approved in 2015.

These incentives programmes are a part of the package of alternative measures mentioned in article 7.9 of Directive 2012/27/EU, and they have been accompanied by regulatory advances geared towards promoting the infrastructure required for the development of electric mobility. One example of this is the approval of Royal Decree 647/2011, of 9 May, regulating the role of charging network operators and Royal Decree 1053/2014, of 12 December, adopting new supplementary technical instruction 'BT 52: Special-purpose facilities. Electric vehicle recharging infrastructure'. The former has allowed for the existence of 39 certified charging network operators entitled to sell electric energy for charging electric vehicles to this day, and the latter has established, among others, the minimum requirements for electric vehicle charging infrastructure in new buildings or parking lots and on public roads.

The evolution of the alternative vehicle fleet over the last few years has been significant[18], *Figure 3.15,* amounting to approximately 20 000 electric vehicles, 55,000 LPG-powered vehicles a little over 6 000 natural gas-powered vehicles by late 2016. Existing infrastructure for electric vehicle charging currently amounts to 1,659 stations (4,574 charging points). With regard to automotive LPG, there are currently 540 stations open to the public, whereas natural gas has a little over 100 public and private CNG and LNG supply stations around cities.

Figure 3.15: Evolution of the Stock of Alternative Vehicles



Source: *IDAE/DGT/AOGLP/GASNAM*

[18] The growth in Autogas vehicles stands out due to the fact that this technology was initially developed in converted used vehicles, which implied a lower implementation cost compared to other alternative technologies.

Biofuels, on the other hand, have made significant progress owing to Order ITC/2877/2008, of 9 October 2008, whereby a mechanism to promote its use for transport purposes was introduced. This regulatory framework was reviewed and new targets for biofuels have been approved through Royal Decree 1085/2015, of 4 December for the 2016-2020, from 4.3% in 2016 to 8.5% in 2020 and which are being fulfilled on a yearly basis.

Other measures contributing to efficiency in transport are the classification of vehicles based on their polluting potential and taxation. Through Resolution of 13 April 2016 of the Directorate-General for Traffic, 4 environmental distinctions based on the environmental impact of vehicles - "zero", "ECO", "C" and "B"- have been approved. These labels affect 50% of the national vehicle fleet, for a total of 16 million vehicles, but more are expected to be implemented in order to achieve 100% coverage for vehicles running in Spain.

With regard to taxation, Law 34/2007 on air quality, whereby a tax on new private cars based on CO_2 emissions applies. On the other hand, in the tax reform of 2015, a reduction[19] in the value of the assessment was approved as a reduction in kind to income tax, applicable to vehicles provided by companies for private use by their employees.

Patterns and Dynamics of Energy Efficiency Measures

Figure 3.16 below displays the evolution of energy efficiency measures implemented in the transport sector in Spain throughout different time periods and categorised into nine different categories:

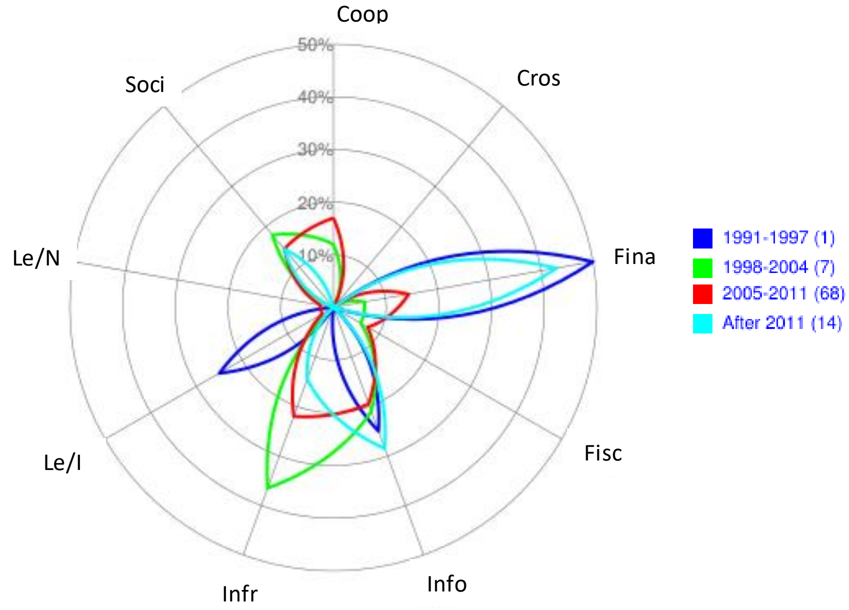
- Coop: Cooperative measures.
- Cros: Cross-cutting measures with characteristics specific to the transport sector.
- Fina: Financial.
- Fisc: Fiscal/Tariffs.
- Info: Information/Education/Training.
- Infr: Infrastructure
- Le/I: Legislative/Informative.
- Le/N: Legislative/Regulatory.
- Soci: Social planning

The graphs display as many axes as there are categories[20] for different time periods. Over the last few years a large number of measures that fall into several categories have been approved, and most of them are a part of the first Action Plans of the E4 Strategy. Under this framework, measures geared towards planning and management of transport infrastructure, such as the Urban Mobility Plans and Company Transport Plans, have gained importance. Added to this is the 2005-2020 PEIT Plan, which was recently reformulated as the 2012-2024 Strategic Plan for Infrastructure, Transport and Housing (PITVI).

[19] The reduction amounts to 15% for Euro 6 vehicles with emissions below 120 gr CO_2 /km and up to 30% for electric vehicles.

[20] The distribution of measures on each axis is related to their categorisation, which, in some cases, may be of a multi-dimensional nature. Therefore, the number on the caption does not necessarily correspond to the total number of real measures, as it considers all types of measures in their different dimensions

Figure 3.16: Development of Energy Efficiency Measures by Types over time in the Transport Sector



Source: MURE. Note: ongoing and completed measures.

