SAVING AND ENERGY EFFICIENCY STRATEGY IN SPAIN 2004-2012

E4

ACTION PLAN

2008 - 2012

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GENERAL AND AGGREGATE FRAMEWORK OF PLAN

1.- INTRODUCTION

The energy situation is governed, owing to its very nature, by a complex dynamic, inter-related with the economy, for the most part, and is very sensitive to external factors (through the externalities that it induces), imposing new challenges that translate into more pressurized scenarios, which require new market strategies. That framework is shaped by Laws and Directives and, in the latter case, by guidelines, recommendations, communications and regulations, in addition to market forces. For this reason, it is necessary to put forward an approach to a series of different scenarios in which complex interactions are generated, which will variously affect the 2008-2012 Action Plan (PAE4 2008-2012), pointing out the key areas closest to current strategies, the objectives of which cross over into the energy arena, and which set out the background conditions to obtain the necessary changes in trends. Accordingly, a series of considerations are set out below concerning the energy sector, the strategies affecting it and some interesting dynamics to be highlighted when outlining the objectives to be proposed:

a) The Spanish Saving and Energy Efficiency Strategy (E4)[1], approved on 28.11.2003, identifies the strategic objectives, as well as the route that energy policy should take to achieve the objectives of same: security of supply in terms of quantity and price with some basic levels of self-sufficiency, taking into consideration the environmental impact that its use entails and the importance of the competitiveness of our Economy.

b) This Strategy is interwoven with two others in the sphere of sustainability[2]: the Spanish Climate Change and Clean Energy Strategy (EECCEL), and the Renewable Energy Plan (PER)[3] 2005-2010. These are joined by a fourth on the technological

[1] Its predecessor was the Saving and Energy Efficiency Plan (PAEE), annex to the PEN (National Energy Plan) 1991-2000, approved by the Council of Ministers on 26.5.1991.
[2] The draft of a Spanish Sustainable Development Strategy is being prepared that will include all these.
[3] The current PER, 2005-2010, approved by the Council of Ministers on 26.8.2005, is a revision of the PER 2000-2010. It maintains the original commitment of a 12.1% contribution of renewables to the primary supply, and incorporates two new indicative objectives: to obtain 30.3% of electricity generation using renewables and it promotes the introduction on the market of biofuels with a contribution of 5.83 %.

side as one of the main stimuli to earlier developments[4]. In relation to the first, the main mandates originate from the National Allocation Plans (PNA)[5] for emission rights and especially for energy sector intensities.

c) At a time when it is necessary to intensify action in the direction of improving energy efficiency, as a result of the start of the period for calculating emissions according to the Kyoto Protocol[6], the formulation of a second Action Plan, after the current plan for the period 2005 to 2007, is consistent with the current state of affairs. However, action on this matter must be maintained and only intensified if there is a requirement to quicken the pace for achieving the objectives, as is the case today. It should be pointed out that, during the Plan period, conjunctural changes may be expected, but structural changes probably require more time, although the sooner the actions start, the sooner they will be adopted by Society and the market.

d) In this respect, the EECCEL identifies the diffuse sectors (transport, residential, commercial and institutional, agrarian, fluorade residues and gases) as responsible for the increase in GGs and proposes direct action to reduce them by 188.5 MtCO2 over the five-year period; in this sense, the PAE4 2008-2012 has an important role to play in this strategy. The EECCEL dedicates a special chapter to so-called "clean energy" which includes renewables and energy efficiency. As regards efficiency, this Strategy clearly points out the need to make an impact particularly on transport, and domestic and office equipment, with extra special effort. It also highlights the following actions: to incentivize campaigns to make known the investment potential and return on same; to modify the pricing structure to bring about a change in behaviour; to stimulate investment using financial and fiscal measures; and, to activate application of the Directive on energy services.

e) The launch of the first Action Plan (PAE4 2005-2007), of the E4, approved by the Council of Ministers on 8.7.2005, set out priority measures to start a process applying pressure to all sectors, so as to reduce growth rates in consumption and in energy intensity indicators, and especially to signal a route to be followed in the current plan. Accordingly, the launch of a co-management system for the Plan with the CCAAs (Autonomous Communities) and the IDAE (Institute for Energy

[4] The Commission announced at the Amsterdam Forum (3.4.2007) that there is preparation of a technological strategy within the EU to take the initiative in promoting technologies in these directions. The basic framework is set out in the document "Towards a European Strategic Technology Plan"; COM(2006) 847 final. 10.1.2007.

[5] Royal Decree 1370/2006 of 24 November approving the national plan for Allocation of Greenhouse Gas Emission Rights, 2008-2012. The previous period was regulated by RD 1866/2004 of 6 September for the period 2005-2007.

[6] Council Decision of 25.3.2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change. DOCE L130/1/2002. The Spanish Strategy, in that respect (in order to comply with the Protocol) was approved by the National Climate Council on 10.2.2004.

Diversification and Saving) was the most important part and is producing some very interesting results. In this respect, the challenge of mobilizing more than 30 different measures in a coordinated and simultaneous manner, stimulating the wide spectrum of sectors of the economy, including not only the energy-intensive sectors but also the so-called diffuse sectors, using new and imaginative measures to achieve their objective, represented a milestone in the fight to save energy and action against the inefficient use of same.

f) The provisional results, since this is the third year of application, of the current PAE4 2005-2007 were assessed, from which the following aspects and experiences can be highlighted:

- the significant advance in management of public funds through participation in the Plan, coordinated by the IDAE, of the 19 CCAAs, by which a highly efficient technical framework for co-management has been established;
- the number of measures implemented has grown continuously: 8 in 2005, 22 in 2006 and 24 in 2007;
- public resources brought into play have meant a very significant quantitative change amounting to €540.5 M;
- the end-user is being affected by imaginative measures and shock tactics in the diffuse sectors, since more than 1,325,500 actions have been taken, with measures such as the Household Appliance Renovation Plan involving 1.25 million operations, the 53,500 actions of the transport sector, or the 15,000 of the buildings sector; that is, in the diffuse sectors alone;
- actions in intensive sectors, such as Industry, are leading to more than 3,000 operations; over 500 actions in Agriculture and another 500 in energy transformation;
- the measures arise from aid to encourage investment in measures for training and dissemination, which have a very active future value, and legislative actions with still wider scope since they effect a change of policy;
- perhaps the so-called strategic operations should be highlighted in view of their innovation; these are carried out by the IDAE, with collaboration from the CCAAs throughout the State, and in those which an optimization effect from public resources is achieved by acquiring high-efficiency equipment in bulk and introducing it to the market (for example: the replacement of traffic lights with LED, the bulk purchase of low-consumption bulbs, etc.);

- this type of measure has allowed for introduction of the energy label as an example of dissemination and information[7], and efficiency as investment in all the equipment purchased by end-users;
- in the analysis of results obtained (still provisional) the significance of the induced effects was noted, these being as important as the direct effects: the removal from the market of inefficient products, the speed of introduction of new technologies, the dissemination effect of training, etc.;
- finally, attention is drawn to the importance of implementing legislative measures that project a more structural character, some of those implemented over the period having a strong impact, such as the Technical Building Code[8] with minumum requirements on energy efficiency or the Buildings Energy Certificate[9].

g) The publication by the European Parliament and the Council of Directive 2006/32/EC of 5 April 2006[10] concerning energy services and end uses confirmed the appropriateness of the plan that Spain had prepared on this subject and allowed for the launch of actions with benefits for the learning curve that it will translate into and the fulfilment of more extensive objectives and commitments.

h) At a later date, the Commission issued the document "Action Plan for Energy Efficiency: Realising the potential", dated 19.10.2006 COM(2006)545 final[11], which points out the Member States' obligation to submit national plans that translate their policies in these areas, with minimum objectives and given accounting methods.

[7] The label concept is based on the principle of informing purchasers of the technical features of the equipment being bought, allowing them to do so freely on the market, but with awareness of the cause. As regards the measure to encourage the public to buy more efficient equipment, in addition to the advantage of helping the environment, an exception laid down in Articles 87 and 88 of the Treaty and thereby compatible with the common market, the administration is obliged to seek a general benefit.

[8] Royal Decree 314/2006 of 17 March, by which the Technical Building Code was approved.

[9] RD 47/2007 of 19 January, by which the basic procedure for energy certification of new buildings was approved. Ministry of the Presidency. BOE (Official Bulletin) 31.1.2007. This RD partially transposes Directive 2002/91/EC on energy performance of buildings.

[10] And the Commission Green Paper on Energy Efficiency: "A European Strategy for Sustainable, Competitive and Secure Energy". COM(2006) 105 final. 8.3.2006

[11] The document of the Social and Economic Committee, SEC(2006)1175 on the PAEE gives a summary of impact development, emphasizing the significant value for socio-economic and environmental aspects.

i) The Autonomous Communities, within the limit of their powers, are developing through various legal instruments[12] their specific energy plans, which finalize or emphasize certain special or individual aspects.

j) In Spain, various Energy Agencies[13] have been set up which represent a growing potential for management and dissemination of PAE4 measures and could carry out a very interesting regional or local mission.

On the other hand, analysis of the trend in energy consumption in Spain is giving some very interesting signals, even though some of them are merely early signs since the establishment of trends requires longer periods for proper interpretation, but they allow us to confront the new phase of action with more confidence, knowing that the efforts made are bringing about important changes. The data[14] and their resulting assessment can be summarized in the following indicators:

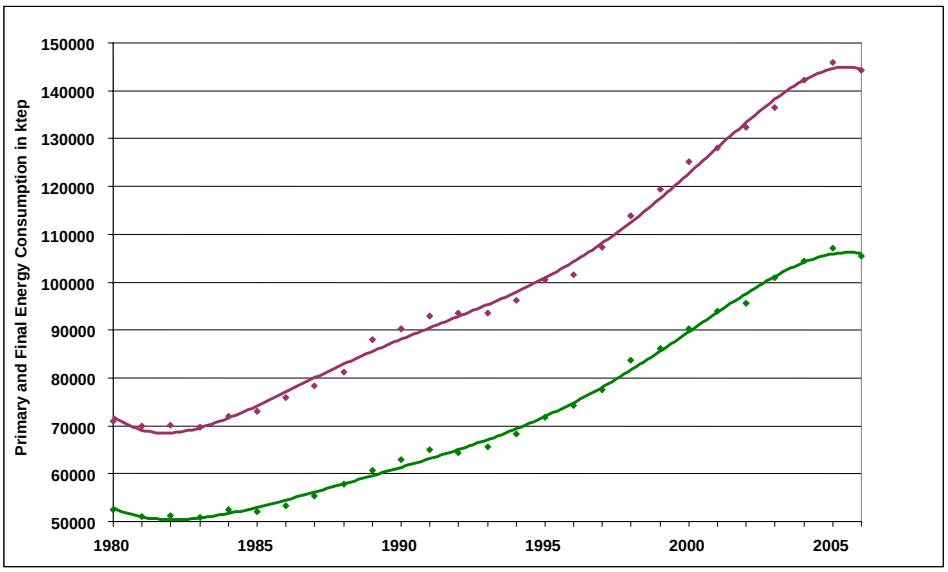
k) Analysis of Graph 1.1, showing the development of primary and final energy consumption, gives an average annual rate over the entire period 1980-2006 of 3.4%, as against that of the last phase 1995-2006 of 3.7%, in primary terms. However, a more detailed trend adjustment signals an incipient, but notable, damping down in the latest phase of 2005 and 2006.

[12] Energy Plans of Navarra, Cantabria, Cataluña, Aragón, Euskadi, Madrid Community, Andalucía, Valencian Community, Canaries, Balearic Islands and cities such as Seville and Barcelona; and Laws on promotion of renewable energy and saving and energy efficiency in Andalucía, Castile –La Mancha and Murcia.

[13] Comparative study of energy agencies similar to the IDAE within the EU framework. IDAE. 2006

[14] Energy Planning Subdirectorate. MITyC (Ministry of Industry, Tourism & Trade). 24.4.2007

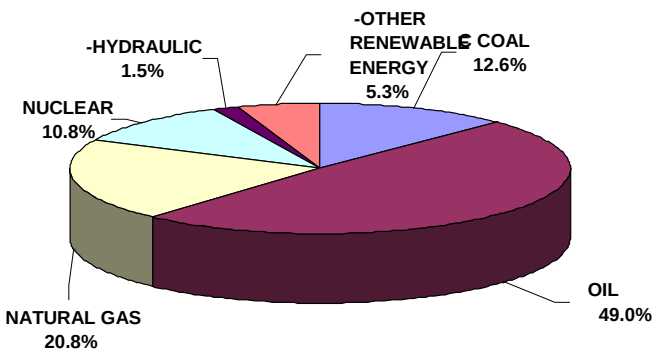
Graph 1.1. Primary and Final Energy Consumption Trends, 1980-2006 (red and green line respectively)



l) In a more detailed analysis of the latest period 2003-2006, the trend in consumption of primary energy was +4.4%, +2.6 % and -1.1%; as compared with that of final energy of +3.7 %, +2.5 % and -1.4 % respectively. This confirms the effect of damping down and the improvement in the processes of transformation from primary energy, electricity and refining sectors, to energy distributed for end use.

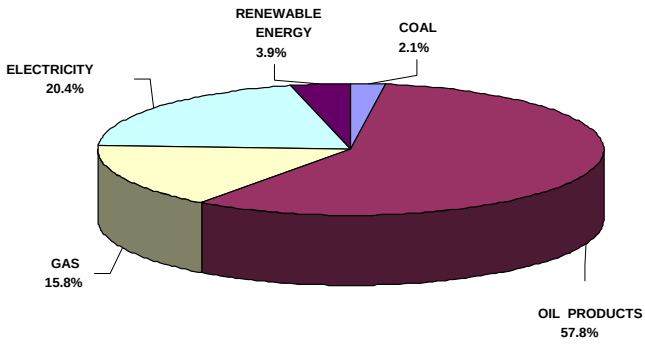
m) Graph 1.2 shows the distribution, by energy source, of the primary supply, highlighting: oil with a slight fall to below 50%; the growing participation of natural gas; and a significant, increasing contribution from renewables, with the remaining primary sources showing a slight downward adjustment.

Graph 1.2. Contribution to primary energy consumption in 2006, by source



n) In relation to consumption by source for end uses, according to the 2005 and 2006 statement, as reflected in Graph 1.3, the following stand out: oil products exceeding 50%, although with a slight downward trend; electricity in second place with a contribution of 20.4 % and slight growth; natural gas with a slight fall, as compared with its increase in primary; significant and promising growth in renewables; and, finally, a continued fall for coal as a fuel for end use.

Graph 1.3. Contribution by source to final energy consumption in 2006



o) Substantial improvement in the contribution of renewable energy sources to primary consumption, reaching 6.8% in 2006[15], with an increase of 11.1% as compared with 2005; and a very significant increase in its contribution to

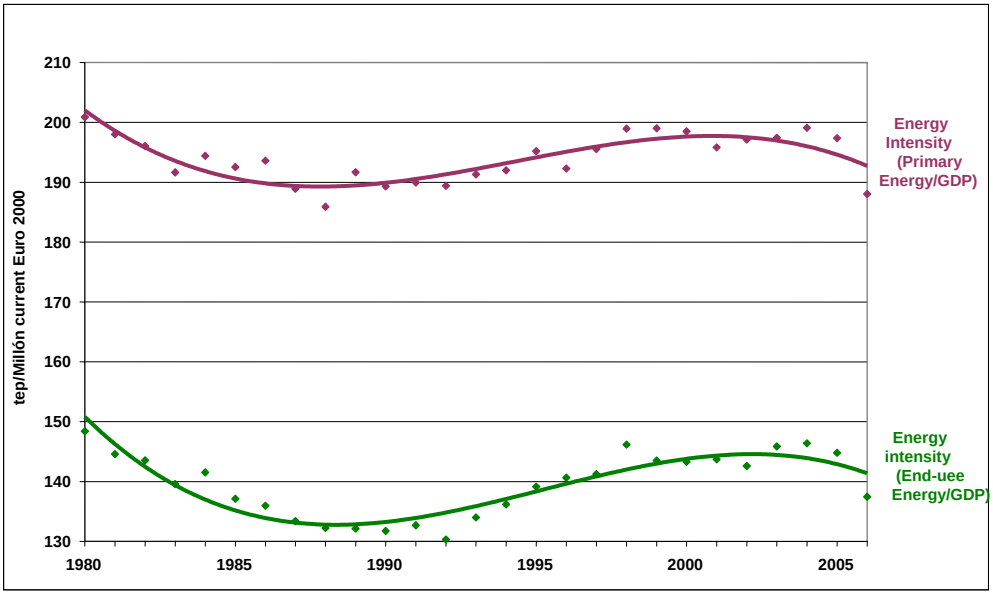
[15] PER 2005-2010 underlines the objective of contribution of renewables to primary energy supply in 2010 at 12.1%.

electricity generation in 2006, reaching 20.1%[16], with growth of 12.9% as compared with the previous year.

p) The above indicators show a cumulative improvement in effects on the degree of self-sufficiency, the "Achilles heel" of our energy sector, reaching 22.1% in 2006, improving by 1.0% against that for 2005. This effect is crucial for the balance of payments, in addition to the general strategic value.

q) With regard to energy intensities (Graph 1.4), the positive effect of damping down demand has, moreover, an additional benefit on the energy intensity indicator, which relates energy consumption to general economic activity. The general trend of these indicators during the period 1980-2006 follows a sinusoidal line, with a minimum in 1988 and a maximum in 2003, coupling energy as the engine of economic growth; whereas from 2004 there was a notable downward trend, with an incipient disconnection of energy consumption and the Economy, since the latter maintains its strength with rates even above that proposed in the E4, supported by internal consumption and notable external growth. This translates into an improvement in intensities of 2.8% in primary and 3.1% in final, extraordinary values which allow for new objectives to be considered concerning the true energy-saving potential of the Spanish system.

Graph 1.4. Primary and Final Energy Intensity Trends (tep/M€ $_{2000}$)



[16] PER 2005-2010 underlines an objective of contribution from RES to electricity generation in 2010 of 29.4%.

r) As part of R+D+i, the development of national plans, especially the PN R+D 2004-2007, has meant a concrete step forward in the search for efficiency by drawing up strategic programmes which concentrate economic resources. Energy efficiency has its area of action in the Plan, although it is sparse in terms of number of initiatives[17], even though there is growing interest confirmed by the increasing number of proposals (specifically those submitted to the 2007 summit meeting on Promotion of Technical Research[18]) as compared with previous years. However, according to the OECD report on the situation in Spain[19], the incentive system is inefficient and clearly inadequate.

s) The sectoral consumption trend has been very uneven, since against notable increases, such as transport or buildings, the decrease has been on the Industry side, and variations in intensity have also pointed up clear differences. This dynamic reflects structural changes and displacement of activity between sectors (analysis is carried out in the sections relating to each sector with differentiated readings).

Consequently, taking up the basic proposal of the E4, the results of the PAE4 2005-2007, and the energy trend of the national and international framework, and especially the mandates relating to commitments concerning GGs, the guidelines for design of the new Plan should be the following:

1. energy efficiency contributes to security of supply and to reducing external dependency, this being one of the immediate instruments that are within reach, without resorting to third parties;

2. reduction of emissions through efficiency and saving is immediate, proportional and cumulative, this being one of the main instruments for achieving fulfilment of the Kyoto obligations;

[17] R+D+i in Energy: Europe and Spain. 2007 Situation Report. General Secretariat of Energy Subdirectorate for Energy Planning. March 2007

[18] ITC/675/2006 orders for granting aid for the research promotion programme of the PNR+D; and CENIT programme for promotion of public-private cooperation.

[19] The policy mix for research, development and innovation in Spain. Key issues and policy recomendations. DSTI/STP/TIP(2006) 12/final. 22.1.2007. OCDE

3. energy efficiency and demand management measures are profitable investments in economic terms, and in environmental terms they are beginning to have a market value;

4. energy-efficiency actions are in line with the Lisbon Strategy[20] by stimulating innovation and improvement of economic competitiveness;

5. dissemination of results is as important as concrete action, which is why the induced effect must be sought, especially in the diffuse sectors;

6. technological innovation represents one of the engines of continuous improvement of energy efficiency in the use of energy and its transformations, and contributes to the development of a specific industrial and services actvity;

7. efficient management of public resources is one of the keys to achieving the objectives, and co-management with the Autonomous Communities is the best instrument, honed during the previous period, from which it must be expanded and improved.