Financial measures to support energy efficiency in transport have a significant presence in all analysed periods. Recently, the aforementioned PIVE, PIMA Aire, MOVELE and MOVEA Plans stand out, to which the assistance programmes from the National Energy Efficiency Fund for this sector are added.

Other implemented measures are of a legislative/regulatory and informative nature, and they mostly arise from European directives, such as the application of vehicle labelling and classification based on their polluting potential or the regulation on alternative fuel infrastructure (Royal Decree 639/2016, of 9 December). Likewise, since 2007, the Commission has promoted a fiscal measure that has an impact on the energy efficiency of this sector through the adaptation of taxes to vehicles based on emissions.

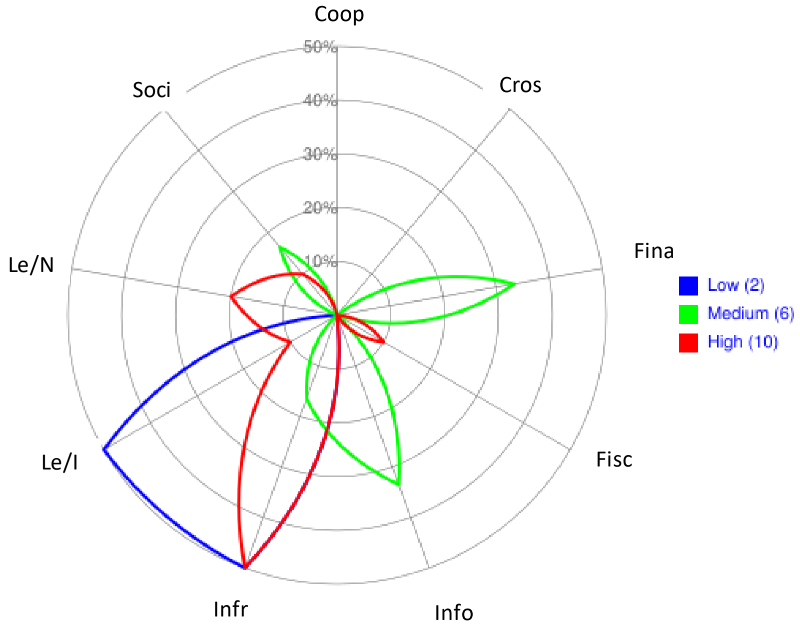
Evaluation of Energy Efficiency Measures: Impact Assessment

The impact assessment of the measures was carried out taking into account the expected impact as well as the impact based on the ***"Ex-ante"*** assessment criterion established in the context of the ODYSSEE-MURE project. In accordance with the latter, based on the relationship between expected energy savings derived from the application of the measure in a given sector and the forecast energy consumption in said sector, three energy efficiency impact categories can be obtained: low: < 0.1%; average: 0.1-0.5%; and high: ≥ 0.5%. A qualitative assessment of the possible impact was carried out in those cases in which there is no quantitative evaluation.

There are currently a total of 11 measures applicable to the transport sector in the MURE database [21], most of which are average and high-impact. Measures with the highest impact are infrastructure management, and those of a legislative/regulatory and fiscal nature. Most of the legislative measures respond to requirements from European directives.

[21] *La Base de Datos MURE cuenta con una amplia selección de las medidas más relevantes de aplicación en el sector transporte.*

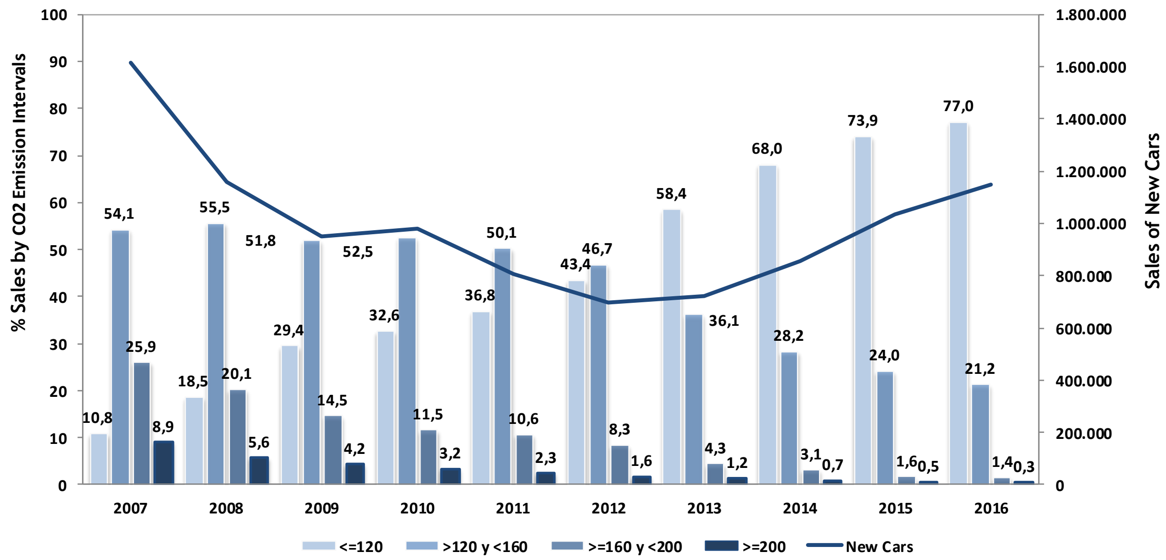
Figure 3.17: Impact of Energy Efficiency Measures in the Transport Sector by Types



Source: MURE. Note: Ongoing measures.

Taxation applied to vehicles through an emissions-based registration tax, in combination with assistance programmes for the purchase of efficient vehicles, is having a significant impact on the penetration of cleaner and more efficient vehicles into the market, thus forcing the renovation of the automobile fleet, *Figure 3.18.*

Figure 3.18: Vehicle Registrations (%) by CO_2 Emission Intervals



Source: ANFAC/DGT

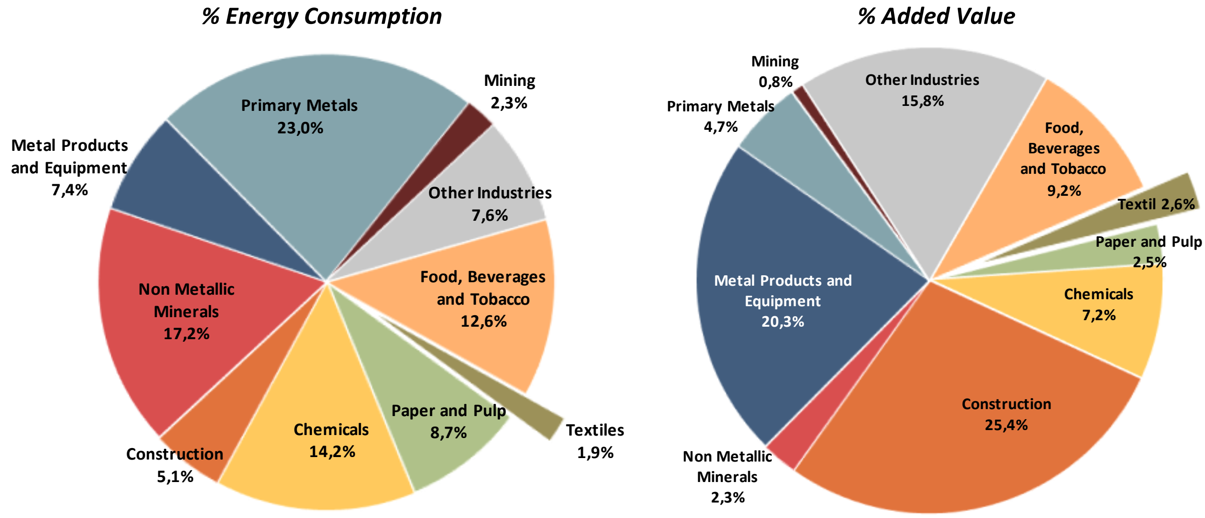
4. ENERGY EFFICIENCY IN INDUSTRY

4.1. ENERGY EFFICIENCY TRENDS

Spanish industry represents 23% of overall energy demand and this share has remained practically stable in 2016, with a slight 0.3% increase compared to the previous year. 75.6% of this consumption is concentrated in five branches - metallurgy, non-metallic minerals, chemistry, food, beverages and tobacco, and pulp and paper -, *Figure 4.1,* which, in aggregate, contribute 25.9% of Gross Added Value (GAV) to industry - three times less than the weight of its consumption.

This contrast between the shares in terms of demand and GAV is especially pronounced in the non-metallic mineral and metallurgy industries, whose respective contributions to the GAV are 7.5 and 5 times lesser than their associated energy demands.

Figure 4.1: Energy-Economic Characterization of the Industry Sector by Branches, 2016

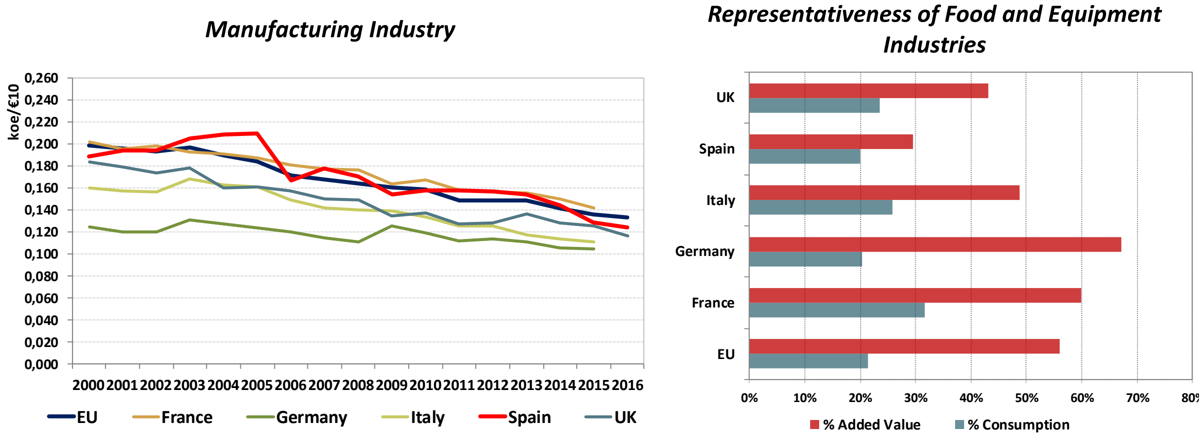


Source: MITECO/IDAE. Note: Non-energy uses excluded.

This characteristic, which is visible in the main branches of industry, along with the sector-based structure of Spanish manufacturing, which is characterised by a moderate share held by less intensive branches (food and equipment) explains the intense nature of the manufacturing industry, which displays a higher level of energy intensity than the EU average, *Figure 4.2,* as well as that of other neighbouring countries such as France, Germany, the United Kingdom and Italy, where the contribution of these branches to the GAV is more significant, thus lessening intensity.

Since 2005, the indicator for intensity in the manufacturing industry has followed a downward trend that continued after the beginning of the crisis in 2008. In 2016 intensity decreased by 3.7% owing to the positive evolution of industrial manufacturing activity, reflected in the increase in its GAV (+3.1%), along with a stabilisation in consumption (-0.3%).