[20] Relaunch of the Lisbon Strategy: COM(2005) 24 final of 2.2.2005. In March 2000 the Council proposed a series of improvements; among these was an increase in productivity and employment; it also emphasizes innovation as the engine of productivity; ecological innovations within the energy and transport framework.

2.- ANALYSIS OF SCENARIOS AND AGGREGATE AND SECTORAL SAVING POTENTIAL

2.1. Analysis of scenarios

The scenarios for carrying out analysis of potential savings relate to distinct projections for trends in energy demand, and are presented as two different frameworks: one directly relating to the trend and dynamic of general economics, very sensitive to structural changes, and the other, formed by sectoral aggregation and derived from analysis of the dynamic of energy-consuming sectors, more closely linked and connected to the situation, even though it is closely connected with the above.

Analyses linked to the first aspect allow projections to be reached by induction and correlation with studies concerning macroeconomic scenarios, the major aggregates of the economy, and give good results in strategic analyses[21]; in the case of Spanish energy, the energy requirements have been closely linked to economic rhythms and cycles, which is why the correlation factor between both, in the past, has been very high and definite trends could be inferred from the study of same.

The second way of visualizing the scenario is through disaggregation into sectors and analysis more closely linked to its specific dynamic; here the different rhythms are emphasized and usually they are more disconnected from the general economy, although they maintain very strong correlations with the economy of the sector, competitiveness and external markets. In addition, by having an impact on the major aggregate indicators, they relate more closely to the medium term. In this way, in the face of structural analyses based on macroeconomic scenarios, such as that carried out in the E4, “down-up” sectorized analyses are proposed for this PAE4, which construct global objectives per aggregation. This last type of analysis usually gives better results in the short and medium terms, and that is why it has been applied.

For the first method, and in order to visualize the different scenarios under consideration, those which highlight the various strategies currently in force have been outlined. They are as follows:

[21] On the initiative of the General Secretariat for Energy, a Forecast is being prepared concerning the structure of energy supplies in 2030, currently in the study phase.

a) The E4[22], as a strategic scenario, defined a baseline scenario, which was connected with the macroeconomic scenario defined by: increase in GDP at an average annual rate of 2.9% over the period in real terms, with a slight acceleration of 3% in the 2006-2012 phase; continuous fall in the unemployment rate; convergence of inflation with the EU; decrease in the importance of Industry, especially the energy-intensive sectors, increasing growth in Transport by road and air and strong growth in the Services sector. From these a projection of energy consumption was deduced with an average growth rate, in terms of primary energy, of 3.1%, and in final energy, 3.4%. In this way, an improvement in the energy transformation system (electricity and refining) was introduced with annual rates of 0.3%, although energy intensity was lost with rates of 0.1%.

b) From that baseline or trend scenario, which develops naturally by not realizing any effort of reduction and improvement in the use of energy, the efficiency scenario was defined showing an upward movement with rates of 3.4% until 2006, and from 2006 to 2012 with a more moderate increase of 2.3% in terms of final energy. In this way, an improvement of 1.1% was produced in the 2006-2012 phase. As regards primary energy intensity, an average annual fall of 0.7% was forecast as a result of the cumulative effect of improvement in efficiency in end use added to that of transformation, and in final energy intensity, the average rate meant a fall or improvement of 0.1%.

c) Accordingly, in the period 2004-2012 a cumulative saving was estimated with respect to the baseline scenario of 41,989 ktep in final energy (in 2012 the saving was 9,824 ktep) and 69,950 ktep in primary energy (in 2012 the saving would be 15,574 ktep). The total reduction of emissions as a result of this cumulative saving was estimated at 190.00 ktCO_2.

d) Another scenario taken into consideration is that defined in the 2005-2011 revision of the *Planning for the Electricity and Gas Sectors 2002-2011, revision 2005-2011*[23], in which the following reference indicators are highlighted: average annual growth rate of GDP of 3.0% in the 2005/2011 phase; average growth rate of final energy in the period 2007-2011 of 2.4% (2.4% in Industry, 2.8% in Transport and 2.0% in Miscellaneous Uses); and, primary energy consumption will increase between 2007-2011 at an annual rate of

[22] Saving and Energy Efficiency Strategy in Spain 2004-2012. State Energy Department, Industrial and SME Development. Ministry of the Economy. 28.3.2003

[23] Planning carried out by the State Energy Department.. Subdirectorate of Energy Planning. MITyC. March 2006. Currently being updated.

1.7%. According to this, the annual rate of improvement in the energy system as a whole would be 0.7%.

e) The Actual scenario projected gives actual consumption up to 2006 inclusively, and is projected according to the average energy intensity of the previous three years, supposing that the trend maintains this differential improvement, although small, with respect to the efficiency scenario, which it approaches in the first phase.

f) The so-called Directive scenario relates to that mentioned in point 1, Art. 4, Chapter II of Directive 2006/32/EC in which it is reflected that the Member States will adopt the necessary measures to achieve a nationally oriented energy-saving objective of 9% for the ninth year of application of same. This proposal, for the first time, is unrelated to GDP or other indicators, with the aim of conclusively defining the concrete proposal. That is to say, the scenario is based on an average reduction with annual rates of 1%, adjusted to forecast consumption in 2007, and as from this year, some baseline scenario growth rates, established in the E4, are maintained. These savings will have to begin to be measured as from 1.1.2008, following the procedure laid down by the Directive or equivalent. Similarly, a series of follow-up indicators are established in each sector which will allow for in-depth study of the changes generated, and these may affect the consumption structure.

These scenarios are set out in Graph 2.1, taking up this range of projections which go from the baseline scenario, with its origin in the original E4 study, to the mandate, in terms of energy saving as an instrument of emission reduction, laid down in the E2C2 and which has been translated into an additional effort called scenario E4+. In their current state, some of these projections may have been modified; however, it is thought that the general framework is maintained with the objective of indexing the abovementioned indicators[24].

In particular, a series of variations from the Baseline scenario to that of Efficiency should be highlighted:

- a quantitative adjustment for the years 2005 and 2006 of some 5 Mtep with regard to the baseline scenario. In this respect, undoubtedly, one of the instruments that have contributed to this was the effects of the saving and energy-efficiency policies

[24] From the projections with distinct origins and intentions, the following stand out: the IMF for 2007 proposes 3.6% in (omission) and 3.4% in 2008; the MEH (DGPE) (Ministry of Economy & Finance (Directorate-General for Economic Policy)) for 2006 3.8% and for 2007 3.4%; the Network Planning of the SGPE (Economic Planning Subdirectorate) for the period 2005-2011 gives a growth rate of 3% of GDP; and finally, the Group of experts for the 2030 forecast point to 3.4% up to 2010 and 2.6% to 2020.

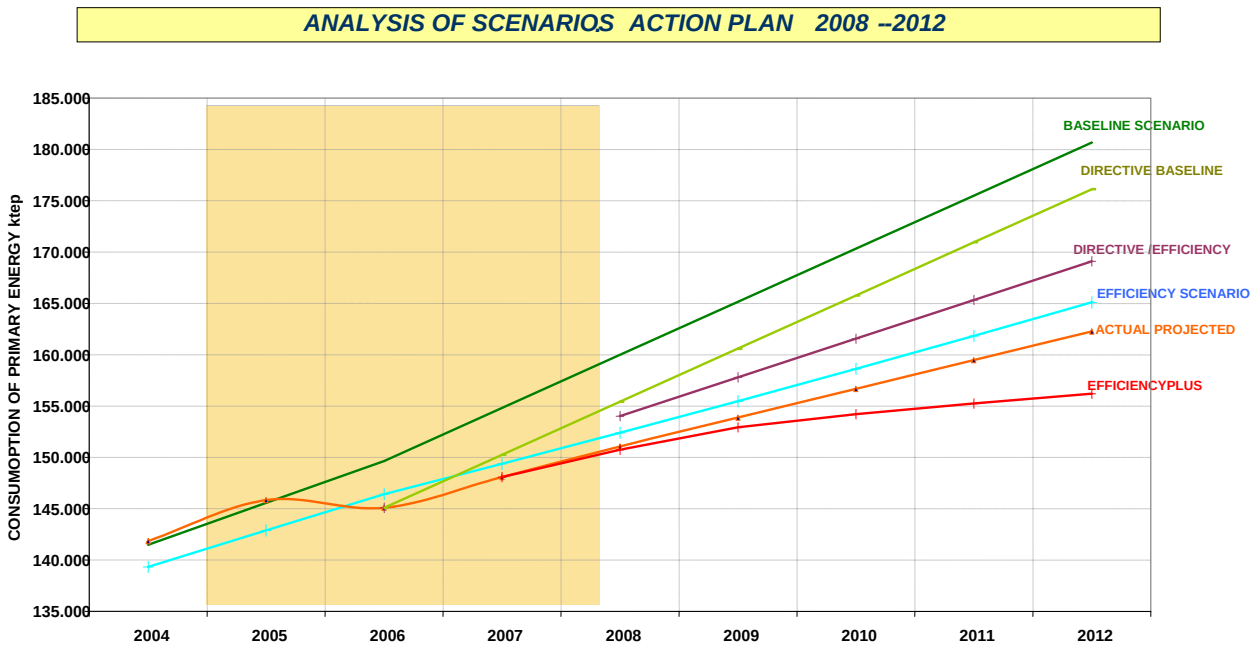
implemented with great perseverance by the public. Additionally, factors such as a certain amount of transfer among economic activities between sectors, the actual energy prices or the introduction of more efficient technologies in production and transformation processes, etc., are inducing different growth models, in addition to substantial modifications to the energy supply basket;

- improvement in the energy intensity indicator, probably as a result of this transfer of consumption towards less intensive sectors or improved efficiency in end processes and uses;

- a clear trend of following the path laid down in the efficiency scenario proposed in the E4, which certainly signals that the present action plan is actually being read by all consumer sectors;

- improvement in dependency on external supply in which renewable energy sources are showing interesting signs of activity, adding the saving effect to its own policies and substantially improving its indicators.

Graph 2.1 Analysis of scenarios of different strategies and plans.



However, new challenges in addition to those proposed in due course since the environmental framework, are pointing up new objectives to be covered by saving and energy-efficiency policies. Accordingly, the Spanish Climiate Change Strategy (E2C2)[25] points out that, in addition to the saving and energy-efficiency policies currently in place, an additional effort must be made, especially in the diffuse sectors, signalling a major role in the present Action Plan, in order to contribute to the reduction of 188,500 ktCO_2. In the E2C2, in addition to saving and efficiency, efforts are focussed on sinks and flexibility mechanisms, in order to reach the 15% to which Spain is contractually committed.

In this situation of updated scenarios, an analysis of potential saving and energy efficiency was carried out for all sectors, revising the measures to be carried out, the necessary incentives, the possibility of increasing the speed of entry into force of same, the adaptation of the legislative framework to the new requirements of the energy market and highlighting those areas that require immediate action.

For the present PAE4+ 2008-2012, these baseline indicators are centred on the following reference values: GDP will exceed, in all forecasts of the various national and international bodies, 3%, which is that which the Ministry of Industry, Trade and Tourism takes up in its Network Planning; the growth rate of primary energy demand will be 1.07%, with a saving differential with respect to the baseline scenario of 2.03% and 1.07% of energy efficiency; energy intensity in primary energy must improve at an annual rate of 1.93%. That is to say, in the next PAE4 period 2008-2012, there is an additional effort of the same order of magnitude as that already forecast in the E4, i.e., a doubling of that proposal.

If one takes, as a trend, the average growth rates of the various proposed scenarios, that is, the average curves of each of the proposed projections, they can be compared with each other. These values have been taken up in Table 2.1; together with these average rates the study periods of each of them are given. The range of possible rates oscillates between 3.1% of the baseline scenario up to 1.07% of that proposed for the PAE4+. Next to these absolute rates, those relating to the baseline scenario and that of efficiency have been assessed. To sum up, for the scenario of the E4+ it can be seen that the additional effort in saving is

[25] Spanish Climate Change and Clean Energy Strategy. Horizon 2012. Revision by the Interministerial Climate Change Group. 8.2.2007. On page 22, it points out that the objective must be that GG emissions should not exceed 37% with respect to the baseline year in the diffuse sectors and according to the provision in the proposal of the National Allocation Plan 2008-2012.

located above that proposed for efficiency with rates of 1.07%, reaching levels in relation to the baseline of the E4 of 2.03%.

Table 2.1. Average rates of analyzed scenarios, in primary energy.

SCENARIO	PERIOD	Average consumption growth rates	Average differential rate	
Baseline	2004-2012	3.10	0	0.96
Efficiency	2004-2012	2.14	-0.96	0
Actual/Projected	2002-2006/2012	2.06	-1.04	-0.08
Directive	2004-2012	2.59	-0.51	+0.45
Network planning	2005-2011	1.70	-1.40	-0.44
PAE4+	**2008-2012**	**1.07**	**-2.03**	**-1.07**

From general analyses based on trends marked out by the various scenarios, an initial picture of energy objectives has been obtained, which coincides with that established by the first E4. On the other hand, this general analysis has allowed a series of objectives to be achieved which should be consistent with the aggregate sectoral studies; however, both analyses show small differences as a result of the factors mentioned and are especially interesting in relation to the capacity of each sector to make additional efforts. As explained, in a general analysis, closely connected with macroeconomic aggregates, the more specific, more sectoral, conjunctural changes may pass unnoticed; however, the changes, for example, in structure of energy supply[26] by source, impact very significantly on factors such as emissions or saving potential.

For this reason, for the definition of objectives of the PAE4 2008-2012, aggregate sectoral analysis will be used (the factors of transfer between final and primary energy have been analyzed using the sectoral consumption structure of 2005, and have been applied according to the chart that appears in the General Glossary of Terms and Tables), because it proved to be more reliable in earlier planning; additionally, the differences between both methods will be analyzed in order to highlight them and give an assessment of same.

The following points will outline the framework for implementation of the sectoral objectives, a description of which has been studied in more detail in the section "Sectoral Framework", and developed from point 8 of this document. It is pointed out, finally, that the detailed sectoral analysis has been removed from this document, but it is there that one

[26] According to the Planning for the Gas and Electricity Sectors, during the period 2007-2011: the contribution of coal to the primary energy supply will decrease by 7.7%, oil will increase by 0.3%, natural gas will grow by 6.0%, nuclear will decrease by 1.2%, and renewables will grow by 12.1%

can find more detailed analysis of markets, trends and more appropriate instruments for development of potential.

2.2. General Analysis of Industry Sector

The Industry sector has reduced its weight, in percentage terms, on the energy scales: it went from 37.8% in 2000, to 35.7% in 2005, with an average annual growth of 2.3%, as against the final 3.5% of the national total.

The Industry Sector is made up of Activity groupings, some of which are intensive in energy consumption and assigned to the allocation plans (PNA I). These Groupings and the industrial combustion plants (P> 20 MW) are absorbed into the emission trading scheme of the PNAII and, in any case, should not be taken into account in relation to the Directive on end use.

The development of the Industry Sector in the period 2000-2005 was less than that forecast in the E4 and slightly below the efficiency scenario. This decrease in sectoral energy consumption, moreover, was produced with a deterioration in energy intensity that rose from 155.3 to 164.7 tep/M€ from 2000 to 2005, that is, with an annual rate of 1.2%. This effect was produced by a series of structural changes as described in the specific analysis of same.

Analysis of the potential of the sector in relation to saving shows that in 2012 an improvement in sectoral consumption of 8.9% will be able to be obtained; this will mean a reduction of emissions for that year of 14.8 $MtCO_2$. Sectoral analysis carried out on the possibility of making an effort, in addition to the former, concluded that, owing to the development of the sector, it is not possible to obtain improvement quotas that might exceed the objectives.

The measures to be applied to the sector are: Voluntary Agreements, energy audits and an extensive public aid programme to activate investment. In addition, a wide-reaching legislative measure is proposed, since it is emphasized that all investment projects entail energy analysis (LCA) which selects the most energy-efficient technology available.

2.3. General Analysis of Transport Sector

The PAE4+ assumes continuation and consolidation of the measures in the transport sector carried out in the PAE4 2005-2007. It should be emphasized that the initiatives implemented by other institutions, such as the EU, in the sector, maintain a clear parallel with the actions set out in the latter Plan.

During the period 2000-2006, the sector showed a slowing down in energy consumption growth arising from a number of factors which go beyond the measures of the E4. Factors such as the increase in the cost of fuels, legislative measures in favour of public transport and awareness campaigns have had a positive effect on the sector.

The strategic lines of the PAE4+ for the sector are based on the following pillars: to reinforce modal change with mobility plans in cities and work centres, to promote training schemes for all means of transport, to update private car fleets and industrial vehicles and to increase the penetration of biofuels in the sector.

The PAE4+, after analysis of the sector, as set out in the sectoral part of this document, assumes for same a strong capacity for achieving energy-saving objectives that will induce, in 2012, a reduction of consumption in the baseline scenario of the E4 of 17.2%; the forecast damping down of demand estimates a decrease in emissions of the same order, contributing by both indicators to the significant impact of the global objectives.

The most relevant measures and action are focussed on achievement of the highlighted strategic lines, with special emphasis on the requirement level of the regulatory and legislative measures that have to be implemented. In this respect, of vital importance to the achievement of the planned objectives is the role that development of the Basic Mobility Legislation will play and the implementation of private vehicle taxation measures which incorporate energy efficiency in their calculation, in addition to the introduction of the energy-labelling mechanism for private cars as a means of moving the market towards more efficient equipment.

As regards the barriers, the administrative factors linked to the dispersion of powers, those economic factors which affect the introduction of the most appropriate technologies, and

fragmentation through dealing with a 'diffuse' sector are the key elements to obtaining a successful outcome in applying the Plan.

Lastly, the differential effort of the PAE4+ is rooted in greater intensity in the requirement that must be given to compliance with the legislative measures and their extension to areas not provided for in the PAE4 2005-2007.

2.4. General Analysis of Buildings Sector

The Buildings Sector includes services that have a major role in the energy consumption of buildings: thermal plants (heating, air-conditioning and hot water production) and internal lighting plants, both in the residential and tertiary sectors. Final energy consumption for this Sector represents 17% of national final energy, corresponding to 10% for the residential sector and 7% for the tertiary sector.

As a more direct indicator for this sector, the growth in the surface area covered by buildings in Spain is highlighted; during the period 1990-2005, this was 143%, that is, an average annual rate of 9.5%, with increased final energy consumption of 4.8%, that is to say, at a rate that is almost half that of the previous year.

The PAE4+ therefore appears to be in a phase in which the new equipment of this very important area is already functioning and with averages of 10 years of operation. For this reason, after analysis of the sector, as given in the sectoral part of this document, a reduction in consumption in the baseline scenario of the E4 of 10.1% is laid down as an energy-saving objective. This will mean a reduction of emissions for 2012 of 10.7 $MtCO_2$, contributing during the period to a total reduction of 35.5 $MtCO_2$, which represents 14.9% of the contribution to the final result of the Plan, and therefore it is of seminal importance. If, moreover, the diffuse nature is emphasized, the dispersion of this type of consumption, the effort to be implemented is much more significant.

The strategic measures of the PAE4+ for the sector are divided into 3 directed at the area of existing buildings and 2 directed at the area of newly constructed buildings. In the first, the energy saving is sought through improvements in envelopment, in thermal plants and lighting plants; while, for new buildings, the promotion of buildings with a high energy rating, with an increase in the levels of energy required by the current legislation of the Technical Building Code, is sought.

The main barrier to introducing the measures proposed in existing buildings is economic, since the expenditure in energy only represents 3% of general use expenditure, in a building of the tertiary sector, and a similar percentage for the family budget in the case of housing, which makes any saving measure seem unattractive. In the case of new buildings, the barriers are more associated with administrative factors linked to the dispersion of powers and the large quantity of players involved in the building process.

Lastly, the differential effort of the PAE4+ arises from the greater intensity in the measure for improving energy efficiency of lighting plant of existing buildings and in the incorporation of 2 new measures for newly constructed buildings, one for promoting buildings with high energy rating and one legislative measure which revises the building regulations.