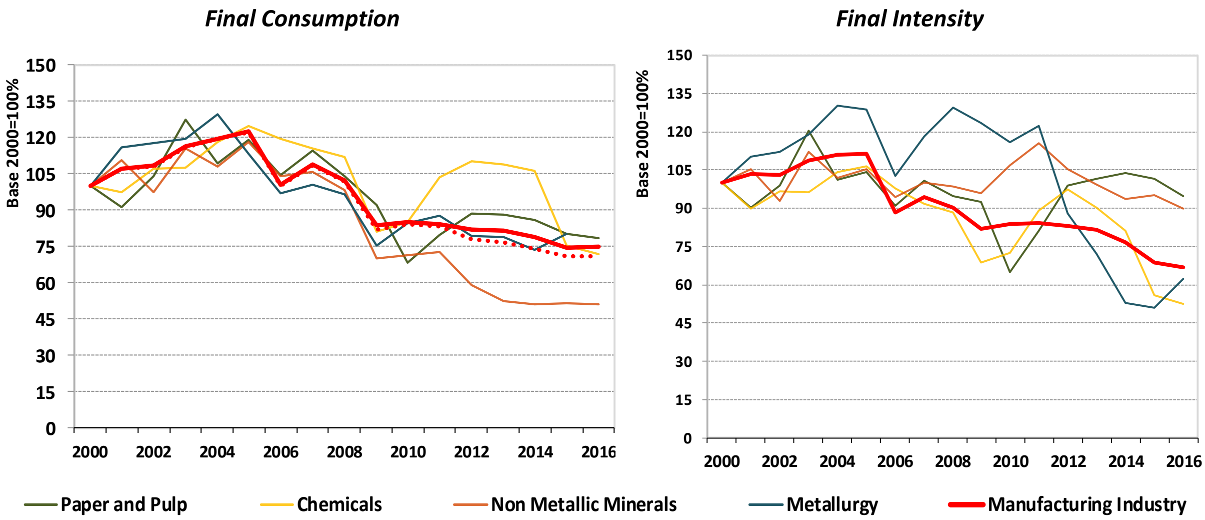
Figure 4.2: Trends of Energy Intensity in Manufacturing Industry in Spain and the EU, 2000-2016



Source: EnR/IDAE/INE

The activity of the chemical, paper and non-metallic mineral industries have made the greatest contribution to this improvement of the manufacturing industry intensity, *Figure 4.3.* These branches display a positive balance between their respective energy demands and their contributions to the GAV of industry.

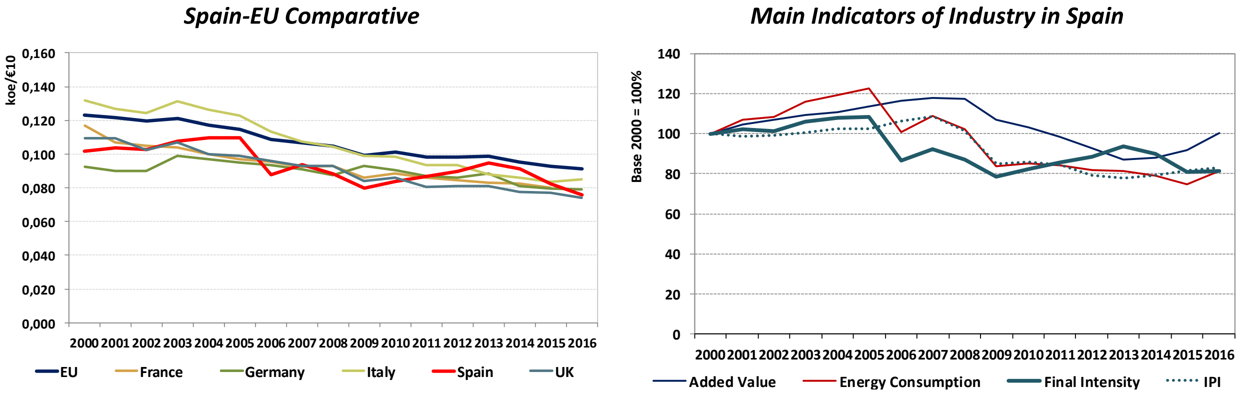
Figure 4.3: Trends of Energy Intensity and Consumption in Intensive Industry Branches, 2000-2016



Source: INE/MITECO/IDEA. Note: Non-energy uses excluded.

Considering industry as a whole, energy intensity, *Figure 4.4,* evolved below the European average, with a general downward trend that was interrupted from 2009 onwards, at the time of the beginning of the financial crisis. From 2014 onwards the original trend was recovered, with an 8.2% improvement recorded in 2016 as a result of the recovery in the economic activity of the entirety of industry, as can be seen from the 9.1% and 1.6% growth in GAV and the IPI, respectively, in conjunction with a reduction in consumption (+0.3%).

Figure 4.4: Trends of Energy Intensity in Industry Sector in Spain and the EU, 2000-2016



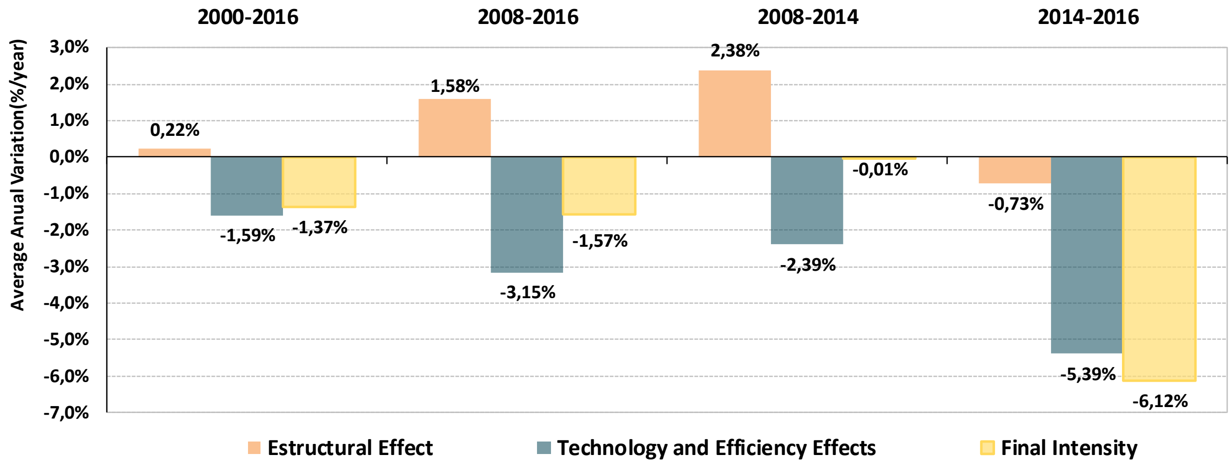
Source: INE/EnR/MITECO/IDAE

In relative terms, the lower level of intensity for overall industry compared to manufacturing industry is related to the construction sector, whose contribution to the GAV (21.9%) of industry is over four times greater than its share of energy demand (5.1%), which tends to lower the overall intensity. Nevertheless, activity in the construction sector has a carry-over effect on demand for industrial goods, especially those related to non-metallic minerals, and its evolution therefore has an effect on the demand and intensity of the main branches of the manufacturing industry.

Thus, the behaviour of industry as a whole is largely conditioned by the evolution of the construction sector. This sector was particularly hard-hit by the financial crisis, both due to the collapse of the real estate market as well as by budgetary adjustment policies that limited investments in civil works. The decline in real-estate activity led to a progressive loss of the relative weight of construction in total GAV, which has contributed to a worsening of overall intensity in industry.

From 2014 onwards, the recovery in construction, mainly associated to housing, along with the improved performance of the manufacturing industry, had a positive effect on the improvements to global industry, as can be seen from the analysis of structural effects on different periods before and after the beginning of the crisis, *Figure 4.5.*

Figure 4.5: Impact of Structure Effect on Industry Intensity in Spain, 2000-2016

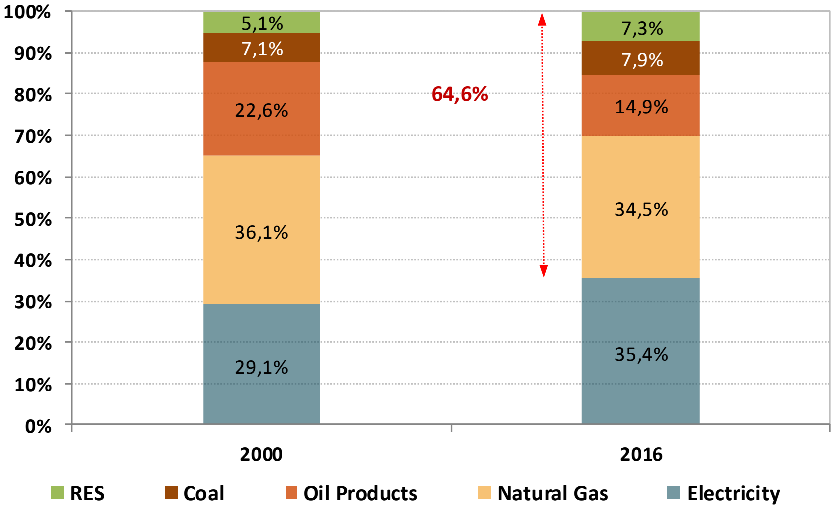


Source: IDAE

The negative contribution of structural effects on intensity over the 2008-2014 period, which was caused by the contraction in building activity, is plain to see. A positive structural change took place during the following period owing to the recovery in construction.

Energy intensity in industry is likewise correlated to the structure of the energy demand, *Figure 4.6*, in which fossil fuels hold a dominant position with over two thirds of overall demand owing to the need for heat in different industrial procedures.

Figure 4.6: Energy Consumption by Energy Sources in the Industry Sector in Spain, 2000-2016

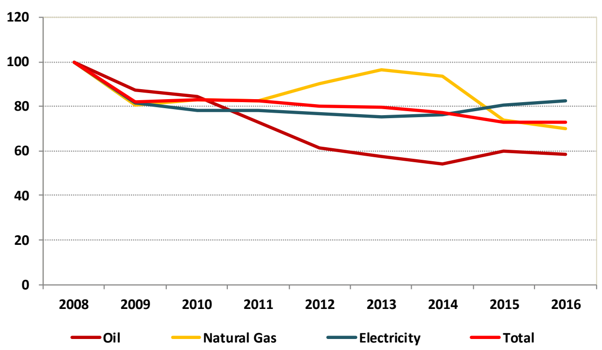


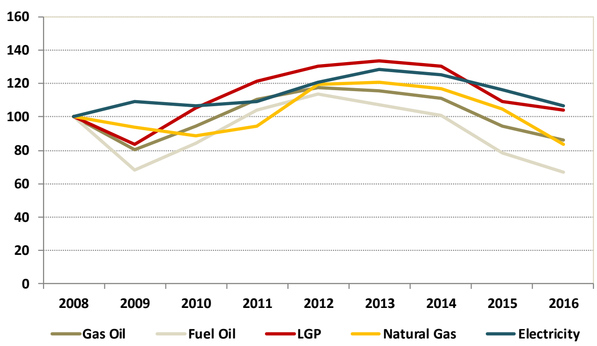
Source: MITECO/IDAE

The presence of natural gas stands out although electricity has been gaining ground to the point that it has recently surpassed gas in demand. These two fuels determine the behaviour of demand in industry, thus influencing the evolution of intensity. In 2016, demand associated to natural gas contracted by 5.3%, whereas consumption for other energy sources increased, although these increases were not sufficiently high so as to counteract the lower demand for natural gas. This has led to a destabilisation in demand with a slight 0.4% increase, thus contributing to the observed improvement in intensity.