2.5. General Analysis of Domestic and Office Equipment Sector

The Domestic and Office Equipment Sector includes the energy consumption of electrical appliances, including domestic air-conditioners up to 12 kW and cookers and ovens, and office equipment, both in the residential and in the remaining sectors. The equipment percentages of the main energy-consuming appliances in homes extends to almost 100% of homes, as fridges, cookers, washing-machines or televisions. The final energy consumption of this sector represents 3.8% of national final energy consumption. Of this consumption, 55% relates to electrical appliances, 28% to consumption in kitchens, 14% to offices and the remainder to small air-conditioning plants (the equipment level is only 25%, although with very high penetration rates).

The average annual growth in final energy consumption in this sector during the period 2000-2004 was 4.4%. The possibilities of improvement in energy efficiency in this sector would be mainly in the updating of existing equipment by other more energy-efficient equipment, activating the market with all the means available. For this reason, the Renovation Plan for existing electrical appliances and the Plan for Public Administrations will promote saving by way of a purchasing policy using energy criteria and a rational use of same.

El PAE4+, after analysis of the sector as set out in the sectoral part of this document, establishes as an energy-saving objective a reduction of consumption in the baseline

scenario of the E4 for 2012 of 11.9%; this will mean a reduction of emissions for that year of 2.7 MtCO2. The differential effort asked of the PAE4+ arises from the continuation and intensification of the effect of updating electrical appliances, taking advantage of public awareness achieved in the previous period by all players.

As regards the barriers to introducing the proposed measures, it is pointed out that the main one is that of economic attractiveness and turns on the awareness of citizens; and administrative and management procedures in the case of the Saving Plan in the Administrations.

2.6. General Analysis of Agriculture and Fisheries Sector

The agricultural sector has a lesser impact on total energy consumption, but it is a strategic sector in which the energy efficiency measures provided for may contribute to the sustainability of the rural environment.

The energy and environmental objectives proposed for the period 2008-2012 can be summarized as obtaining a saving of 1,634 ktep of primary energy and an associated reduction of emissions of 5,112 ktCO_2; these are measures that will require public funding in the sum of 93,754 k€ in order to activate an investment by the sector of 683,207 k€. With reference to the final year of the scenario, the sectoral saving will be 7.6%. With respect to the E4, the additional effort of the PAE4+ means some increases in support of 25.6% and significant improvement in the objectives.

The PAE4+ for this sector considers proposals for conservation of agriculture by way of ground cover and the development of energy crops; the energy-labelling of tractors in the RENOVE (RENOVATION) plan of the MAPA (Ministry of Agriculture, Food and Fisheries); and the necessary work for the development of regulations to promote the movement from irrigation systems by spraying to localized irrigation systems which will allow not only for more energy-efficient pumping but also greater efficiency in the use of water.

Accordingly, farm work activities in the face of abandonment of the land, efficient updating of machinery and optimization of water resources are the three axes on which the strategy for action in the Agriculture sector is based, which together with more than 550 briefing and training days across the nation are serving to inform farmers of the procedures that

they have to hand in order to contribute to the improvement of energy and environmental efficiency.

The most relevant measures to be developed in the period 2008/2012 are, to a great extent, a continuation of those introduced during the 2005/2007 period, and which we can summarize as follows:

- Training and Information on techniques for efficient use of energy in Agriculture and Fisheries
- Agricultural Machinery: Energy-labelling of tractors in the Renovation Plan, and introduction of energy TIV (technical inspection of vehicles).
- Irrigation Agriculture: Development of Guidelines for the movement from irrigation systems by spraying to localized irrigation systems.
- Conservation Agriculture: Technical and economic support for the movement from traditional agriculture towards Conservation Agriculture (Direct sowing and ground cover).
- Fishing Sector – improvement in the energy efficiency of propulsion systems.

2.7. General Analysis of Public Services Sector

The energy intensity of consumption in this sector (Public Lighting and public water treatment, essentially) is directly related to urban and population growth, which in Spain has been very high over the last few years.

The introduction of measures for energy improvement in this sector is very complex owing to the diversity and administrative autonomy of its stakeholders and the procedures for public contracts, in which there are no basic rules which establish a threshold for energy efficiency, and for this reason, the measures are introduced at a later date with the consequent extra cost, it still being possible to recover the investment through the savings generated.

Analysis of the sectoral potential for the period gives a saving of 1,739 ktep in primary energy and an associated reduction of emissions of 3,712 ktCO2; these are measures that will require public funding in the sum of 89,000 k€ to activate an investment in the sector of 1,351,000 k€. With reference to the end of the Plan scenario, savings will represent 22% of forecast consumption, a percentage which represents a real challenge to the sector even

though its potential for improvement is very high, since this is where the main innovative developments are concentrated. The additional effort of the PAE4+ means an expansion of objectives of 10.1%.

The most relevant measures to be developed in the period 2008-2012 are a continuation of those introduced in the previous plan and centred on the development of a regulatory framework which addresses energy efficiency in its entirety and at source; demonstrating by way of energy audits the economic profitability of investment in energy improvement; and, continuing the line of incentives for introducing more efficient equipment. Specifically, the most significant measures are:

- To promote replacement of existing equipment for external public lighting by other more efficient types.
- To carry out energy audits, sharing the cost, and aimed at the public sector, City Councils or Concessionary Companies of these Public Services.
- To promote replacement of existing technologies in plants for drinking-water, supply, purification and desalination of water by other more efficient technologies.
- To draw up and publish Energy Efficient Regulations for Public Lighting Plants which rationalize specific consumption.

2.8. General Analysis of the Energy Transformation Sector

The chapter on Energy Transformation includes three sectors with very different features: Oil-Refining, Electricity Generation and Cogeneration. The trend shown by these sectors in terms of saving and energy efficiency from the start of the period of the E4 has not been the same for all of them, which is why it is necessary to analyze each one individually.

The Oil-Refining sector has shown average year-on-year growth in the period 2002 – 2006 of 2.2% as regards production, despite the fact that consumption itself in the same period recorded an average year-on-year increase of 0.9%. The ratio of production to primary energy consumed was 92.6% in 2006, with consumption 1.7% less than that of the efficient scenario set out in the E4, by which the energy efficiency situation is in line with the objectives of the said strategy. It is well known that own consumption of refineries has a great impact on the cost structure, the reason, among others, for the great interest in reducing this consumption in the sector.

On the other hand, the Electricity Generation sector experienced an average increase in consumption itself, from its activity, of 4% in the period 2003 – 2005 owing to the low

hydraulicity of the last few years. As regards the comparison with the E4, in 2005 the sector verified the consumption indicated by the efficiency scenario, which is why it is en route to achieving the objective of 2012 with a saving of 767.5 ktep. In this sector, the impact on transformation efficiency brought about by combined cycles is significant, increasing the final energy ratio produced per primary energy unit for thermal generation to 40% in 2005.

With respect to cogeneration, the installed capacity in the period 2004 – 2006 at special rating was 368 MWe, which coincides with that forecast in the Gas and Electricity Sectors Planning 2002 – 2011. The 2005 – 2007 Action Plan proposed a more ambitious capacity-increasing objective in line with the need to comply with the National Allocation Plan. The forecast increase was 769 MWe at the end of 2006 as compared with 2003, which represents a deviation in the other direction of 52% in relation to the current situation. This was due, on the one hand, to the delay in implementing a new regulatory framework, now materialized through Royal Decree 661/2007 of 25 May, by which the production activity of electricity generation at special rating is regulated, and on the other hand, to the movement of fuel prices and the electricity sold.

The energy, economic and environmental objectives proposed in the plan for each subsector are as follows:

- Oil-refining: the E4 objective for 2012 is maintained with a saving of 576.5 ktep, a reduction of annual cumulative emissions of 1,729 ktCO_2 for 2012
- Electricity generation: as in the previous case, the E4 objective is maintained for 2012 with an expected saving for that year of 767.5 ktep. This means annual cumulative emission avoidance of 1,792 ktCO_2 for 2012
- Cogeneration. In order to create a demanding scenario in which there is reference to increasing the installed capacity with respect to that forecast in the E4, and to confront the actual situation arising from the regulatory delay, a new objective is established of 8.400 MWe installed in 2012 for special regime cogeneration. In the same way, an objective significantly more extensive than that set out in the E4 is created which refers to improving energy efficiency in cogeneration, proposing a saving of 363 ktep as against the 150 ktep proposed by the E4

In order to implement these objectives, the 2008 – 2012 Action Plan advocates both the continuation of measures consolidated in the previous Action Plan and the incorporation of new measures for the promotion of cogeneration. These include the development and introduction within Spanish legislation of a regulation on connection to the low-voltage

electricity grid of small-capacity cogeneration, which will encourage development of so-called micro-cogeneration and its introduction in sectors with minimal presence.

3.- GENERAL AND AGGREGATE OBJECTIVES OF ACTION PLAN 2008-2012

With regard to the objectives of the scenario proposed by the E4+, these represent an additional improvement in the efficiency scenario proposed in the E4 of 1.07% in terms of consumption growth rate, as set out in Table 2.1, as mentioned above. As regards the baseline scenario proposal, the total improvement is 2.03%, of which 0.96% relates to improvements achieved during the period of the 2005-2007 Action Plan.

With respect to the reduction of energy consumption using absolute values (Table 3.1), reduction of consumption, in terms of primary energy, during the period amounts to a total of 87,933 ktep of primary energy and 59,454 ktep of final energy. These are objectives which, referring to energy consumption for 2012, mean a reduction of 12.4% and 13.7%, respectively (Table 3.2). The additional effort that the present Plan imposes on the various sectors means an improvement of 10.8% in final energy saved, and 11.4% in primary, according to Table 3.1. As regards emissions during the period, it will be possible to reduce the volume by 238,130 ktCO_2 with the additional effort of the measures of the PAE4+ which manage to increase the results by 27,709 ktCO_2 , meaning 1l 1.6%.

Table 3.1. Total and differential sectoral energy and emission-reduction objectives relating to E4, PAE4+ 2008-2012

SECTORALIZED RESULTS		ENERGY SAVINGS 2008-2012				EMISSIONS AVOIDED 2008-2012	
		TOTALS PAE4+		ADDITIONAL TO E4		TOTALS PAE4+	ADDITIONAL TO E4
		FINAL (ktep)	PRIMARY (ktep)	FINAL (ktep)	PRIMARY (ktep)	ktCO_2	ktCO_2
END- USE SECTORS	INDUSTRY	17,364	24,750	-	-	59,165	-
	TRANSPORT	30,332	33,471	4,373	4,826	107,479	15,495
	BUILDINGS	7,936	15,283	1,631	3,141	35,540	7,304
	DOM. & OFFICE EQUIPMENT	1,729	4,350	314	790	9,288	1,687
	AGRICULTURE	1,402	1,634	45	52	5,112	164
	PUBLIC SERVICES	691	1,739	69	174	3,712	371
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION		6,707		1,011	17,834	2,688
TOTALS		59,454	87,933	6,432	9,993	238,130	27,709
% ADDITIONAL EFFORT/TOTAL PAE4 2008-2012				10.8%	11.4%		11.6%

Table 3.2 gives the savings and emissions avoided through implementation of the Plan, referring to the consumption forecast in the baseline scenario and to the final year of the scenario, 2012. The average effort in terms of final energy is 12.4% of the consumption

forecast in the baseline scenario in 2012, a percentage that points to an extraordinary effort, since the Directive, for example, lays down an annual saving of 1%, which would be equivalent to achieving a saving of 5.1% over the next five years.

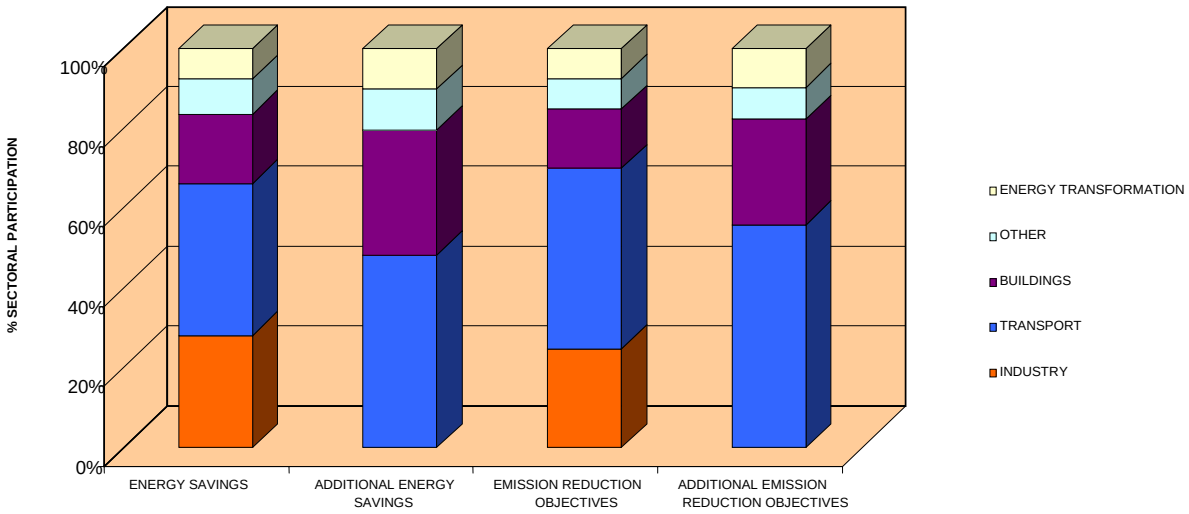
With regard to the sectoral effort, Public Services stand out, essentially with electricity-saving measures, as does the Transport Sector, whose strategic reduction of oil products will allow for a series of very significant benefits to be obtained. In the Buildings sector, a very substantial effort is also sought in relation to those with public resources dedicated to the sector or from the high volume of investment to be mobilized.

Table 3.2. Sectoral savings and emissions avoided in 2012 in relation to the baseline scenario

SECTORAL APPLICATION		ENERGY SAVINGS 2012/Base. Sc. (ktep)		EMISSIONS AVOIDED 2012 (ktC02)	ENERGY SAVINGS 2012/ Base. Sc, %		EMISSIONS AVOIDED 2012 %
		FINAL	PRIMARY		FINAL	PRIMARY	
END-USE SECTORS	INDUSTRY	4,355	6,207	14,839	8.9%	8.9%	8.9%
	TRANSPORT	9,088	10,028	32,203	17.2%	17.2%	17.2%
	BUILDINGS	2,390	4,603	10,703	10.1%	13.0%	13.1%
	DOM. & OFFICE EQUIPMENT	497	1,250	2,670	11.9%	11.8%	11.7%
	AGRICULTURE	375	437	1,367	7.6%	7.9%	7.7%
	PUBLIC SERVICES	178	448	956	22.0%	22.0%	22.0%
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION		1,802	4,792		5.3%	5.3%
TOTALS		16,883	24,776	67,530	12.4%	13.7%	14.0%

The division of sectoral effort, in relation to energy savings and reduction of emissions, is shown explicitly in Graph 3.1 (in percentages and referring to each factor of the entire plan), in which the transport sector stands out both in savings and emissions, and total volume and additional effort. Similarly, the effort that the building sector will contribute is highlighted; and, all this is consistent with the effort required by the environmental mandate concerning the diffuse sectors. Perhaps it is time to point out the relative efforts that each sector must make, over and above the percentage contribution to the Plan, since this conduct may represent the greatest benefit to be gained from some of the measures (for example, those arising from the Saving Plan in buildings and Public Administration installations, with a dissemination and demonstration value relatively greater than the absolute savings themselves).

Graph 3.1. Total and additional sectoral objectives of the PAE4+ on energy and emissions.



Savings and reduction in emissions are achieved by investment, essentially, even though there are measures which can be implemented at very low specific cost, as described in the corresponding sectoral analyses; and for this investment, when not carried out naturally, even when the profitability of same is attractive in economic terms, it is necessary to provide incentives, to obtain investment from the Administration, which is why a set of support instruments is proposed, the economic translation of which is given in Table 3.3. This is public effort that is profitable in economic terms but also brings with it indirect benefits as important as the former, as will be analyzed in more detail in the following section.

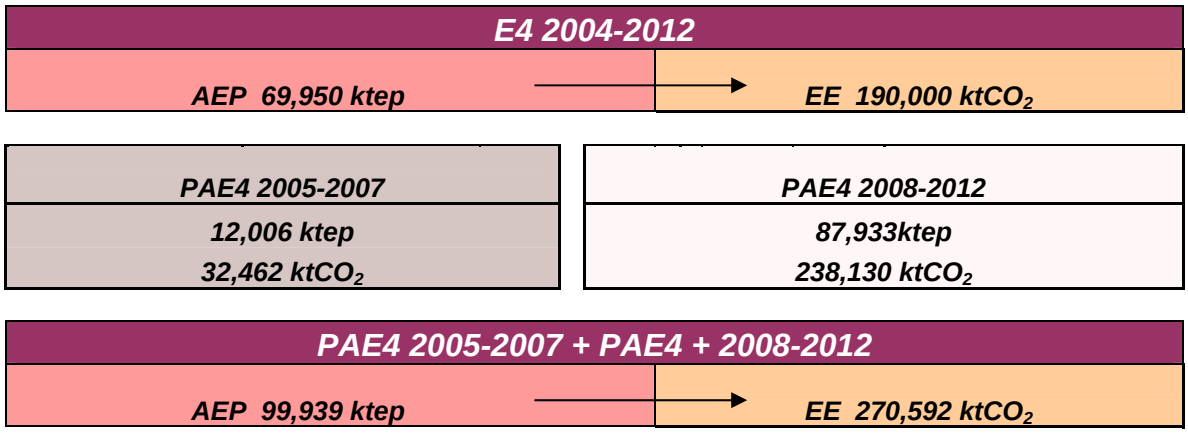
Table 3.3 General economic summary of PAE4+

SECTORAL APPLICATION		INVESTMENT TOTALS (k€)	PUBLIC FUNDS TOTALS (k€)	ADDITIONAL PUBLIC FUNDS (k€)	Incentive intensities (%)	Additional incentives/ Total incentives (%)
END-USE SECTORS	INDUSTRY	1,671,000	370,000	0	22.1	0.0
	TRANSPORT	1,892,718	408,291	117,937	21.6	28.9
	BUILDINGS	13,469,477	803,671	287,266	6.0	35.7
	DOM. & OFFICE EQUIPMENT	1,992,235	532,500	-	26.7	0.0
	AGRICULTURE	683,207	93,754	24,000	13.7	25.6
	PUBLIC SERVICES	1,351,000	89,000	28,000	6.6	31.5
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	1,085,330	29,284	21,652	2.7	73.9
COMMUNICATION		40,000	40,000	0	100.0	0.0
TOTALS		**22,184,967**	**2,366,500**	**478,855**	**10.7%**	**20.2%**

Undoubtedly, the volume of total investment to be made over the next 5 years is underlined. With intensities in terms of public support of 10.7%, a very high percentage in relation to other energy efficiency plans, each saving and efficiency rung on the ladder requires more unit investment, but it needs this level of incentives if it is to push through the proposed changes by way of the measures. The additional cost of the PAE4+ means an increase in the aid burden of 20.2%, which clearly points to the increasing marginal effort specified for this type of investment, since a growth in energy objectives of 11.4% will thus be achieved.

In the following chapter, the economic benefits and the specific impact produced will be analyzed, but it should be pointed out that the effect obtained in the PAE4 2005-2007 is prolonged throughout the years of this Plan, producing within it a contribution to the reduction of consumption of 43.3%, as against the specific effect of the PAE4+ which contributes the remaining 56.7%; and, within this contribution, the efforts of actions and investment that have been taking place contribute by 44.7% and the additional effort, as stated, with the remaining 12.0%. Graph 3.2 shows this cumulative effect of earlier actions on the total scenario of the E4, giving values to the objectives achieved by the earlier effort that are projected cumulatively in the future[27].

Graph 3.2 Global results of the PAE4 2005-2007 and PAE4+ 2008-2012



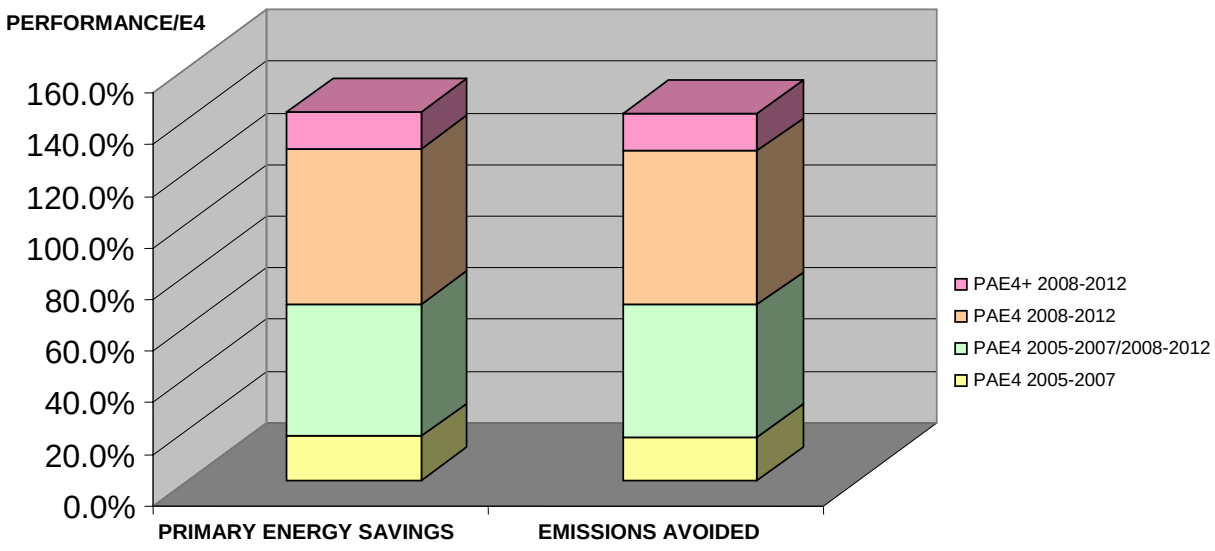
Lastly, in this analysis of contributions to the general objective, understanding the Strategy as a whole (including therefore the combined effects of both action plans) Graph 3.3 shows, referring to the objectives of the E4 and primary energy savings, that the first 2005-2007 Plan is having effects on the whole Strategy of 17.2% during the current period; its effects

[27] This assertion is valid in the opposite sense: all that is not done today is multiplied and amplified in future.

are projected in the phase of the next period as contributing, moreover, 51.3%, by which the actual contribution is 68.5%. The present Plan PAE4+ contributes, using the E4 diagram for the period, 60.1% and the so-called additional plan, 14.3%, by which the PAE4+ as a whole, up to the end of the scenario, will obtain 74.4%. The joint and continued action of both plans produces total results of 142.9%, as compared with that of the E4. With regard to emissions avoided, the results are: 68.2% of savings generated in PAE4 2005-2007 up to the end of the period, and 74.3% of results of the PAE4+, of which 14.6% of objectives are reached with the so-called additional effort.

It should be pointed out that the effort of the present plan, by affecting a shorter period and having a similar impact on the whole, will have to be more intensive, as has been seen, in relation to investment and incentives. This complex of inter-relations between both plans have been set out in the final table at annex, relating to the general results, which gives the most important indicators.

Graph 3.3. General results of E4 in its two Action Plans



4. ANALYSIS OF GLOBAL IMPACT AND COST-BENEFIT ANALYSIS

As already indicated in the 2005-2007 Action Plan (precursor to the current plan), the objectives pursued in the Saving and Energy Efficiency Strategy 2004-2012 are having, and will have, positive socioeconomic and environmental effects on the country as a whole and specifically in the sectors of activity on which they act. Undoubtedly, owing to the close relationship that they have, the most significant and visible effects will be those relating to the energy environment and emissions reduction, but additionally, in economic terms, it should be pointed out that the results of the 2008-2012 Action Plan are also positive in the assessment of public and private efforts that it entails.

The experience of the current 2005-2007 Action Plan and the various mechanisms that have been put in place for its realization and implementation, together with the measure-for-measure analysis of the steps taken, carried out by the IDAE, allow the new Plan to impact on those measures that involve a simpler implementation process than that indicated three years ago, such that the drawbacks observed in this period may be overcome by more determined action.

In the same way, an analysis of the global impact of the new Plan must highlight the fact that the measures proposed in all the consumer sector studies go well beyond the original objectives of the E4, through the need to incorporate a set of environmental objectives in the Plan for reduction of pollutant emissions, the translation of which into saving and energy-efficiency objectives requires a very high level of performance and effectiveness from the measures.

The 2008-2012 Action Plan is an essential contribution to the sustainable development of our country, insofar as it allows for the combination and stimulation of economic growth, environmental protection and social progress. These three objectives define the concept of sustainable development and it is, in this new scenario, on this basis that the actions to promote energy efficiency are fully justified.

The following sections will review the various impacts of the 2008-2012 Action Plan that society will experience as a result of achievement of the objectives set out in the Plan.

4.1. Reduction of energy consumption and imports: less external energy dependency

The 2008-2012 Action Plan has as its objective a saving of 87,933 ktep of primary energy between 2008 and 2012. This figure is equivalent to 55% of total primary energy consumption forecast for 2008 and, bearing in mind that oil imports in that year are estimated at 435 million barrels, the saving set out in the Plan would imply the equivalent of 150% of these imports (650 million barrels).

The achievable saving, to be applied to all measures considered in the Plan, rises to 24,776 ktep of primary energy in 2012, which would imply 13.7 % of energy consumption for the same year in the baseline scenario of the E4.

The cumulative savings in the Plan are summarized per sector in the following table:

Table 4.1.SECTORAL ENERGY AND EMISSION OBJECTIVES OF THE PAE4 2008-2012

SECTORAL APPLICATION		ENERGY SAVINGS (2008-2012)		EMISSIONS AVOIDED (2008-2012) (ktCO2)
		FINAL	PRIMARY	
END-USE SECTORS	INDUSTRY	17,364	24,750	59,165
	TRANSPORT	30,332	33,471	107,479
	BUILDINGS	7,936	15,283	35,540
	DOM. & OFFICE EQUIPMENT	1,729	4,350	9,288
	AGRICULTURE	1,402	1,634	5,112
	PUBLIC SECTOR	691	1,739	3,712
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	0	6,707	17,834
	COMMUNICATION	0	0	0
TOTALS		59,454	87,934	238,130

In this table, the transport and industry sectors take on 80% of the final energy savings estimated in the Plan. In the case of transport, arising from the fact that 98% of the sector's energy consumption is in the form of products derived from oil, achievement of the objectives means a considerable impact on the reduction of the level of energy dependency, covering one of the basic objectives of Spain's energy policy, also in the sense of reducing the macroeconomic risks associated with a high level of dependency on oil derivatives which affect almost all the economic vectors of the more developed countries.

The movement over the last few years of oil prices and the foreseeable maintenance of same around 60 $/b allow for adoption of effective measures for the reduction of inflation risks and, consequently, which adversely affect the growth and competitiveness of the

Spanish economy. It is for this reason that the present Action Plan 2008-2012 aims to channel the public support necessary to make profitable, in the energy-consuming sectors, the investments to improve energy efficiency such that the Spanish economy may anticipate periods of inflation risk.

In the case of industry, it should be borne in mind that this cumulative assessment of savings includes, in addition to the actual measures of the Plan for the industrial sector, the effects of less energy activity in the residential, tertiary and equipment sectors, the result of which will be less consumption of electricity than that expected in the baseline scenario as a consequence of the Plan measures themselves.

4.2. Reduction of environmental impact of energy through less energy consumption

Consideration of the reduction of greenhouse gases, especially CO2 emissions, linked to energy activity, takes on great significance in the design and development of the measures of the 2008-2012 Action Plan. The introduction of the objectives laid down in the Spanish Climate Change and Clean Energy Strategy of the National Allocation Plan for greenhouse gas emission rights 2008-2012 (PNA II) required the sectors analyzed in the Plan to incorporate measures to promote additional energy saving, or rather a higher level of requirement in the performance of the measures or the accelerated implementation of the actions provided for, with special attention to legislative or administrative action.

These objectives have a special impact on the 'diffuse' sectors in which the increase in CO2 emissions is greater, specifically in the transport, buildings and equipment sectors. The set of additional measures, not originally set out in the E4 Strategy, together with incorporation of the actual energy data for the period 2000-2006 in the scenario assessment, which are in short aimed at the greatest possible reduction of emissions by way of energy saving, have meant an increase in the energy saving objectives of 9,993 ktep between 2008 and 2012 and additional public support in the same period of 479 M€.

The total volume of emissions avoided through the Plan between 2008 and 2012 rises to 238.1 Mt CO_2, distributed sectorally as per Table 4.2 and which represent sectoral annual reductions as given in same.

Table 4.2. CO_2 EMISSIONS AVOIDED PER SECTOR ($ktCO_2$)

SECTORAL APPLICATION		EMISSIONS AVOIDED (2008-2012)	
		CUMULATIVE	YEAR 2012
END-USE SECTORS	INDUSTRY	59,165	14,839
	TRANSPORT	107,479	32,203
	BUILDINGS	35,540	10,703
	DOM. & OFFICE EQUIPMENT	9,288	2,670
	AGRICULTURE	5,112	1,367
	PUBLIC SECTOR	3,712	956
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	17,834	4,792
	COMMUNICATION	0	0
TOTALS		238,130	67,530

As in the period of the earlier Plan, the contribution of each sector to environmental improvement is different, continuing with the Transport Sector in the lead which avoids, between 2008 and 2012, 45% of total CO_2 emissions avoided, followed by Industry (25%) and Buildings (15%).

4.3. Other impacts

The application of energy-efficiency improvement measures has undeniable impacts on improvement of the competitiveness of the economy in general and companies and services in particular.

Over the last few years, our neighbouring countries have made improvements in energy intensity the direct results of which are an improvement in energy competitiveness as compared with other countries who have not implemented these measures. The significant dependency of modern economies on energy 'input' means that an improvement in energy intensity translates into various competitive advantages, especially those associated with the inflation risk implied by the volatility of oil costs, which have a repercussion on the entire product value chain and consequently on final prices.

Similarly, those companies and sectors of activity which implement these measures improve their competitive position by encouraging job and wealth creation, as well as reducing risks associated with delocalization, which is of increasing importance in economies dependent on ever more globalized markets.

The objectives of the 2008-2012 Action Plan, with a potential saving of 14.4% on the original baseline scenario, will have to have a significant positive impact on the general and

particular economy of companies. In the same way, the public support committed in the 2008-2012 Action Plan, of the order of 2,367 M€, will allow for stimulation of public and private investment in productive and technological capital, which will also translate into improvements in the competitive position of national companies in external markets.

In short, it can be stated that investments to improve energy efficiency produce a double benefit: that arising from the reduction of energy costs, on the one hand, and that arising from the incorporation of more technologically advanced equipment, which allows for increased production and reduction of costs other than energy, as well as an improvement in the quality of same.

Technological innovation and dedication of an increasingly higher percentage to Research, Development and Demonstration activities, in both the private and public domain, is necessary for improving Spanish productivity. The 2008-2012 Action Plan, in this respect, claims to offer the necessary incentive for these activities by way of instrumentation of finance lines and appropriate support, and the development of promotion and information activities which demonstrate the economic viability of energy-efficiency actions, however high energy prices might be.

In the same way, the *Saving and Energy Efficiency Strategy 2004-2012* (E4) and the present Action Plan 2008-2012 will have effects on the competitiveness of industrial companies and will contribute to the appearance of new trading opportunities.

The present Action Plan 2008-2012 means, consistent with the general objectives of the original Strategy, mobilization of a volume of public and private investment (22,185 M€) with sufficient significance to induce positive effects on the productivity of the Spanish economy and, consequently, on employment.

Finally, one of the basic elements that supported the *Saving and Energy Efficiency Strategy 2004-2012* (E4) and, consequently, the Action Plans 2005-2007 and 2008-2012 which complete and develop it, is to contribute to the sustainability of the Spanish development model. In fact, it could be said that they are essential policies to ensure that the economic growth of the Spanish economy can be maintained in the medium term, without deterioration of the environment and quality of life. In addition, as mentioned above, the objectives of the *Spanish Climate Change and Clean Energy Strategy* and *Royal Decree*

1370/2006 of the National Allocation Plan for Greenhouse Gas Emissions 2008-2012 have been one of the basic elements for definition of the measures provided for in this Plan.

The present Action Plan 2008-2012 aims to avoid the emission into the atmosphere of 238 million tonnes of CO_2 and emissions of other atmospheric pollutants such as SO_2, NOx or particles produced in the combustion of fossil fuels. The concentrations of these pollutants in urban centres cause damage to human health, essentially through higher incidence of respiratory illnesses.

The measures included in the 2008-2012 Action Plan, especially those considered for the Transport Sector, will contribute to improvement of the quality of life. The congestion associated in particular with the intensive use of private vehicles, as against other options for collective transport of passengers, has negative effects on health, and increases, enormously, journey times, which makes this a cost that is not only individual but also collective. The productivity of the Spanish economy is reduced when an excessive amount of time is spent on the journey from home to workplace.

The improvement of the quality of life, a benefit of the reduction of concentrations of pollutants in the atmosphere through lower consumption from mobile emission sources – essentially, the private vehicle; from the reduction of the negative impact of climate change – through fewer greenhouse-gas emissions – on productive activities and human health and ecosystems; from the creation of quality jobs; from technological innovation; from improvement of road safety and the better air quality of cities, is a clearly positive impact of the E4 and this new 2008-2012 Action Plan.

4.4.Cost-benefit Analysis

The 2008-2012 Action Plan has the objective of achieving a volume of energy savings of 87,933 ktep during its entire effective period. If all the measures set out in the Plan were applied, the annual primary energy saving in 2012 has been estimated at 24,776 ktep/year (a percentage of 14.38% on the original baseline scenario). Insofar as the useful life of investments made during the period is greater than the actual period of application of the Plan, and especially in some sectors in which it reaches 15 years, the savings achieved will be maintained in the medium and long terms.

The following tables give the total volume of investments of the Plan necessary for the development and effective implementation of the energy-efficiency measures under consideration, and the total volume of public support necessary to mobilize the resources required for the Plan horizon. Both investment and public support are broken down by sector.

The investment necessary for the 2008-2012 Action Plan rises to 22,185 M€, as against 7,926 M€ for the 2005-2007 Plan, and estimated public support rises to 2,367 M€, as against 729 M€ for the previous Plan. Logically, both the greater period of application of the new Plan and the stricter requirements of the measures are the basic reasons for this difference. It should also be taken into consideration that the new measures have a shorter timeframe for application than those indicated in 2005-2007, which means that the ratio of € invested per saving generated is increasingly less.

Table 4.3. PUBLIC INVESTMENT AND SUPPORT (M€)

SECTORAL APPLICATION		INVESTMENT 2008-2012	PUBLIC SUPPORT
END-USER SECTOR	INDUSTRY	1,671	370
	TRANSPORT	1,893	408
	BUILDINGS	13,469	804
	DOM. & OFFICE EQUIPMENT	1,992	533
	AGRICULTURE	683	94
	PUBLIC SECTOR	1,351	89
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	1,085	29
	COMMUNICATION	40	40
TOTALS		22,185	2,367

This public support of 2,367 M€ will materialize in public aid programmes, incentives for changing energy-consuming equipment and information, promotion and awareness campaigns concerning the responsible consumption of energy.

The following table gives an economic assessment of the above energy savings for the horizon of the 2008-2012 Action Plan, using a price of 65 dollars/barrel (more realistic than that used — 25 dollars/barrel — for the economic assessment of benefits arising from savings from the *Saving and Energy Efficiency Strategy 2004-2012* and also that used in the 2005-2007 Action Plan of 45 $/barrel). The economic assessment of the energy savings amounts to 42,208 M€ over the period 2008-2012.

Table 4.4. ECONOMIC BENEFITS ARISING FROM PRIMARY ENERGY SAVINGS (M€)

SECTORAL APPLICATION		ECONÓMIC SAVINGS (2008-2012)	
		CUMULATIVE	ANNUAL
END-USE SECTORS	INDUSTRY	11,880	2,376
	TRANSPORT	16,066	3,213
	BUILDINGS	7,336	1,467
	DOM. & OFFICE EQUIPMENT	2,088	418
	AGRICULTURE	784	157
	PUBLIC SECTOR	835	167
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	3,219	644
TOTALS		42,208	8,442

The environmental benefits most easily assessed in economic terms are those arising from the lower volume of CO_2 emissions, given the existence of an international market for emission rights, which gives an economic value to each tonne of CO_2 that is not emitted into the atmosphere. Emissions of CO_2 have been evaluated at 18 €/tonne. The price adopted in this 2008-2012 Action Plan is certainly conservative, and therefore underestimates the environmental benefits of the Plan with respect to those which would result from application of a higher price per tonne.

Table 4.5. ECONOMIC BENEFITS THROUGH AVOIDED EMISSIONS OF CO_2 PER SECTOR (M€)

SECTORAL APPLICATION		ECONOMIC BENEFIT THROUGH AVOIDED EMISSIONS (2008-2012)	
		CUMULATIVE	ANNUAL
END-USE SECTORS	INDUSTRY	1,065	213
	TRANSPORT	1,935	387
	BUILDINGS	640	128
	DOM. & OFFICE EQUIPMENT	167	33
	AGRICULTURE	92	18
	PUBLIC SECTOR	67	13
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	321	64
	COMMUNICATION	0	0
TOTALS		4,286	857

Consequently, the environmental benefit arising from the 2008-2012 Action Plan, measured in cost of tonnes of CO2 avoided, rises to 4,286 M€ over the entire effective period.

Therefore, as regards an economic assessment of the 2008-2012 Action Plan, the objectives indicated will mean the following economic returns:

Table 4.6. TOTAL ECONOMIC BENEFITS PER SECTOR (M€)

SECTORAL APPLICATION		CUMULATIVE ECONOMIC BENEFIT (2008-2012)			
		ENERGY SAVING	EMISSIONS AVOIDED	TOTAL	ANNUAL
END-USE SECTORS	INDUSTRY	11,880	1,065	12,945	2,589
	TRANSPORT	16,066	1,935	18,001	3,600
	BUILDINGS	7,336	640	7,976	1,595
	DOM. & OFFICE EQUIPMENT	2,088	167	2,255	451
	AGRICULTURE	784	92	876	175
	PUBLIC SECTOR	835	67	902	180
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	3,219	321	3,540	708
	COMMUNICATION	0	0	0	0
TOTALS		42,208	4,286	46,495	9,299

Given the strategic nature of the 2008-2012 Action Plan, the following is an assessment of the economic impact arising from the achievement of the Plan's energy and environmental objectives. Taken as a parameter for analysis are the economic savings arising from the investment made, using the format € saved per € invested, as against a criterion such as the TIR, more focussed on specific assessment of investment projects. In this respect, it should be remembered that many of the Plan's legislative or regulatory measures do not carry associated actual investment and certainly generate important savings. Moreover, investment in transport infrastructures is not included in the assessment of the Plan's

economic efforts since this has, for the most part, already been evaluated in the specific infrastructure plans.

For this analysis, periods of amortization of the various investments and, consequently, some periods of generation of the various expected savings have been taken into consideration in the different sectors. The economic assessment of future savings has been made using a discount rate of 3%.

Table 4.7. GEARING EFFECT OF INVESTMENTS (€ FOR EACH € INVESTED)

APLICACIÓN SECTORIAL		PERIODO (AÑOS)	2012	2017	2022
SECTORES USOS FINALES	INDUSTRIA	5	4,73	11,16	---
	TRANSPORTE	5	5,80	13,70	---
	EDIFICIOS	15	0,36	1,16	1,86
	EQUIPAMIENTO DOM. Y OFIMATICA	5	0,69	1,63	---
	AGRICULTURA	10	0,78	2,52	3,44
	SECTOR PUBLICO	15	0,41	1,31	2,09
SECTOR TRANSFORMACIÓN	TRANSFORMACIÓN DE LA ENERGIA	5	1,99	4,70	---
	COMUNICACIÓN	0	---	---	---
TOTALES/MEDIA		9	1,28	3,26	3,75

Key:

SECTORAL APPLICATION		PERIOD (YEARS)	2012	2017	2022
END-USE SECTORS	INDUSTRY TRANSPORT BUILDINGS DOM. & OFFICE EQUIPMENT AGRICULTURE PUBLIC SECTOR				
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION COMMUNICATION				
TOTALS/AVERAGE					

The 2008-2012 Action Plan could be considered, globally, as cost-effective. By sector, the investments dedicated to improving energy efficiency in the Industry Sector show a rate of return — at the end of the effective period of the E4, in 2012 — of 4.73 € per € invested. In the Transport Sector, recovery of Plan investments is almost immediate; in this case, the measures proposed are of a regulatory nature which mean a reduced volume of investment and investments in infrastructures have not been taken into consideration in the analysis.