During the last few years, energy consumption in industry has dropped progressively owing to the economic situation, the slowdown in activity and the upward trend of energy prices for industrial consumers, *Figure 4.7.*

Figure 4.7: Energy Demand of Industry in Spain vs Energy Prices, 2000-2016





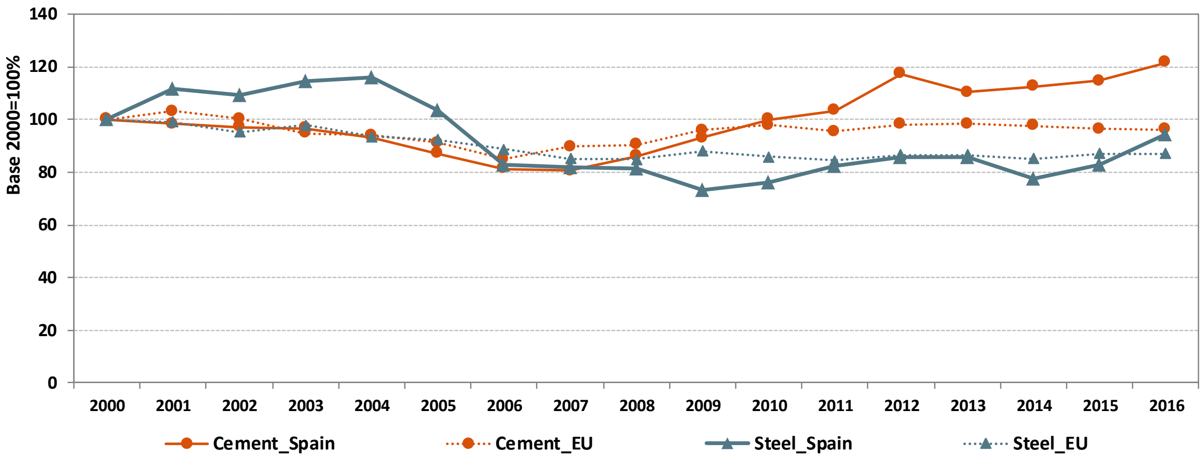
Source: AIE/EUROSTAT. Note: Taxes included.

The drop in demand for oil products has been reinforced by its replacement with natural gas, owing to its greater efficiency, as well as by the difference in prices between both fuels, which explains the recovery in demand for natural gas over the 2011-2014 period. The reduction in energy prices since 2015, along with the recovery in activity, contributes to the increase in demand for most fuels except for natural gas.

A retrospective analysis of the line followed by industry in Spain and in most European countries displays a dependency between the fluctuations in energy intensity and the evolution of economic cycles. In periods of recession there is a disconnection between the rhythms of variation in productive activity and their associated energy demand. This is due to the lower efficiency of used equipment caused by the reduction in the degree to which their productive capacity is used as well as the fact that part of the energy required[22] is independent from activity levels.

The above explains that energy demand tends to decrease at a lower rate than that of associated production, and that the energy consumed per unit of production tends to increase during periods of recession. This can be seen by following the trends of the unit consumption in the cement and steel industries, *Figure 4.8*, the first of which is integrated in the non-metallic minerals sector and the second of which belongs to the metallurgy sector which, as is well known, are two of the most intensive branches in industry.

Figure 4.8: Trends of Unit Consumption (toe/t) of Steel and Cement in Spain and the EU, 2000-2016



Source: IDAE/OFICEMEN/UNESID

The increase in the unit consumption in these two branches is symptomatic of the effects of the crisis, which represented a turning point in the downward trend that had begun earlier as a result of improvements to efficiency that had been implemented in these branches. In what concerns cement, the greater growth in the unit consumption has been reinforced by increased production of Clinker for export, which entails an increase in energy consumption for its production.

Further analysis of trends in industrial energy efficiency can be obtained through the ODEX index. In industry, this index is calculated at the level of 12 branches: 10 branches in manufacturing industry[23], construction and mining. Throughout the 2008-2016 period, ODEX indexes for the manufacturing industry and for global industry displayed yearly improvements at a rate of 1.9%. Taking the

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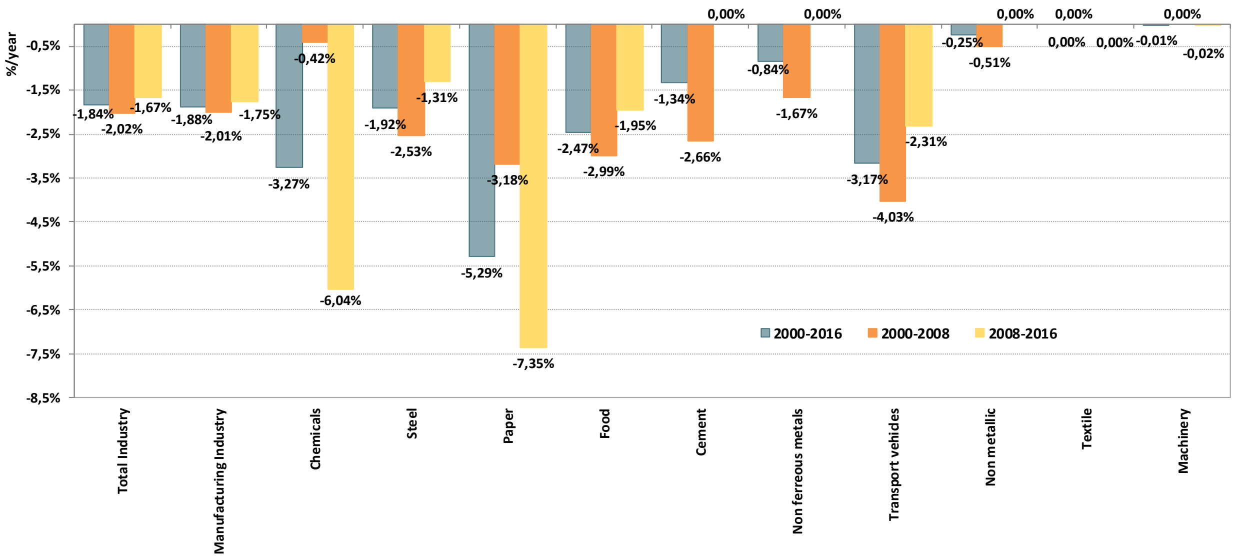
[22] Lighting, heating and air conditioning services.