In the remaining sectors, the various periods of amortization make the gearing effect of the investments move over time towards more moderate values.

As a whole, although it is difficult to make such a major simplification, it could be said that the 2008-2012 Action Plan will allow for the recovery of 1.28 € per € invested in 2012, this figure increasing to values of 3.26 in 2017 and 3.75 € saved per € invested in 2022.

4.5. Other considerations

The cost-benefit analysis carried out in the 2008-2012 Action Plan was limited exclusively to assessment of the economic benefits arising from primary energy savings, at sectoral level, and environmental benefits, the latter being restricted to those arising from the lower volume of CO2 emissions.

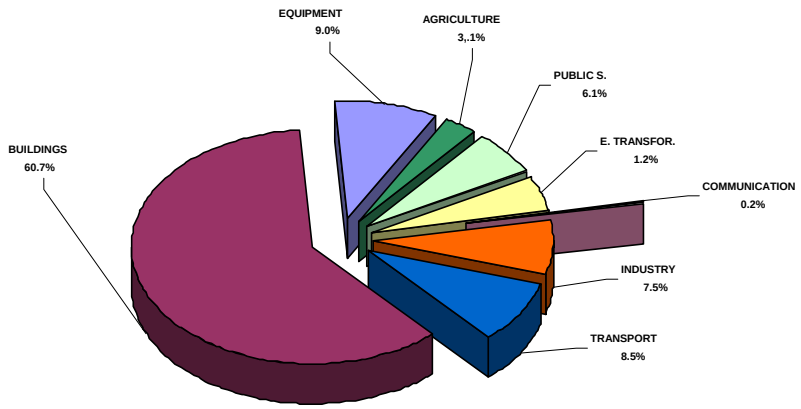
A complete cost-benefit analysis will require inclusion of the economic value of the new jobs created as a result of applying the Plan, and the economic value of other environmental benefits arising from the lower volume of emissions from pollutants other than CO_2. Additionally, benefits of the Plan could include those arising from improvement of road safety, which are logically liable to be assessed in economic terms (reduction of the road accident rate, for example) or those arising from reduction of traffic congestion in town centres. These positive externalities of the Plan have not been included in the cost-benefit analysis but have an undeniable economic value.

In the same way, a more complete analysis should allow for inclusion in the Plan of investments in infrastructures that could affect the sectors under consideration, which have not been assessed to their full extent.

5. FINANCING OF PLAN

The financing of the Plan is based essentially on investments in the private sector and in public services, and for this reason it will be passed on to the end-users or consumers, and employers, who will make investments which improve the processes or equipment that they bring to the market, and the services that they provide are carried out with less consumption of energy. For this reason, the investment provided for in the period will be 22,185 M€, with distribution per sector as shown in Fig. 5.1 which highlights: buildings with 60.7% of the investment effort of the Plan, followed by 9.0% of investment in equipment and the 8.5% of the Transport Sector. This effort clearly points to the diffuse sectors, concentrating the public effort in same.

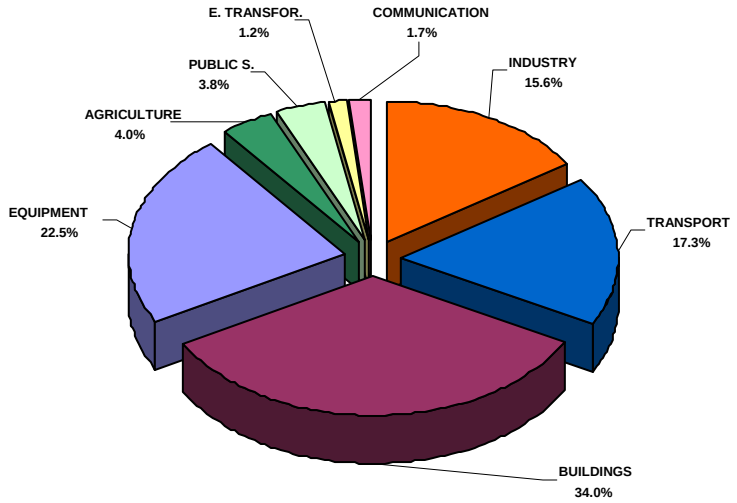
Graph 5.1 Total investment per sector



In order to incentivize investors, even though, as has been seen, these are generally profitable investments at current energy prices and that of emissions, public support has been provided for, with very varied sources, which is focussed on carrying forward the proposed measures, and which totals 2,367 M€; that is to say, the percentage of support amounts to 10.7%, with many variations as regards the intensity of the aid that it is necessary to apply to the various sectors and measures in order to reach a certain threshold of interest for possible investors.

In this way, in parallel with the proposed investments, the sectors with the greatest concentration of resources, as shown in Graph 5.2, are: buildings, with 34.0% of resources; equipment, with 22.5%, and transport, with 17.3%, concentrating in these three diffuse sectors around ¾ of the total of same, again emphasizing the effort and intensity of the Plan in that direction.

Graph 5.2. Sectoral destination of public funds applied to the PAE4+



It should be pointed out that, in relaton to aid that could be applied to companies which operate in the market, according to the Treaty[28], the exceptions exactly correspond with the measures as regards environmental improvements, and the saving and energy efficiency measures, in accordance with the Community Directives on state aid for the environment of 2001[29], directly point to these investments as active instruments of that policy.

Table 5.1 combines the origins of public resources and the application or destination of same (the area of the bands reflects the volume of sectoral aid), graphically highlighting the direction of economic efforts as mentioned above.

[28] The exceptions to the EC Treaty in relation to state aid are qualified as exceptions to the activity, according to 3(c) of Art. 87 of the Treaty and catalogued as horizontal state aid in the Guidelines on State Aid for the Environment, 2001/C 37/03.

[29] At the time of drafting this Plan, a new, even more active, framework was in the consultation phase with the Member States for entry into force before the end of this year.

Table 5.1. Origin and application of public funds

ORIGIN OF PUBLIC FUNDS FOR THE 2008-2012 PLAN			
		RESOURCES PERIOD 2008-2012 (k€)	RESOURCES ANNUAL AVERAGE (k€)
PUBLIC FUNDS ORIGINATNG FROM	GSB-IDAE	175,000	35,000
	GSB-MINISTERIAL ORDERS	50,000	10,000
	ERDF VIA NATIONAL TRANCHE	64,000	12,800
	RETURN ERDF-IDAE GS	13,000	2,600
	AC (OWN+ERDF VIA TR)	400,000	80,000
SECTORAL REINVESTMENTS	GAS TARIFF	285,000	57,000
	ELECTRICITY TARIFF	1,379,500	275,900
TOTALS		2,366,500	473,300

PUBLIC RESOURCES AND THEIR SECTORAL APPLICATION			
		PUBLIC RESOURCES PERIOD 2008-2012 (k€)	RESOURCES ANNUAL AVERAGE (k€)
END-USE SECTORS	INDUSTRY	370,000	74,000
	TRANSPORT	408,291	81,658
	BUILDINGS	803,671	160,734
	DOM. & OFFICE EQUIPMENT	532,500	106,500
	AGRICULTURE	93,754	18,751
	PUBLIC SERVICES	89,000	17,800
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION	29,284	5,857
	COMMUNICATION	40,000	8,000
TOTALS		2,366,500	473,300

Resources originating from the regulated tariffs represent 1.5% of billing. The contribution of the electricity tariff means an increase of 0.7% with respect to the PAE4 2005-2007. The gas tariff contribution starts with this PAE4+ 2008-2012.

The following elements stand out from the abovementioned Table 5.1:

- resources arising from the General State Budgets and allocated to the IDAE (Energy Diversification and Saving Institute) or other bodies of the AGE (Energy Use and Management) and which are intended for Plan actions, in addition to the ERDF (European Regional Development Fund) resources (returns on financing from the ERDF-IDAE[30] GS(Global Subsidy)) and from the national tranche for the period 2007-2012, represent a total of 12.8%;
- those which originate from the Autonomous Communities, their own resources, cofinanced or not by ERDF resources and which are planned for the achievement of energy efficiency objectives, represent 16.9%;
- resources reinvested to induce actual improvements in the electricity and gas market, and which will have to be translated into substantial improvements in efficiency in themselves and their applications, represent 58.3% and 12.0% of the above sectors[31] respectively.

[30] ERDF-IDAE Global Subsidy Report IDAE and MEH. 2004.

[31] Sectors mean all the production, transformation, distribution, marketing and end-user industries, as well as all service companies; to this set of players, who make up the market, a reinvestment of expenditure is allocated as an instrument for continuous improvement of the system..

As regards sectoral application, the allocation of those resources, according to Table 5.1, is: 15.6% to the Industry Sector; 17.2% to the Transport Sector; 34.0% to the Buildings Sector; 22.5% to the Domestic and Office Equipment Sector; 4% to the Agricultural Sector; 3.8% to the Public Services Sector; and, lastly, to the Energy Transformation Sector, 1.2%; in addition, 1.7% must be dedicated to communication measures.

It should be pointed out that the diffuse sectors, mainly transport, buildings and equipment, account for 73.7% of that sector distribution. That is to say, the effort, as will be discussed in the management section, of all types (staff, logistical, economic, etc.) is multiplied by bringing together, on one side, the high volume of resources applied to these sectors (mainly as laid down by the E2C2), and on the other side, by such a high volume of operations to be carried out, since the target public is the entire Spanish population, and it is expected to reach at least 25% of same with individual incentivization operations.

Finally, the financial system will have to come up with resources in answer to this appeal from the Plan as regards volume and in terms of profitability. In this way, investments may be backed by the capacity for recovery via savings from this type of investment, under the terms referred to in the previous section. The type of investment to be made requires, on the one hand (in the case of diffuse investments), relatively low loans, and extensive, general financing schemes determined in relation to the size and risk of the operations; and, on the other hand, specialized resources, such as risk capital funds or investment funds which take on this wager through rational investment in relation to efficient consumption and minimum environmental impact.

6.- GENERAL FRAMEWORK OF MEASURES

The strategic objectives around which the actual measures that make up the Action Plan Strategy must be developed should be configured along the following lines:

1. *Recognizing saving and energy efficiency as an instrument for economic growth and social wellbeing.*
2. *Making conditions such that awareness concerning saving and efficiency, in Society, is extended and developed.*
3. *Ensuring that saving and energy efficiency are all-pervasive in National Strategies, especially in the Spanish Climate Change Strategy.*
4. *Developing market competition using saving and energy efficiency as guiding principles.*
5. *Consolidating Spain's position in the vanguard of saving and energy efficiency.*

These strategic objectives must be translated, in their turn, into planning in the current context of the Economy and environmental obligations, within a determined timeframe, and within the framework of the resources available. Their development is achieved along several sectoral axes, defined below, which are made concrete in specific measures of the Action Plan. This pyramid structure of objectives, axes, and measures constitutes the true instrument of the Plan, and by linking all these a series of legislative actions is identified which should configure the true scheme of the E4.

6.1. Sectoral strategic axes

The specific measures of the Action Plan must be supported by legislative actions, as indicated in the following section by requiring complex administrative development, which deal with strategies of wider scope. In addition, the measures are assembled along strategic axes, as a project beyond the Plan, such that they induce those structural changes indicated in all sectors. This conjunction of sectoral strategic axes with a focal objective clearly defined throughout development of the Plan content is structured per sector along 12 axes, as follows:

a) ***Transport:***

1. *To act using legislative measures (taxes, deterrents, etc.) against vehicles, achieving a more rational use of the private car.*

2. *To change priorities of infrastructure policies by considering energy efficiency as a planning indicator, and establishing selective speeds, system selection, and highlighting energy efficiency criteria at the same level as environmental impact analyses, etc.*

3. *To exploit synergies arising from "administrative and legislative acts from other spheres" in order to introduce the principle of analysis and measures for energy efficiency (Air Quality Act, Public Administration Supply Tenders, Mobility Act, Policy Assessment, etc.).*

b) ***Domestic equipment:***

4. *To study in depth the changes initiated in market behaviour (growth in demand for more efficient equipment) obtaining the labelling of all equipment and to seek the confluence of all the players involved: manufacturers, retailers and users.*

5. *To impact on measures for electricity consumption (actual total and partial metering units) and thermal consumption (central heating systems measuring consumption per household/radiator, ACS, etc.) in order that users can respond through their behaviour and see that their efforts have an effect on their costs.*

c) ***Building:***

6. *To increase energy certification of buildings (making the habitability permit obligatory) and make it visible to the public such that demand is generated for buildings with low energy consumption (high efficiency, bioclimatic, sustainable, etc.) motivating innovation, in this market, in the case of new buildings and a greater demand for energy rehabilitation of existing buildings.*

d) ***Industry:***

7. *To Introduce in administrative authorizations for new plant, process changes, equipment rehabilitation, analysis of better available technology with energy efficiency as a basic parameter (equivalent to an "industrial label" and parallel to that for domestic equipment).*

8. *Control, surveillance and monitoring of compliance with emissions established by the PNAII, since this would in parallel comply with the PAE4+.*

e) ***Agriculture:***

9. *To exploit synergies for the efficient use of water as a tool for access in connection with energy efficiency, in the use and cost of same.*

f) Public Services:

10. *To reinforce the professionalization and requirements of companies that provide energy services based on energy efficiency (in parallel with quality or environmental stamps to promote the creation of energy efficiency trademarks on their products, processes, services, etc.) in all sectors.*

11. *To promote energy efficiency programmes in Public Administration buildings as a saving measure and by way of example.*

g) Energy transformation:

12. *Continuous improvement of outputs from energy transformation and their distribution.*

The Plan, in fact, is a complex of measures structured by sector and strategic axis. There is therefore a description from point 8 of the "Sectoral Framework" section of this document which gives details of the scope and specific objectives of each of these. They are set out in this section, in aggregate and summary form, for the purpose of identifying the same and determining the contribution of resources for their implementation. Added to these are the so-called legislative actions which represent the projection of the former since, in many cases, they transcend the Plan itself in their objectives and effects.

The measures to be carried out are divided into four sections:

- *Legislative actions*, generally of wide scope, which represent the framework of a complex edifice of recommendations, regulations, rules for sound operation, restrictions, and guidelines with obligations for fulfilment in general. In these, additionally, are found the arguments which make it necessary to adopt certain measures which, in other circumstances, Society does not adopt naturally.

- *Incentivized measures* with the aim of carrying out audits and analysis of consumption, of the technologies used, measured by real consumption, and promoting investment in equipment which saves or increases efficiency in the use of energy.

- *Training in good practices,* knowledge of the technologies available, advances and new techniques for managing demand, consumption and correct use of energy in general.

- *Dissemination* of recommendations, the saving culture, impact awareness, losses in the production and transformation chain, etc. in a general way.

On the other hand, it should be emphasized that there is a clear separation of measures in relation to the number of participants. Accordingly, against the Renovation plans for domestic appliances, with over 600,000 operations in 2006, or the replacement of traffic lights with LED, there are those which, through their size and diffusion, could be considered as exceptional. These entail the difficulty of the cost of the operations, others have the complexity of numbers and the logistics of their application.

In this way, each sector has proposed those actions and measures that should be put into practice in the period covered by the Plan, and which ought to produce, in any case, the first results in that period. Logically, as already mentioned, to carry out the launch efficiently in other cases, this means intensifying the effects of 42 measures with 13 legislative actions, which requires very intense public and private effort. In addition, these measures may be extended by those which the 19 Autonomous Communities may consider necessary, specifically within their territorial domain, through which the number of measures to be managed increases significantly.

6.2. PAE4+ action measures

Undoubtedly, a plan as complex and extensive as this, since it affects all consumer and transformation sectors, requires a definition of measures with maximum precision and detail, but clearly pointing out the instrumental and economic objectives and means. The specific detail of each of the measures is analyzed with a complete breakdown in the sectoral analysis in the "Sectoral Framework" section of this document.

However, it should be pointed out that of the 59 actions, as given in Table 6.1, 36 are economic incentive measures for investment, through various aid instruments; 3 measures refer to promotion activities specifically aimed at the sectors; 4 measures refer to training, or training of trainers, where necessary; and, lastly, 16 of them are regulatory actions (laws, decrees, regulations, etc.) which use this instrument for their development. The number of measures in the transport sector stand out, closely linked to the diversity of uses and the extension of the target public.

Table 6.1. Summary of measures and actions by type and sector

SECTORS	Investment Aid	Promotion	Training	Total Measures	Regulatory Actions
Agriculture and Fisheries	5	2		7	1
Building	5			5	
Residential and Office Equipment	2			2	
Industry	2	1		3	1
Public Services	3		1	4	1
Transport	12		3	15	12
Energy Transformation	7			7	1
TOTALS	36	3	4	43	16

The following page gives a list of measures by sector, highlighting the objectives to be achieved by each of these, investment and support.

Summary Framework of Measures

6.3. Communications plan

The communication actions are supported by a long-term Strategy of Effort through a continuous and constant presence in the communications media. This strategy of persistence is absolutely necessary if we want to go on, in the medium term, changing citizens' behaviour, their habits, with respect to saving and energy efficiency.

As seen from the experience of the PAE4 2005-2007, efforts in this direction have been very significant by impacting on aspects of mass promotion (Renovation Plan for domestic appliances), the effect of which is being assessed, but which has affected a population of over 600,000 people, retailers and new marketing images in which savings and the environment appear to be linked. In addition, training actions have a dissemination effect which offers models to be used in the communications sphere, for example, in learning how to sell energy-quality articles, thereby contributing towards shaping citizens' behaviour with intensification along the chain of players.

The Communications Plan and its campaigns will turn on three main strategies:

- Conventional publicity: through traditional TV "slots", radio items, press leaflet inserts, externally and over the Internet, with special attention to this medium in the campaigns to be carried out, given the link between the IDAE and the Ministry that manages the Information Society
- Unconventional publicity: with complementary direct marketing and/or public relations activities (presence on the streets, consumer centres, mobile telephony, etc.)
- Participation and presence in the content produced for communications media, such as informative, documentary programmes, etc., or programmes expressly developed to contain institutional messages regarding saving and energy efficiency.

The total cost of the three measures proposed for the entire period 2008-2012 rises to 45,000 euro, with annual periodification of 9,000 euro. The campaigns and actions in question will be included annually in the Institutional Publicity Plan of the State Administration, submitted, therefore, to the Institutional Publicity Commission which regulates this Plan, and approved by the Council of Ministers.

The Institutional Communication Campaigns are developed along two axes:

a) Execution of Publicity Campaigns using the mass media regarding "Citizen awareness-raising, mobilization and action for responsible energy consumption".

a.1. General objectives:

- To value energy, vis-à-vis the citizen-consumer, as a precious asset that we must care for
- To save energy, starting from awareness of the problem and creation of currents of opinion, mobilization and action of citizens in their daily activities: at home, at work and using means of transport
- To give information to citizens regarding practices so that they know how to save by their individual actions
- To position saving and efficiency policies as tools in the service of a new national energy model based on sustainability, energy efficiency and contributing towards halting climate change

a.2. Specific objectives:

- To mobilize citizens to take part in the challenge to consume energy in an intelligent and responsible way. Citizens are responsible for 30% of total energy consumption (12% at home and 18% in the car)
- To promote the purchase of equipment bearing the "A" class energy label (houses, cars, domestic appliances, air-conditioning, bulbs, etc.). Efficient equipment, compared with that which is not, may consume less than half the energy.
- To promote public transport in general, as well as alternative means of transport to the private car, in town centres in particular. If we were to stop using only 1% of our vehicles to go to work, taking public transport instead, we would save 20 million litres of fuel annually and we would reduce noise, pollution and traffic-jams.
- To promote responsible use of private vehicles. In the city, 50% of car journeys are to cover distances of less than 3 km, and 75% of these trips are made with only one occupant.

- To promote energy saving by responsible use of HEATING equipment in the winter. Almost half of the energy that Spanish families consume in their homes is in heating.
- To promote energy saving by way of responsible use of air-conditioning equipment in the summer. These campaigns will be directed essentially at achieving a reduction of consumption in the services sector (hotels, business and leisure centres, etc.). The cooling of buildings in Spain (not including industry) accounts for 11.1% of national electricity consumption, the cooling in buildings of the tertiary sector being the largest consumer of conditioned air, reaching 98% of electricity consumption in air-conditioning or 11% of national electricity consumption.

b) To promote, specifically, those actions identified annually as priorities in the Plan.

As part of this measure, it is sought to design and carry out publicity campaigns with extensive reach ("universal target": 100% of the population) for broadcasting in the communications media, with preference to the medium of *Television*, this having the greatest social impact, and the Internet, for the reason given above.

The frequency of the campaigns should be yearly in order to maintain constant pressure on consumers.

The campaigns, and all the actions included in same, will entail measurement activities, and will be supported by conclusions and guidelines obtained through analysis and research studies (discussion groups, working groups, qualitative and/or quantitative surveys, etc.).

The campaigns and actions will give continuity to those previously carried out by the IDAE ("Energy for all. Energy forever" (2004), and all the TV programmes: "Turn off the Light" (2005), on TVE1; "Energy Saving in Good Company (2006-2007)", Disney Chanel; or mass distribution of the "Practical Energy Guide. Efficient and Responsible Consumption": four million distributed in 2005 through the free press-release distribution services of the Ministry of Industry, Trade and Tourism, and another four million copies of a new edition corrected and updated in 2007 through the Sunday supplements of the four national daily newspapers).

In the period June 2007/February 2008, the IDAE is, similarly, devising a communications strategy with the abovementioned objectives, for the sum of 13

million euro, with a very intensive campaign ("You are the king…") that will be broadcast on TV, radio, in the press, externally and over the Internet . The campaign includes, moreover, an important package of complementary measures to make it visible at sports events, superstores, (omission)

The cost of the measure is 45,000 k€ for the whole period, with linear and continuous distribution to maintain the necessary pressure on the target public and so that the efforts of one compaign might be continued into the next.

Table 6.3. Annual Communications Cost of the PAE4+

2008	2009	2010	2011	2012	Total 2008-2012
9,000	9,000	9,000	9,000	9,000	**45,000**

6.4. Participation of R+D+i in Action Plan

The Company is currently meeting some important challenges in the energy sector based on security of supply, sustainability and competitiveness of the economy which require the establishment of some very ambitious objectives for reduction of consumption, both in the short and medium/long terms. The short- and medium-term objectives, as laid down in the Action Plan, are based on investment in mature technologies and on citizens changing their habits. However, the achievement of objectives established in the long term will require very significant technological advances in all sectors, as set out in the Cotec Report[32], particularly pointing out the disconnection between the public and the private, or the SISE[33] which studies its causes in depth.

In this respect, the new National R+D+i Plan specifically considers an Energy Strategic Area within which four of the six priority thematic lines relate to saving and efficient use of energy. These lines are:

- Energy efficiency in end uses
- Transport, distribution and storage of energy

[32] COTEC Report 2005. Technology and Innovation in Spain. This highlights the lack of dedication of business effort to the innovative process; the need to change the public-private relationship; problem of SMEs diverted from innovation; focussing major growth on increasing the differential effort in innovation.

[33] Integral Follow-up and Assessment System. Permanent observatory for Spanish science/technology/society.

- Technologies for clean coal combustion. Capture and storage of carbon.
- Hydrogen and fuel cells

The instruments considered in the Plan will be the following:

- International technological cooperation
- Promotion of R+D+i departments in businesses
- Cooperative projects for generation of technologies
- Cooperative projects for innovation: demonstration projects

The resources specified for the proposals for R+D+i in businesses will be made available to the same by way of subsidies and/or repayable loans.

On the basis of the development of the current R+D+i programme[34] and the scheduled priorities, the Plan proposes an allocation to the thematic lines relating to the saving and efficient use of energy referred to above of 67% of total resources. In addition, the importance is stressed of integrating the energy efficiency actions in the National Science and Technology Strategy[35], approved at the 3rd conference of the Presidents of the Auntonomous Regions on 11.1.2007.

[34] Activities in Research, Development and Technological Innovation. Interministerial Science and Technology Commission. Action to Promote the Technical Research of the Ministry of Industry, Trade and Tourism and Ministry of Education and Science, CENIT Programme (National Strategic Consortia for Technological Research) of the Ministry of Industry, Trade and Tourism. Strategic Projects of the Ministry of Education and Science. CREA Programme (creation and consolidation of Technological Centres).

[35] The ENCYT centred the AGE (Energy Use and Management) policy on the INGENIO 2010 instrument and defined six strategic axes: 1. to place Spain in the vanguard of knowledge; 2. to promote a highly competitive business network; 3. to develop a policy integrating science, technology and innovation: overlapping of the regional areas in the Science and Technology system; 4. To create a favourable environment for investment in R+D+i; and 6. to establish suitable conditions for the creation and dissemination of Science and Technology. Published y the FECYT (Spanish Science and Technology Foundation).

Additionally, and conscious of the ambitious objectives laid down by the European Union on Energy-Saving Policy, aiming at 20% in 2020, the Government will promote the creation of a specific centre for R+D+i on energy saving. The objective is to create a centre of excellence for international reference along technological lines concerning Saving and Energy Efficiency by way of Research, Technological Development and Innovation, working in coordination with the Administration, businesses and universities. That is to say, to activate the Science/Technology/Business network from which the benefits arising from each rung on the ladder must be extracted; accordingly, the promotion of specialized R+D+i centres for Saving and Energy Efficiency, and in their turn they will serve as the antenna for more complex systems of widespread international scope.

In order to optimize the available resources, all the projects and actions will have to obtain synergies and complementarity with European Union programmes, especially with Framework Programme VII and with the Community Innovation and Competitiveness Framework Programme 2007-2013.

7.- MANAGEMENT SYSTEMS FOR PLAN

7.1. Management Mechanisms

The management mechanisms to carry out all measures and implement instruments, and where necessary their operation, requires very significant human resources, working in unison and coordination. For this reason, the State structure of the autonomous regions adapts well to most actions, especially those which are based on incentivization through public support, widely dispersed, based on a large number of small investments. In addition, the type of action to be carried out requires specialized teams for advice and support in most cases, and the knowledge of the staff of the Energy Agencies, Autonomous Administration Services, coordinated with the team of the IDAE, so they can set up the required network.

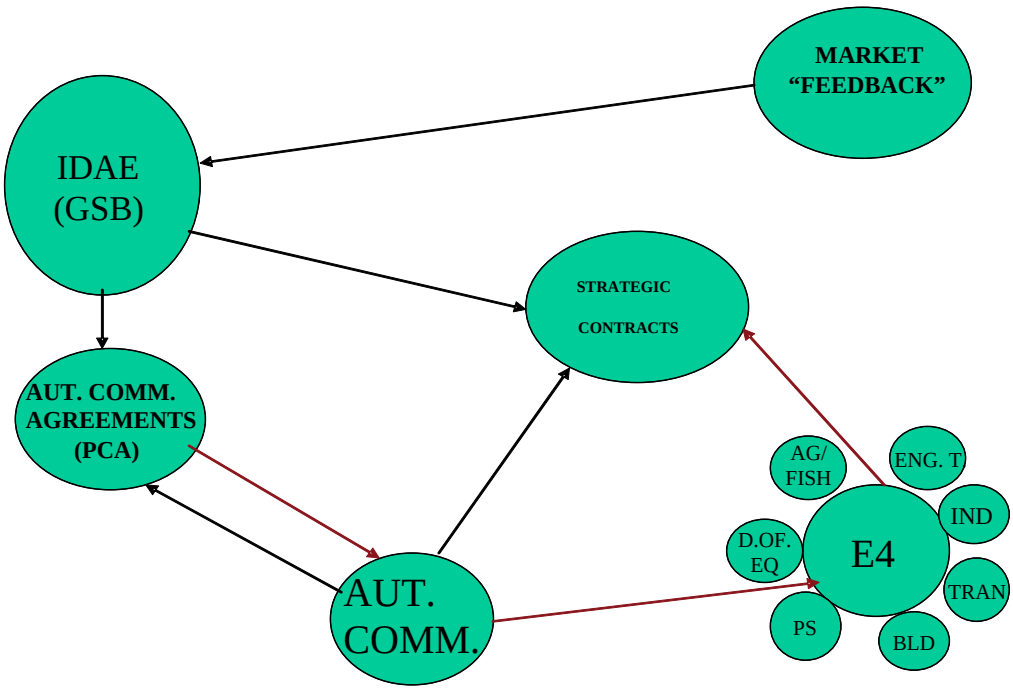
In the PAE4 2005-2007, a co-management and co-financing mechanism with the Autonomous Communities was used with success, based on collaborative agreements in which the measures proposed by the IDAE were selected by them, according to their management potential or the structure of the energy consumers. With this general framework of actions proposing measures in all consumer sectors, the Autonomous Communities drew up their own “ad hoc” Work Plan. This scheme has allowed for coverage of a substantial part of the spectrum of actions laid down in the E4 and in the action plan.

The instrument of collaborative agreements, although bearing fruit, requires a new design based on flexibility and simplicity, not forgetting elements such as complementarity, additionality, efficiency and effectiveness of public resources. In this way, the co-financing of incentives from the public, the axis of same, should be orchestrated in a less complex manner. For this reason, the most appropriate Agreement for carrying out certain measures will be studied jointly within the framework of the CADER (Rural Development Support Centres).

Necessarily, in the new Action Plan, owing to the extent of the objectives and measures to be launched, which represent an additional effort that was being made by the Collaborative Agreements, the number and type of agents involved in management should be increased, or some of the instruments intensified. Accordingly, there are companies and groups of same (superstores, development companies, etc.) which have distributed their activities throughout the territory at hundreds of sites and it would be necessary to give them access to the framework of aid in a unique way, increasing the effectiveness and costs of management. Equally, local bodies are seeking more direct and specific participation since their energy-efficiency framework requires concrete instruments.

On the other hand, as seen from various Directives, documents and recommendations issued by the EU, new players are being pressed into service, such as the Energy Service Companies (ESCOs) who could do some good promotion work by selling saving and efficiency, advocating and engaging their benefits to achieve objectives. This type of company would be a good intermediary for the application of saving policies.

Table 7.1 Diagram of participation and co-financing within the framework with the Autonomous Communities



7.2. Follow-up of Plan

Implementation of Plan measures will involve different ministerial departments, the Autonomous Communities and Local Bodies, as well as numerous private agents. Correct knowledge of the level of execution, barriers to their implementation and possible modifications, requires a single follow-up centre, this being the IDAE which, in collaboration with the ministerial departments involved and the Autonomous Communities through the Saving and Energy Efficiency Consultative Committee, will carry out this function.

It has been established by the IDAE, and according to the Commission's recommendations in its document COM (2006) 545 final, that there is a requirement that the Action Plans to be prepared by the Member States should provide follow-up indicators validated by practice. For this reason, each sectoral analysis proposes the most appropriate indicators to assess the progress of the measures.

To carry out the follow-up of the Plan as a whole, and not only the bilateral relationship with the Autonomous Communities, periodical meetings will be held with all the Ministries participating in implementation of the Plan, such that actions are coordinated and a follow-up is carried out to make, where necessary, adjustments or proposals, and these are submitted to the competent bodies.

SECTORAL FRAMEWORK

This section gives the analyses of the various consumer sectors: Industry, Transport, Buildings, Domestic and Office Equipment, Agriculture, Public Services, and Energy Transformation. They, in turn, summarize more detailed analyses carried out on these sectors and which are the reference documents for this Action Plan.

The content below, therefore, is based on the sectoral analysis carried out in the light of the E4 scenarios, the development of markets over the last few years, the prospects of structural and technological change, and market expectations.

In view of the specific outline of each sector, the capacity for saving and improvement in energy efficiency is set out based on: investment in more technologically advanced equipment (renovation or new technologies) through audits, investment aid, financing, R&D incentives, etc; promulgation of legislative measures in the sphere of standardization, labelling, establishing specific consumption thresholds, etc., so as to put pressure on the market to move towards more efficient usage; communication actions (educational campaigns, changes in behaviour, training, dissemination of causes and effects, etc.). All this analysis concludes, for each sector, with a proposal for energy objectives to be achieved during the period, environmental improvements arising from same, the necessary investment and public support; and a framework of measures to be launched with instruments more suited to moving the sector in the proposed direction.

It should be pointed out that the success of the Plan depends, in large part, on the framework of measures, the intensity of same and the speed of their introduction, and that the intervention of ministerial departments and, where necessary, the community or municipal administrations involved in their activation is essential. Lastly, the involvement of the private sector in investment, by being based mainly on profitability criteria, will have its limit of acceptance, it being the responsibility of the promoter of public support to gauge adequately the percentage of same in order to be effective in applying resources.

8. AGRICULTURE AND FISHERIES

8.1 Sector Position

Context

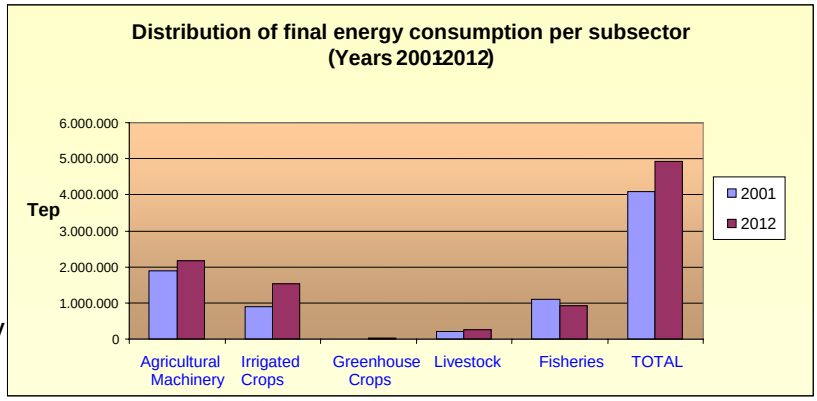
Currently, most of the attention of the agrarian sector is focussed on the opportunities that the energy sector offers agriculture as producers of renewable energy (biomass and biofuels), but attention should essentially be on demand, efficient and sustainable use of energy in the sector.

The agricultural sector has a limited impact on total demand (3.5% of final energy consumption) but it is a strategic sector in that energy efficiency measures could be highly important for its future, both by reducing its energy costs and aiding the sustainability of rural development. This is in spite of the increased effort necessary, both technical and economic, regarding information and awareness-raising for each measure laid down in this Plan.

Energy trends for the sector

In the analysis carried out in the E4 of energy consumption in the sector and its forecast development, it can be observed how agricultural machinery and irrigation systems account for a large percentage of consumption for the sector and, therefore, this is where the effort has been concentrated to date to introduce energy efficiency criteria.

Graph 8.1.



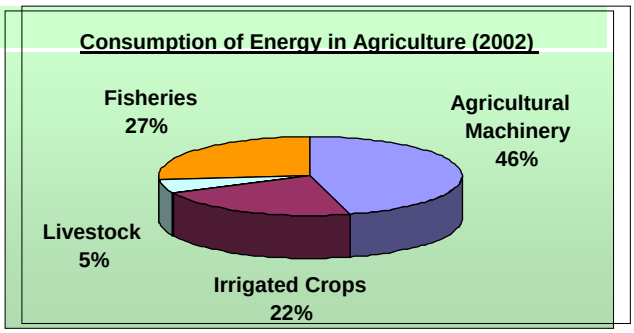
It can also be seen that the third consumption element is the fisheries sector.

In the snapshot of energy consumption in the sector taken at that time, and in the forecast development of energy to the year 2012, the following results appeared:

- An **increase in total energy consumption** is foreseeable in agricultural cultivation techniques, as well as the increase in irrigation surface areas, which gives rise to an increase in consumption (4.08 Mtep/year in 2000 up to 4.92 Mtep/year in 2012).

- **Agricultural machinery,** together with irrigated crops, accounts for around 70% of energy consumption for the sector.
- **There is a potential saving** through modernization of agricultural vehicle fleets and the change from irrigation by spraying to localized irrigation and other less significant actions.

Graph 8.2.



In the PNA II, the agrarian sector is fully taken into consideration, both as energy consumer and for its importance as a carbon sink.

Consumption 2004-2007

The agricultural sector represents around 12% of total so-called Miscellaneous Use consumption, remaining more or less constant throughout the last few years.

As sources of energy, diesel accounts for 85% in 2004 of energy consumption in the Agriculture and Fisheries sector (90% in 2001) and the remainder is consumed mainly as electricity at 13%, essentially for irrigation agriculture.

It should be emphasized that, according to the "Electricity Industry Statistics" for 2004 (Ministry of Industry, Trade and Tourism), Agricultural Irrigation consumed more than 2,287 GWh, which accounts for 1% of national electricity consumption and a bill of more than 155 M€.

There are important differences in actual energy consumption in the agriculture and fisheries sector, according to the various available sources (IDEA Bulletin on Energy Efficiency and Renewable Energy Sources number 8, Ministry of Agriculture, Food and Fisheries, Oil Statistics Bulletin of the Oil Product Strategic Reserve Corporation (CORES)).

Nevertheless, it has been decided to keep the data obtained in the E4, supported by sectoral and consensus studies, and it will be assumed that actual consumption up to 2007, and therefore the starting point of this 2008-2012 action plan, is the same as that estimated as the efficiency scenario in the E4 and the 2005-2007 Action Plan.

Therefore, the following will be taken as actual consumption:

Table 8.1. ACTUAL CONSUMPTION IN AGRICULTURE AND FISHERIES (ktep)
(Based on the E4 Efficiency Scenario)

Year 2000	Year 2006	Year 2007
4,089	4,306	**4,350**

Source: E4 2004-2012.

Objectives:

Baseline Scenario/Efficiency Scenario of the E4.

The definition of the objectives of the 2008-2012 Action Plan will take as its starting point the objectives of the E4 2004-2012 and the results of the 2005-2007 Action Plan.

For this, the baseline and efficiency scenarios of the E4 are taken into consideration, which define the saving objectives for the sector. The E4 forecasts for the period in question are given in point 3.1.

In order to define the objectives of the 2008-2012 Action Plan, the following criteria have been used:

- Taking as reference consumption for the year 2007 the figure of 4,350 ktep, which relates to the E4 efficiency scenario.
- Maintaining the efficiency scenario in 2012. The potential energy saving in the year 2012, forecast in the 2008-2012 Action Plan, will be 348 ktep, the objective set out in the E4.
- In 2012 the annual saving would be 348 ktep, equivalent to 7.1% of the consumption forecast by the E4, and the cumulative saving in the period of the Action Plan (1,357 ktep).
- The reduction of CO_2 emissions in the five-year period 2008-2012 would be 4,925 ktCO_2.

Table 8.2. Baseline Scenario/Efficiency Scenario of the E4 in Agriculture and Fisheries

	2008	2009	2010	2011	2012	Total 2008-2012
Baseline Scenario E4	4,588	4,671	4,754	4,837	4,920	23,769
Efficiency Scenario E4	4,394	4,437	4,482	4,527	4,572	22,412
Saving Objective E4 (ktep)	**194** 4.2%	**233** 5.0%	**272** 5.7%	**310** 6.4%	**348** 7.1%	**1,357**
Emissions Avoided ($ktCO_2$)	**702**	**843**	**985**	**1,126**	**1,269**	**4,925**

The implementation measures taken into account to achieve the estimated saving are grouped around the following concepts:

- Training and Information in techniques for efficient use of energy in Agriculture and Fisheries (measure 1).
- Agricultural Machinery
  - Incorporation of energy efficiency criteria in the Renovation Plan for tractors, in order to modernize the agricultural tractor fleet (measure 2).
  - Improvement in the energy efficiency of tractors in use, by way of energy TIV, with overhaul of energy consumption components (measure 6).
- Irrigation Agriculture
  - Guidelines to encourage migration from irrigation by spraying to localized irrigation (measure 3).
  - Audits and plans to implement energy improvements in irrigating communities (measure 5).
- Fisheries: Improvement in saving and energy efficiency in the Fishing sector (measure 4).
- Conservation Agriculture: Technical and economic support for the migration from traditional agricultural to Conservation Agriculture (Direct sowing and ground cover) (measure 7).

Measures 4, 5, 6 and 7 were considered in the previous 2005-2007 Action Plan as complementary measures that are developed in this new Action Plan.

The costs of the Action Plan will essentially be geared towards the removal of economic barriers, of inefficient habits, and communication and training.