[23] 3 intensive branches (steel, cement and pulp and paper) as well as 7 other branches of the manufacturing industry (chemical, food and beverage, textile, transport equipment and machinery, non-ferrous metal, other non-metallic mineral and other industries).

manufacturing industry as an example, due to its relevance in global industry, improvements can be seen in all branches, *Figure 4.9*. The paper, chemical and motor vehicle industries stand out with improvements of 3% per year. Generally speaking, progress in all branches was greater during the period prior to the crisis, except for the cases of the chemical and paper industries.

As it has been stated earlier, the most intensive branches such as steel, non-metallic minerals and the paper industry play the biggest role in determining the progress of the manufacturing industry. Over the last few decades, these branches have been incorporating improvements in production processes that have had a positive impact on energy efficiency.

Figure 4.9: Energy Efficiency Progress of Manufacturing Industry, 2000-2016



Source: IDAE/ ODYSSEE

With regard to the cement industry, significant investments were made in energy efficiency over the course of the 2000-2008 period which explains the yearly improvement rate of nearly 3%. More recently, the ODEX index does not reflect any improvements in this branch, mainly due to two factors: on the one hand, the need to recoup previous investments in energy efficiency and, on the other, a certain deterioration in the efficiency of productive facilities owing to the crisis, which explains the increase in specific consumption. In addition to this there is an increase in the production of Clinker over the last few years, which also entails an increase in energy consumption associated to its production.

As for the paper industry, observed progress may be due to the implementation of saving measures due to the crisis, such as the increase in pulp imports and the use of recycled paper in connection with the consumption of new paper, for paper production. According to the Bureau of International Recycling, energy savings may have reached up to 65%. This could explain the evolution of the ODEX index in the paper industry, considering that this index is more sensible to technological improvements and changes in processes.

4.2. ENERGY EFFICIENCY POLICIES

Energy efficiency measures in the industrial sector have chiefly been developed in the context of the implemented Action Plans, and they include assistance programmes intended to promote energy audits and investments in projects to improve energy efficiency. Voluntary agreements between business associations and the public administration, which were considered in the first action plans, did not have the expected impact.

Energy efficiency measures that have recently been implemented in this sector are the Aid programme for energy efficiency measures in SMEs (Small and Medium-sized Enterprises) and large industrial enterprises, the Industrial Competitiveness Incentive Programme and the JESSICA-FIDAE Investment Fund. Likewise, the passing of Royal Decree 56/2016, of 12 February, transposing article 8 of Directive 2012/27/EU on energy audits, implied an incentive to improve the energy efficiency of large companies in the industrial sector.

The **Aid programme for energy efficiency measures in SMEs (Small and Medium-sized Enterprises) and large industrial enterprises** was approved in May 2015 and was allocated a total budget of €115.216 M from the National Energy Efficiency Fund in its first call. Measures considered include the improvement of industrial equipment and process technology and the implementation of energy management systems; of these, the first measure was developed the furthest. A second call has been in force since June 2017, with a budget of €168.91 M.

The **Industrial Competitiveness Incentive Programme** [24] was intended to stimulate corporate investments in order to promote the evolution of beneficiary companies towards new, more advanced, efficient and environmentally friendly production models, as well as to provide goods and services with higher added value. To this end, support was provided to investment plans to improve currently functioning industrial facilities through changes and modifications that could have a significant impact on their competitiveness. Beneficiary companies had to fall under the following categories: manufacturing industry; manufacture of vehicles powered by alternative energies manufacturing, equipment, parts and components linked to their infrastructure; and aerospace industry. The budget allocated to the programme in 2015 amounted to €348.5 M, and a total of 297 projects were approved, with associated investments of €548 M.

As it has been stated in Chapter 2, **JESSICA-FIDAE Fund** was intended to fund urban energy efficiency and renewable energy projects developed by energy service companies. The industrial sector was one of the sectors deemed eligible for funding efficiency projects through this fund.

All of these programmes are alternative measures according to the definition of article 7.9 of Directive 2012/27/EU.