Similarly, the introduction of these measures as a whole and within the prescribed time limits would allow the energy efficiency scenario of the E4 to be achieved, with the resulting transformation of the sector according to different parameters which classify the effectiveness of same in terms of energy efficiency.

Efficiency Scenario E4+

An E4+ Efficiency Scenario has been established which gives consideration to additional measures. The additional effort is based, preferably, on increasing economic, regulatory, technical efforts and those for awareness-raising and information, and the necessary aid to raise the final objectives of the measures themselves, with the aim of achieving higher energy savings and, consequently, a larger reduction of emissions.

This leads, on the corresponding dates, to the following energy consumption and saving values, by comparing the scenarios:

Table 8.3. Comparison of scenarios in Agriculture and Fisheries

(Ktep)		2000	2007	2012
BASELINE Scenario (E4)	Energy Consump.	4,089	4,505	4,920
EFFICIENCY Scenario (E4 +)	Energy Consump.	4,089	4,350	4,545
Saving Acheived by Efficiency Scenario E4 +	Energy Saving	0	155	375
Increase in Saving of Efficiency Scenario E4+ over Efficiency Scenario E4	Energy Saving Increase	0	0	**27** **13.9%**

The hypotheses considered in 2007 are the same as those in the planning of the E4.

The additional implementation measures considered to achieve this energy saving and reduction of emissions are as follows:

A. Fisheries: Improvement in saving and energy efficiency in the Fishing sector (measure 4). This means introducing efficient technologies which reduce diesel consumption. The added effort consists of increasing the total consumption saving objective of the fishing sector, with a significant effort in both technical and awareness-raising terms and in economic aid.

B. Conservation Agriculture: Technical and economic support for the migration from traditional agriculture to Conservation Agriculture (Direct sowing and ground cover). This measure 7 promotes Conservation Agriculture, incorporating it in the Rural Development Programmes of the Autonomous Communities as agri-environmental measures. It is hoped that, essentially, with greater awareness-raising, the surface area affected by this migration is increased.

In addition, to boost those measures already developed in the E4 guidelines:

C. Training and information in techniques for efficient use of energy in Agriculture and Fisheries (measure 1).

The necessary effort will consist of greater emphasis on promotion/training measures, with the general Administration as the driving force and the Autonomous Communities introducing the measures. This includes:

- Editorial line on the subject of energy efficiency in the agrarian sector and its dissemination plan.
- Attendance at courses to train the trainers (IDAE).
- Attendance at courses to train farmers in techniques for efficient use of energy in the agrarian sector (Autonomous Communities).
- Technical communication/promotion campaigns in techniques for efficient use of energy in agriculture.
- Promotion of Conservation Agriculture (direct sowing and ground cover): seminars, field days, courses, research lines.

D. Agricultural Machinery

- Incorporation of energy efficiency criteria in the Renovation Plan for tractors, in order to modernize the agricultural tractor fleet (measure 2). This means broadening the objective of renovated tractors by increasing dissemination of the energy classification for tractors and introducing energy labelling, preferential finance, etc.

- Improvement in the energy efficiency of tractors in use by way of energy TIV, with overhaul of energy consumption components (measure 6). The additional effort consists of incorporating filter checks into this TIV and other aspects that might improve energy efficiency.

E. Irrigation Agriculture

- Regulations to encourage migration from irrigation by spraying to localized irrigation (measure 3). It is hoped to widen the objective of migration to localized irrigation by increased public aid.

- Audits and implementation plans for energy improvements in irrigating communities (measure 5). This consists of carrying out energy audits in irrigating communities and establishing aid lines which support replacement of equipment and systems.

The following criteria and hypotheses have been used to define the objectives of the 2008-2012 Action Plan:

- Taking as reference consumption for the year 2007 the figure of 4,350 ktep, which relates to the efficiency scenario of the E4.

- Making the maximum effort in each measure laid down in this sector to achieve the maximum possible energy saving.

- This Plan does not take into consideration the fixation of atmospheric carbon in the soil through migration from traditional agriculture to conservation agriculture (direct sowing in extensive crops and ground cover in woody crops) since this is a reduction of emissions that does not arise from energy saving. If the studies carried out to date are confirmed, consideration of this carbon fixation would mean a considerable increase in emissions saving for the agricultural sector in the Plan.

- Accomplishment of the E4 under the terms by which it was approved, without taking account of additional objectives, means an energy saving in 2012 of 348 ktep/year. From this figure, the new scenario accounts for incorporation of new measures the effects of which are added to those indicated in the E4 itself.

- The additional savings, in terms of energy and emissions, on top of that provided for in the efficiency scenario of the E4, have been estimated at 27 ktep/year and 98 ktCO_2, respectively; that is, an additional 13.9% on top of the saving objectives of the original E4.

- Therefore, the new saving objective of the 2008-2012 Action Plan that takes into account the additional measures for the sector means an energy saving in 2012, on top of the baseline scenario of the E4, of 375 ktep/year (7.6% saving) and a cumulative saving over the period 2008-2012 of 1,402 ktep, equivalent to 30% of consumption for the sector expected in 2008.

- The reduction of CO_2 emissions in the five-year period 2008-2012 would be 5,088 ktCO_2 , through direct energy savings, not including the fixation of atmospheric carbon in the soil owing to the migration from traditional agriculture to conservation agriculture.

Table 8.4. Scenario set out in the Action Plan E4+ 2008-2012 in Agriculture and Fisheries

	2008	2009	2010	2011	2012	Total 2008-2012
Baseline Scenario E4	4,588	4,671	4,754	4,837	4,920	**23,769**
Efficiency Scenario E4+	4,394	4,437	4,477	4,514	4,545	**22,367**
E4+ Saving Objective (ktep)	**194** 4.2%	**234** 5.0%	**277** 5.8%	**322** 6.7%	**375** 7.6%	**1,402**
Emissions Avoided (ktCO_2)	**701**	**847**	**1,001**	**1,171**	**1,368**	**5,088**

The costs of the Action Plan will essentially be directed at the removal of economic barriers, of inefficient habits and communication and training.

These savings were arrived at by starting from the baseline scenario of the E4 and with the separate measures applied, they end up exceeding the objectives of the efficiency scenario of the E4.

In the following table the investment, support and savings provided for are given according to type of measure:

Table 8.5. Action Plan 2008-2012 of the E4+ Agriculture and Fisheries Sector Measures

AGRICULTURE & FISHERIES MEASURES			Action Plan 2008-2012. Efficiency Scenario E4 +					
			Investment (kEuros)	Public Support (kEuros)	Energy Saving (ktep)		Emission of CO_2 avoided ($ktCO_2$)	
					2012	2008-2012	2012	2008-2012
Training & Information	1	Communication campaign/ promotion of techniques for efficient use of energy in agriculture	3,127	3,127	0	0	0	0
Agricultural Machinery	2	Incorporation of energy efficiency criteria in the Plan for Modernization of the agricultural tractor fleet	215,280	53,775	25	107	89	331
	6	Improvement in the energy efficiency of tractors in use by way of TIV	22,987	7,662	224	788	794	3,107
		Total Machinery	238,267	61,437	249	895	883	3,438
Irrigation Agriculture	3	Promotion of migration from irrigation by spraying to localized irrigation systems	190,800	954	38	151	156	390
	5	Plan to implement Energy Improvements in Irrigating Communities	10,608	2,122	38	132	152	587
		Total Irrigation	201,408	3,076	76	283	308	977
Fisheries	4	Improvement in energy saving and efficiency in the Fisheries Sector	235,221	23,522	31	118	108	412
Conservation Agriculture	7	Migration to Conservation Agriculture (Direct sowing and Ground cover)	5,185	2,592	19	107	68	261
TOTAL AGRICULTURE & FISHERIES			**683,207**	**93,754**	**375**	**1,402**	**1,368**	**5,088**

Differential Assessment. Summary graph and table.

The difference between the planning of the E4 efficiency scenario and the E4+ efficiency scenario is relatively small due to the fact that the effort made in this sector has been very significant since the original drafting of the E4.

The ability to obtain greater energy savings than those planned would require very considerable economic effort which is not justified in the face of scenarios with very low or negative returns.

Taking the additional effort into consideration, the following table gives the differences in comparison with the original objectives set out in the E4:

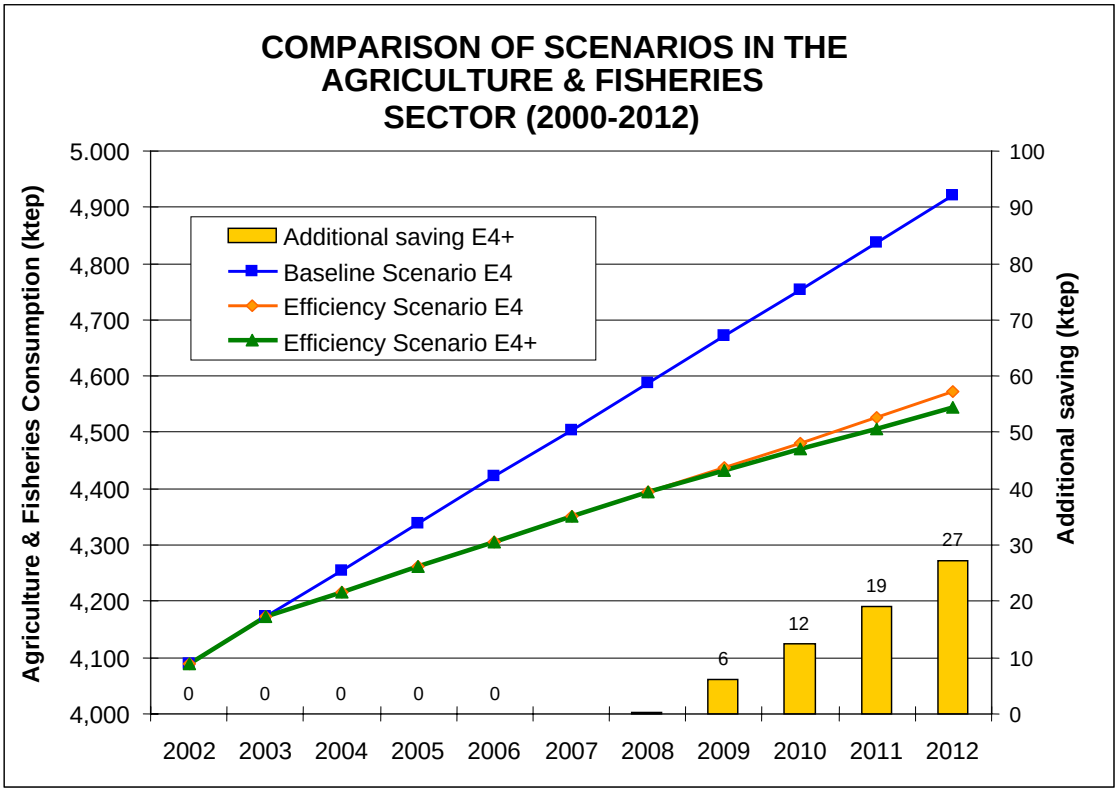
Table 8.6. Comparative summary of scenarios

	Baseline Scenario		Efficiency Scenario E4		Scenario E4+		Scenario Difference	
	2012	2008-2012	2012	2008-2012	2012	2008-2012	2012	2008-2012
Agriculture & Fisheries Consump. (ktep)	4,920	23,769	4,572	22,412	4,545	22,367	-27	-45
Average consumption growth		1.76%		1.00%		0.85%		-0.15%
Direct savings (ktep)					337	1,315		
Induced savings (ktep)					38	87		
Total saving Baseline Scenario E4 (ktep)			348	1,357	375	1,402	27	45
Saving on Baseline Scenario E4 (%)			7.1%	5.7%	7.6%	5.9%		
Total Emissions avoided (ktCO $_2$)			1,269	4,925	1,368	5,088	98	162
Associated investment (k€)				527,235 (*)		683,207		155,972
Public support (k€)				69,803		93,754		23,951

(*) The associated investment in the E4 Efficiency Scenario is adjusted to the corrected scenario

The graphic result of these values can be seen as follows:

Graph 8.3.



8.2. Measures in Agriculture and Fisheries Sector

I. Training and Information

MEASURE 1: Communication campaign/promotion of techniques for efficient use of energy in agriculture

Objective:

To introduce to the agents of the sector, and make them aware of, the importance of saving and energy efficiency in the agrarian sector, especially in the use of energy-consuming agricultural equipment

Description:

Continuation and expansion of the programme for implementation of specific training actions in techniques for efficient use of energy in the agrarian sector aimed at farmers and stockbreeders.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE, Ministry of Agriculture, Fisheries and Food and Sectoral Agents.

Costs, Energy Savings and CO_2 Emissions Avoided:

Table 8.7.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	601	613	625	638	650	3,127
Energy Savings (ktep)	0	0	0	0	0	0
Emissions Avoided ($ktCO_2$)	0	0	0	0	0	0

ACTIONS TO BE TAKEN 2008-2012:

This entails continuing with the process initiated in training and information concerning energy efficiency in agriculture by introducing the promotion of conservation agriculture, expanding the content as per development of the editorial line and improving the existing dissemination programme.

The General Administration (MAPA (Ministry of Agriculure Food and Fisheries) and IDAE), with the support of sectoral agents and Universities, will continue to work as initiator and promotor of the proposed actions, developing training and information instruments, and the Autonomous Communities will be those who introduce the measures.

The dissemination programme is reliant on the running of an annual course for training of the trainers, aimed at equipping technicians so that they can pass on the course content to the farmers of their Autonomous Community. At a later date, specific training actions will be carried out, as Seminars and Field Days, aimed at farmers, in order to train them in saving and energy efficiency in agriculture.

The Autonomous Communities will take on the design and creation of this programme, establishing the regulatory bases and procedures for negotiating aid, which will have to comply with the general requirements described for each of the following specific actions:

a) **Attendance at courses on training in techniques for efficient use of energy** in the agrarian sector aimed at farmers and stockbreeders.

   The Autonomous Communities will promote and advertize these actions on their territory. The IDAE will make available to the Autonomous Communities, if they should be of interest, the documents from the editorial series on saving and energy efficiency in agriculture that it has produced:

   - Promotional three-part document 'Saving and Energy Efficiency Measures in Agriculture'
   - Document nº 1: 'Agricultural Tractor Fuel Saving'.
   - Document nº 2: 'Saving and Energy Efficiency in Irrigation Agriculture'.
   - Document nº 3: 'Saving and Energy Efficiency in Stockbreeding Facilities'.
   - Document nº 4: 'Saving, Energy Efficiency and Agricultural Cultivation Systems'.
   - Document nº 5: 'Saving, Energy Efficiency and Agriculture Production Structures'

   Similarly, the IDAE will contribute the editorial line documents that it produces. For illustrative purposes, other proposed themes are being developed such as: 'Energy Saving and Efficiency in Greenhouses', 'Energy Audits in Irrigating Communities', 'Production and Sustainable Use of Renewable Energy Sources in

the Agrarian Sector', 'Rational Use of Nitrogen and Other Raw Materials in Agriculture', 'Agricultural Techniques with Low Energy Consumption', 'Energy Labelling of Agricultural Tractors', etc.

These editorial documents will be given to training participants.

The features of the attendance course will follow recommendations that the IDAE will make, although the Autonomous Communities may modify them in order to achieve wider end-user dissemination of the techniques for efficient use of energy in the agrarian sector.

b) **Promotion of Conservation Agriculture (direct sowing in extensive crops and ground cover in woody crops).** In general terms, Conservation Agriculture reduces energy consumption and the work arising from farming operations themselves, by orders of magnitude. The features of the proposed actions will follow recommendations made by the IDAE, although the Autonomous Communities may modify them in order to achieve wider end-user dissemination of the techniques for efficient use of energy in the agrarian sector. It is believed that it may be advisable to count on the collaboration of the Spanish Association for Conservation Agriculture/Live Soils (AEAC/SV).

Levels of action are created according to the audience at whom the action is aimed:

b1) Scientific Seminars: The audience will be made up of scientists, researchers, technicians and legislators, for dissemination and exchange of experiences of the benefits from this type of agriculture.

b2) Regional Field Days: The audience will be made up of scientists, researchers, technicians, legislators, agricultural businesses, agrarian cooperatives and agrarian associations at regional level, to pass on this type of technique to farmers in a practical and didactic form and to respond to the concerns and problems of farmers in each region of Spain.

II. Agricultural Machinery

MEASURE 2: Incorporation of energy efficiency criteria in the Plan for Modernization of the agricultural tractor fleet (Tractor Renovation Plan).

Objective:

To promote replacement of part of the current agricultural tractor fleet with new and more efficient units, encouraging the selection of equipment with better energy ratings, which will result in greater energy savings.

Description:

To apply, study the results being obtained therefrom and improve, if deemed advisable, Royal Decree 1539/2006 of 15 December, which regulates the granting of aid for the Tractor Renovation Plan (2007-2009), and which deals with the conditions of same using objective criteria for greater energy efficiency. This Royal Decree incorporates, as differentiating criterion for aid, a premium of 30 euro/hp for A-class tractors and 10 euro/hp for those from Class B, according to the methodology drawn up jointly by the IDAE and MAPA.

Responsibility and Collaboration:

Responsible:

Ministry of Agriculture, Fisheries and Food

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE, Agricultural Councils of the Autonomous Communities, Universities and manufacturers of agricultural machinery.

Costs, Energy Savings and CO_2 Emissions Avoided:

Table 8.8.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	9,105	9,930	10,755	11,580	12,405	53,775
Energy Savings (ktep)	12	15	19	22	25	93
Emissions Avoided ($ktCO_2$)	44	54	66	77	89	330

ACTIONS TO BE TAKEN 2008-2012:

This entails continuing with the study of results being obtained from the Tractor Renovation Plan 2007-2009 (R.D. 1539/2006).

The objective is to continue with the actions being implemented, finalizing, maintaining, updating, introducing and disseminating the energy classification of agricultural tractors for sale in Spain.

The support system based on investment aid may be completed by creating a preferential line of finance, according to their energy classification, for the renovation of tractors older than 15 years.

MEASURE 6: Improvement of energy efficiency of tractors in use by way of TIV.

Objective:

To improve maintenance of the national tractor fleet in use in order to increase their energy efficiency and fuel saving.

Description:

Introduction to the TIV network of controls concerning those elements which impact decisively on the consumption of tractors.

Responsibility and Collaboration:

Responsible:

Ministry of Industry, Trade and Tourism.

Collaborators:

Autonomous Communities, Ministry of Agriculture, Fisheries and Food, Ministry of Industry, Trade and Tourism/IDAE and Sectoral Agents.

Costs, Energy Saving and CO_2 Emissions Avoided:

Table 8.9.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	1,517	1,525	1,532	1,540	1,548	7,662
Energy Savings (ktep)	128	154	178	202	224	886
Emissions Avoided ($ktCO_2$)	455	545	632	715	794	3,141

ACTIONS TO BE TAKEN 2008-2012:

Review of the necessary regulations to be included in the actual TIV activities for agricultural tractors, a set of actions which allow for the revision of elements which impact decisively on tractor consumption, specifically inspection of the state of air and fuel filters and recommendations on the injection system and smoke level.

Economic support is necessary to lessen the extra cost imposed by implementation of these additional TIV tasks so that these inspections do not impact economically on end users. Equally, changing of filters, if recommended in the TIV, must be supported.

III. Irrigation Agriculture

MEASURE 3: Incentives for migration from irrigation by spraying to localized irrigation systems.

Objective:

To reduce energy consumption by way of replacement of systems for irrigation by spraying with localized irrigation systems, on those lands and crops which allow for such a replacement.

Description:

The measures that should be adopted for the achievement of the above objective include the following actions:

- Inclusion, within the rules for use of water for irrigation, of a set of guidelines which direct farmers towards localized irrigation systems as opposed to irrigation by spraying
- Technical and economic support for implementation of this migration towards localized irrigation.

Responsibility and Collaboration:

Responsible:

Ministry of Agriculture, Fisheries and Food.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE and Autonomous Communities.

Costs, Energy Saving and CO_2 Emissions Avoided:

Table 8.10.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	180	185	191	196	202	954
Energy Savings (ktep)	7	8	12	21	38	87
Emissions Avoided ($ktCO_2$)	27	32	50	87	156	352

ACTIONS TO BE TAKEN 2008-2012:

This entails acceleration by way of regulatory measures and technical and economic support of the measures laid down in the National Irrigation Plan, in favour of localized irrigation systems which replace operations using systems of irrigation by spraying.