Patterns and Dynamics of Energy Efficiency Measures

Figure 4.10 below displays the evolution of energy efficiency measures implemented in the industry sector in Spain throughout different time periods and categorised into eight different categories:

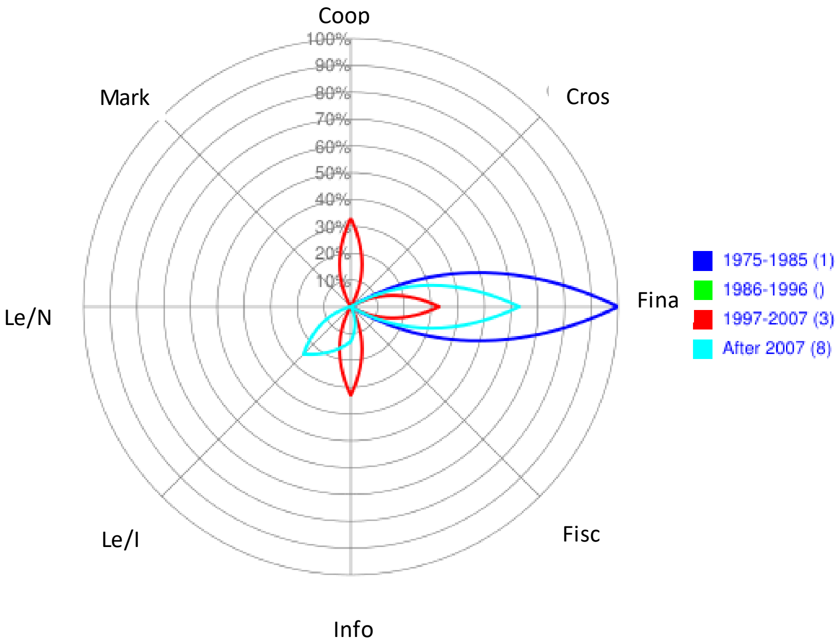
- Coop: Cooperative measures
- Cros: Cross-cutting measures with sector-specific characteristics
- Fina: Financial
- Fisc: Fiscal/Tariffs
- Info: Information/Education/Training

[24] *Order IET/274/2015 of 13 February 2015 announcing the granting of financial aid for industrial investment as part of the public policy to promote industrial competitiveness in 2015*

- Le/I: Legislative/Informative
- Le/N: Legislative/Regulatory
- Mark: New Market Instruments

The graphs display as many axes as there are categories[25] for different time periods. Traditionally, energy efficiency measures in the Spanish industrial sector have been of a financial nature. With the launch of the Action Plans of the Energy Saving and Efficiency Strategy (E4) other measures, such as cooperative measures, voluntary agreements and informative measures (energy audits) were implemented. In practice, voluntary agreements did not work as well as expected, which is why they have been dropped from Action Plans implemented after the E4 Strategy.

Figure 4.10: Development of Energy Efficiency Measures by Types over time in the Industry Sector



Source: MURE. Note: Ongoing and completed measures.

Nowadays, financial measures remain predominant and have recently been joined by a legislative measure (Royal Decree 56/2016 of 12 February) promoting energy audits in large companies in the industrial sector and, consequently, improvements in efficiency.

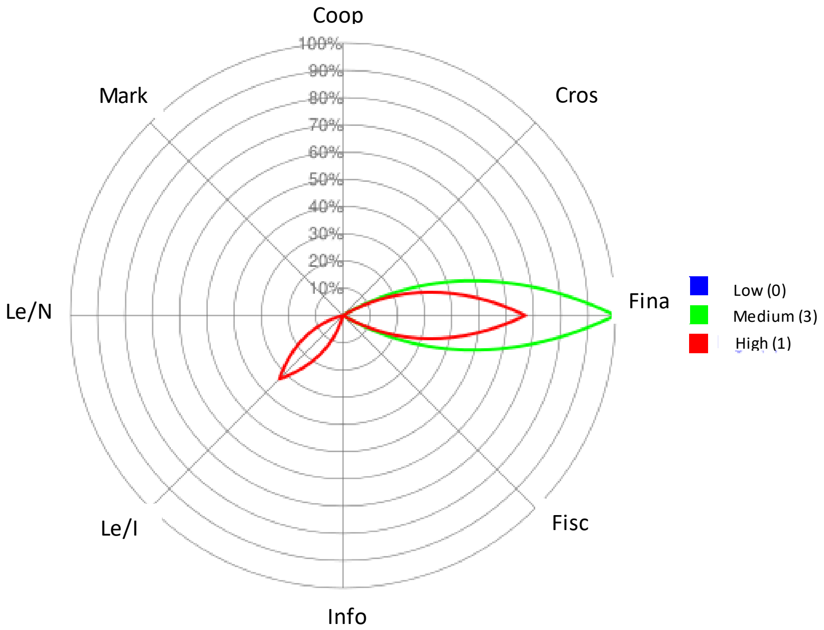
<u>Evaluation of Energy Efficiency Measures: Impact Assessment</u>

The impact assessment of the measures was carried out taking into account the expected impact as well as the impact based on the ***"Ex-ante"*** assessment criterion established in the context of the ODYSSEE-MURE project. In accordance with the latter, based on the relationship between the expected energy savings derived from the application of the measure in a given sector and the forecast energy consumption in said sector, three energy efficiency impact categories can be obtained: low: < 0.1%; average: 0.1-0.5%; and high: ≥ 0.5%. A qualitative assessment of the possible impact was carried out in those cases in which there is no quantitative evaluation.

[25] The distribution of measures on each axis is related to their categorisation, which, in some cases, may be of a multi-dimensional nature. Therefore, the number on the caption does not necessarily correspond to the total number of real measures, as it considers all types of measures in their different dimensions.

There are currently a total of 4 measures applicable to the industry sector in the MURE database[26], 3 of which are average-impact financial measures. These measures were recently implemented, except for third-party financing (TPF), from which there is extensive experience. This last measure was particularly significant among the available modes of funding for energy efficiency projects in industry carried out by the IDAE. It is currently being displaced by commercial financing. The fourth measure is of a legislative nature (Royal Decree 56/2016, of 12 February) and it is expected to be a high-impact measure, although there are no results available to carry out an accurate assessment.

Figure 4.11: Impact of Energy Efficiency Measures in the Industry Sector by Types



Source: MURE. Note: Ongoing measures.

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[26] *The MURE database features a wide range of the most relevant measures applicable to the industry sector.*

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