There is the need to take the measure forward from the work carried out to date in saving and energy efficiency in irrigation, such as the development of a pilot Energy Audit in an Irrigating Community and the creation of a Working Group on Saving and Energy Efficiency in Irrigation that studies possible new actions to be taken in irrigation as part of the E4, as is the protocol on energy audits in Irrigating Communities that is being developed.

It is necessary to provide a line of aid which incentivizes the replacement of systems for irrigation by spraying with localized irrigation.

MEASURE 5: Execution of Energy Audits and Action Plans for Improvements in Irrigating Communities.

Objective:

To promote saving and energy efficiency measures in the irrigation agriculture sector.

Description:

Execution of Energy Audits in Irrigating Communities, the basic approach to this type of action. The results obtained will support the introduction of an 'Action Plan for Improvement of Energy Yields in Irrigating Communities'.

Responsibility and Collaboration:

Responsible:

Autonomous Communities.

Collaborators:

Ministry of Agriculture, Fisheries and Food, Ministry of Industry, Trade and Tourism/ IDAE and Sectoral Agents.

Costs, Energy Savings and CO_2 Emissions Avoided:

Table 8.11.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	399	412	424	437	449	2,122
Energy Savings (ktep)	21	25	29	34	38	146
Emissions Avoided ($ktCO_2$)	83	101	118	136	152	590

ACTIONS TO BE TAKEN 2008-2012:

The Autonomous Community will take on the management and coordination of all actions arising from application of the measure, selecting the Irrigating Communities concerned for carrying out the energy audits.

It is thought advisable to deal with the sector through the National Federation of Irrigating Communities (FENACORE).

The IDAE is working to produce a general model of technical specifications and a generic protocol for energy audits, although the Autonomous Community may adapt this model to the features of its irrigated land, without dispensing with the energy assessment under any circumstances.

The Irrigating Communities affected shall show their support for the execution of the audits and commitment to implement measures by proposing same as and when it is technically and economically viable.

The maximum unit of aid for execution of each energy audit is 75% of the total cost of same, with equivalent maximum net aid per audit of the order of: 3,000 euro (Irrigating Communities < 1,000 ha), 5,000 euro (Irrigating Communities between 1,000 and 5,000 ha) and 10,000 euro (Irrigating Communities > 5,000 ha).

Equally, public support should be given to implementation of measures which propose energy audits by way of investment aid in irrigating communities intending to improve their energy efficiency.

IV. Fisheries.

MEASURE 4: Improvement in Saving and Energy Efficiency in the Fisheries Sector

Objective:

To promote saving and energy efficiency measures in the fisheries sector by introducing efficient technologies.

Description:

The poor general energy efficiency of the fisheries sector and the increase in the price of oil give rise to a serious problem for the sector. With a registered fleet of more than 10,000 vessels and direct employment of some 45,000 people, fuel accounts for a high percentage of total costs.

The best option to confront these problems must be by putting faith in technologies which reduce consumption, achieving both a competitive improvement in the national fishing sector and technological development on the part of Spanish companies which would be able to market new products and services for the national sector and for export.

In this context, the Council of Ministers, at its meeting on 3 June 2005, has already approved an Action Plan in the Spanish Fishing Sector, later amended in November 2005, which considered, among other actions, the preparation of proposals for improvement in use and energy efficiency in this sector.

Responsibility and Collaboration:

Responsible:

Autonomous Communities.

Collaborators:

Ministry of Agriculture, Fisheries and Food, Ministry of Industry, Trade and Tourism/ IDAE and Sectoral Agents.

Costs, Energy Savings and CO_2 Emissions Avoided:

Table 8.12.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	4,257	4,470	4,693	4,928	5,174	23,522
Energy Savings (ktep)	16	20	23	27	31	116
Emissions Avoided ($ktCO_2$)	57	70	82	95	108	413

ACTIONS TO BE TAKEN 2008-2012:

Support for implementation of baseline studies, pilot experiments, energy audits, and introduction of improvements in fishing vessels which might lead to substantial energy saving and improve their efficiency.

As a guide, the areas to be considered for achieving an energy saving and improving efficiency would be:

a) Modification of fishing nets.
b) Modification of fishing routes and logistics.
c) Modifications to vessels.
d) Propulsion system: engines.
e) Capture of exhaust gases.
f) Propulsion system: reducers and propellers.
g) Electric and hybrid propulsion.
h) Electricity generation.
i) Reductions of electricity consumption on vessels.
j) Improvements in energy management.
k) Alternative Fuels.
l) Support for other energy sources (wind, solar, etc.)
m) Dissemination of results by way of information and training in the sector

Implementation of these actions will be promoted by way of technical and economic support for studies, audits and investment in equipment intended for improving energy efficiency on fishing vessels.

IV. Conservation Agriculture

MEASURE 7: Support for migration towards Conservation Agriculture (direct sowing in extensive crops and ground cover in woody crops)

Objective:

The objective of this measure is to encourage migration from traditional agriculture to conservation agriculture (direct sowing in extensive crops and ground cover in woody crops) to reduce the energy consumption of the sector.

Description:

To support, technically and economically, migration from traditional agriculture to conservation agriculture.

In addition to other environmental advantages, with conservation agriculture techniques (essentially direct sowing and the use of ground cover as fruit-trees), most of the work on the soil is eliminated, which gives rise to a significant fuel saving.

In this type of agriculture the soil is left covered by the remains of crops which feed and contribute carbon to the soil. This encourages the carbon sink effect of soils by fixing atmospheric carbon in same.

Conservation agriculture, in comparison with traditional farming and for the majority of crops, produces an estimated energy saving of more than 10-15% and an increase in energy productivity of more than 30%.

In conservation agriculture, the contribution of Carbon to the soil represents, according to recent studies, a fixation of 18 tonnes per hectare. This means, given that 1 tonne of Carbon produces 3.7 tonnes of CO_2 through oxidation, that on each hectare, owing to this concept, the emission of approximately 66.6 tonnes of CO_2 is saved. This Plan has NOT taken this saving of CO_2 by fixation of Carbon in the soil into consideration. If one takes into account that this fixation takes place over 20 years, it could be estimated that the annual saving of emissions is approximately 3.33 tonnes of CO_2/ha per annum.

Responsibility and Collaboration:

Responsible: Autonomous Communities

Collaborators: Ministry of Agriculture, Fisheries and Food, Ministry of Environment, Ministry of Industry, Trade and Tourism/IDAE and Sectoral Agents

Costs, Energy Savings and CO_2 Emissions Avoided:

Table 8.12.

	2008	2009	2010	2011	2012	Total 2008-2012
Public Support (k€)	477	515	524	533	543	2,592
Energy Savings (ktep)	10	13	15	17	19	74
Emissions Avoided ($ktCO_2$) (*)	36	45	53	61	68	262

(*) not counting the fixation of atmospheric carbon in the soil

ACTIONS TO BE TAKEN 2008-2012:

- Economic and technical support for migration from traditional agriculture to conservation agriculture.
- The Autonomous Communities will consider (within their Rural Development Programme) as agri-environmental measures 2007-2013, support for migration from traditional agriculture to conservation agriculture.
- Continuity of training and information concerning conservation agriculture.
- Organization of international agrarian events based in Spain to disseminate conservation agriculture.
- Support for the holding of international field days with high impact that deal with conservation agriculture and energy saving.
- Organization of at least 17 courses and 17 field days per year on conservation agriculture, one event for each Autonomous Community. Over 5 years, various areas will be selected in which farmers will be grouped together by herbaceous and woody crops.
- Promotion of lines of research that are considered of interest in relation to conservation agriculture and energy efficiency.
- Creation of an energy classification of systems for handling agrarian soils and thereby the farmers who cultivate them.

8.3 Summary of costs and benefits by measure

Table 8.13.

	Measure	Final Energy Savings (ktep)						Emissions Avoided ($ktCO_2$)						Public Support (k€)						Investment (k€)					
		2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total
1	Communication campaign/ promotion of techniques for efficient use of energy in agriculture	0	0	0	0	0	0	0	0	0	0	0	0	601	613	625	638	650	3,127	601	613	625	638	650	3,127
2	Incorporation of energy efficiency criteria in the Plan for Modernization of agricultural tractor fleet	12	15	19	22	25	93	44	54	66	77	89	330	9,105	9,930	10,755	11,580	12,405	53,775	36,432	39,744	43,056	46,368	49,680	215,280
3	Incentive for migration from irrigation systems by spraying to localized irrigation systems	7	8	12	21	38	87	27	32	50	87	156	352	180	185	191	196	202	954	36,000	37,080	38,160	39,240	40,320	190,800
4	Improvement in saving and energy efficiency in the Fishing sector	16	20	23	27	31	116	57	70	82	95	108	413	4,257	4,470	4,693	4,928	5,174	23,522	42,569	44,697	46,932	49,279	51,743	235,221
5	Action Plan for Energy Improvements in Irrigating Communities	21	25	29	34	38	146	83	101	118	136	152	590	399	412	424	437	449	2,122	1,997	2,059	2,122	2,184	2,246	10,608
6	Improvement in energy efficiency of tractors in use by way of TIV	128	154	178	202	224	886	455	545	632	715	794	3,141	1,517	1,525	1,532	1,540	1,548	7,662	4,552	4,575	4,597	4,620	4,643	22,987
7	Migration to Conservation Agriculture (Drect sowing and ground cover)	10	13	15	17	19	74	36	45	53	61	68	262	477	515	524	533	543	2,592	954	1,030	1,048	1,067	1,086	5,185
	TOTAL AGRICULTURE & FISHERIES	**194**	**234**	**277**	**322**	**375**	**1,402**	**701**	**847**	**1,001**	**1,171**	**1,368**	**5,088**	**16,536**	**17,650**	**18,745**	**19,852**	**20,971**	**93,754**	**123,104**	**129,798**	**136,541**	**143,396**	**150,369**	**683,207**

8.4 Summary of costs by measure

Table 8.14.

Measure		Investment (k€)					
		2008	2009	2010	2011	2012	Total
1	Communication campaign/ promotion of techniques for efficient use of energy in agriculture	601	613	625	638	650	3,127
2	Incorporation of energy efficiency criteria in Plan for Modernization of agricultural tractor fleet	36,432	39,744	43,056	46,368	49,680	215,280
3	Incentive for migration from irrigation systems by spraying to localized irrigation systems	36,000	37,080	38,160	39,240	40,320	190,800
4	Improvement in saving and energy efficiency in the Fishing sector	42,569	44,697	46,932	49,279	51,743	235,221
5	Action Plan for Energy Improvements in Irrigating Communities	1,997	2,059	2,122	2,184	2,246	10,608
6	Improvement in energy efficiency of tractors in use by way of TIV	4,552	4,575	4,597	4,620	4,643	22,987
7	Migration to Conservation Agriculture (Direct sowing and ground cover)	954	1,030	1,048	1,067	1,086	5,185
TOTAL AGRICULTURE & FISHERIES		**123,104**	**129,798**	**136.541**	**143,396**	**150,369**	**683,207**

8.5 Economic benefits

- From energy: Assessment ratio 1 tep of primary energy - 480 €
- From CO_2: Assessment ratio 18€/tCO_2

Table 8.15.

Measure	Economic Benefit (k€)					
	2008	2009	2010	2011	2012	Total
Economic benefit through Energy Saving	104,614	126,327	149,183	173,970	202,281	756,375
Economic Benedit through CO2 Emissions Avoided	12,620	15,241	18,024	21,076	24,615	91,576
TOTAL	**117,234**	**141,568**	**167,207**	**195,045**	**226,896**	**847,951**

8.6. Additional measures to be implemented in the medium term

1.- Rationalization of Use of Agricultural Machinery. Promotion of joint use of machinery as a form of rational use of same, which translates into a considerable energy saving. Promotion of the creation and consolidation of agricultural machinery companies for shared use of same and/or hiring of machinery or of the service to third parties (machinery cooperatives, cooperatives for community use of land and service companies).

2.- Energy Labelling of New Tractors. To make it obligatory for manufacturers of agricultural machinery to provide information in the catalogue concerning the energy classification of the tractor, the output, CO_2 emissions and fuel consumption, which serves as information to users before making a decision to purchase or replace.

3.- Tractor-implement fittings, from the energy viewpoint. Since agricultural tasks are not only carried out by tractors (they have implements and machinery coupled to them which they pull and operate), it would be advisable to optimize fittings between tractors and agricultural equipment from the energy point of view. To study and establish criteria, from the energy point of view, for adapting tractors and agricultural equipment, dealing with the diversity of work, equipment and conditions to be found in Spanish agriculture.

4.- Obligatoriness of maintenance and control of elements that impact decisively on the consumption of tractors for improvement of energy efficiency.

5.- Advisory Services for the Farmer. Promotion of this Table and awareness-raising as regards saving and energy efficiency.

6.- Development of energy information and management systems in agricultural work. In order to understand and manage the agricultural work to be carried out with maximum efficiency, promoting joint use of machinery and advisory services to the farmer as mentioned above.

7.- Rationalization of the use of fertilizers. The importance of these actions goes beyond energy saving, which would involve rational use of fertilizers in agriculture by reducing its total consumption. The new nitrification techniques (liquid media), the promotion of conservation agriculture techniques and ecological agriculture, may be factors which decisively influence reduction in consumption of these items. The Ministry of Agriculture, Fisheries and Food should look into limitation of fertilizer consumption per hectare or crop type (define reference values and penalize excessive consumption); as well as to determine the impact that these actions could

have on the sector. This measure implies an indirect and environmental energy benefit by reducing soil and aquifer pollution.

8.- Development of equipment and information systems, and telemanagement of water and energy in irrigation. This means modernization of irrigation with work on:

a) Reduction of water consumption. Everything that involves reduction in water consumption has a direct effect on the consumption of eletricity:

- Higher level of technology in collective irrigation networks.
- Adaptation of irrigation teams to the actual needs of the crops at all times, according to crop watering requirements.
- Installation of frequency converters in pumping equipment.
- Optimization of the size of plant through good design of pipe networks and lifting equipment. Special study of the possibility of introducing natural-pressure irrigation systems.
- Appropriate maintenance of plant.

b) Improvement of aquifer management:

- Replace deliveries originating from subterranean waters with volumes of purified water.
- Recovery of over-exploited aquifers, which allows for pumping of water from a lesser depth.
- Improvement and introduction of water regulation and control systems (meters, etc.).

c) Improvement in energy efficiency on smallholdings

d) Establishment of reference energy consumptions

e) Energy rating and/or classification of irrigated land

f) Improvement in training of irrigators in energy-efficient techniques.

g) Study of energy consumption of water originating from desalination and re-use of waste water for use in agricultural irrigation

h) Water and energy information and telemanagement systems

9.- Greenhouses

a) Introduction of energy efficiency criteria in:

- Design and construction of greenhouses (structural elements, covering materials, materials with less transmittance and emissivity, greenhouse orientation, asymmetric designs, double covers, etc.).

- Equipment (high-output boilers, pipe insulation, localized heating, thermal screens, heat storage, etc.)
- Control systems (boiler control, thermal integration of crops, thermal screen control, etc.)

b) Introduction of crops with low energy requirements.

IDAE, in collaboration with the CENER and the University of Almería, is carrying out a pilot study on energy efficiency and introduction of renewable energy sources in greenhouses, which serves as a reference for implementation of this measure.

10.- Livestock

a) Introduction of energy-efficiency criteria in the design and construction of livestock facilities.

b) Installation of more efficient equipment with use, where possible, of residual energy of same: lighting equipment, milking compressors, cooling equipment, etc.

c) Regulatory development of energy efficiency in the design and construction of livestock facilities.

11.- Fostering of ecological agriculture

Support for the increase in surface area intended for ecological agriculture, by consuming less energy, as well as other resources, such as water and fertilizers.

12.- Incorporation of saving and energy efficiency in energy crops

In addition to increasing the surface area intended for energy crops, according to the Renewable Energy Plan, this growth has to be implemented using saving and energy efficiency criteria in order to obtain the longest possible energy life-cycle from biofuels.

13.- Activities of the Ministry of Agriculture, Food and Fisheries

Reduction of energy consumption by way of incorporation of saving and energy-efficiency criteria in the activities of the Ministry of Agriculture, Food and Fisheries itself. This means continuing to promote saving and energy efficiency in the activities of the Ministry of Agriculture, Food and Fisheries by favouring measures which involve greater energy efficiency and actions which, although difficult to quantify, may account for an energy saving.

8.7. Legislative measures.

Legislative or regulatory actions in the sector are summarized as follows:

- Royal Decree 1539/2006 of 15 December which regulates the granting of aid for the Tractor Renovation Plan (with premiums to those of class A and B).
- Regulatory incentive (National Irrigation Plan) for migration from irrigation by spraying to localized irrigation.

In addition, Parliament is currently considering a bill for sustainable rural development which includes action to promote renewable energy sources and efficiency in the use of energy resources in this domain.

As already mentioned, the following can also be cited:

- Obligatory energy-labelling of new tractors
- Obligatory maintenance and inspection of tractors in use by way of TIV
- Obligatory Action Plan to improve energy outputs in Irrigating Communities

Development of regulations on construction of efficient livestock facilities.

8.8.- Assessment of results.

In order to be able to assess the behaviour of the sector, according to certain quantifiable parameters relating to the launch of the different types of measure, a set of indicators for each measure has been defined.

These indicators are explained in more depth in the development of each measure given at annex and are referred to in the following table:

			Indicators	2008-2012
Training & Information	Measure 1	Communication/ promotion of techniques for efficient use of energy in agriculture	Attendance courses (units)	2,500
			Scientific Seminars and Regional Field Days and attendance courses (units)	170
Agircultural Machinery	Measure 2	Incorporation of energy-efficiency criteria in the Modernization Plan for the agricultural tractor fleet	Tractors included in the Renovation Plan for Modernization of the fleet (units)	6,500
	Measure 6	Improvement of energy efficiency of tractors in use by way of TIV	Tractors that have passed the energy TIV (units)	766,249
Irrigation Agriculture	Measure 3	Incentive for migration from irrigation by spraying to localized irrigation systems	Irrigated surface area migrated from irrigation by spraying to localized (ha)	106,000
	Measure 5	Action Plan for Energy Improvements in Irrigating Communities	Energy-audited surface area in irrigating communities (ha.)	1,700,000
			Surface area improved according to energy audit carried out in Irrigating communities (ha.)	1,700,000
Fisheries	Measure 4	Improvement in saving and energy efficiency in the fisheries sector	Baseline studies and energy audits of improvements to fishing vessels (units)	50
			Inversion Ratio/Energy saving in pilot experiments and introduction of improvements to fishing vessels (€/tep)	4,507
Conservation Agriculture	Measure 7	Migration to Conservation Agriculture (Direct sowing and ground cover)	Surface area migrated from traditional agriculture to conservation agriculture (ha).	759,779

9. BUILDINGS SECTOR

9.1. Sector Position

Context

The Buildings Sector includes, for the purposes of the Saving and Energy Efficiency Action Plan (PAEE), services which have a greater impact on the energy consumption of buildings: thermal installations (heating, climatization and production of hot water) and internal lighting plants, both in the residential and tertiary sectors.

The final energy consumption of the Buildings Sector rose in 2005 to 18,123 ktep against a national total of 106,940 ktep, which represents 17% of national final energy consumption. Of this consumption, 10,793 ktep related to the domestic sector, that is, 10% of national energy consumption, and 7,330 ktep to the tertiary sector, 7% of the national total.

Spanish buildings mainly consist of those for which the principal use is residential. In 2005, 85% of the built surface area was formed by residential housing and the remaining 15% by buildings intended for other uses, mainly administrative and commercial. Specifically, 389 million m^2 related to the tertiary sector with its various uses, and the remaining 2,300 million m^2 to the residential sector, of which 1,600 million m^2 were intended as principal dwellings.

According to the data from the Ministry of Housing, principal dwellings rose in 2005 to 23,209,842 houses, of which 68%, that is, 15,884,170 are principal dwellings and 7,325,672, or 32%, non-principal dwellings. In terms of number of principal dwellings per Autonomous Community, the following stand out: Andalucía (17.4%), Cataluña (15.8%), Valencian Community (12.3%) and Madrid (11.7%). Over 57% of principal dwellings built in our country are distributed between these four communities.

The following table shows the number of houses built over the last few years per Autonomous Community.

Table 9.1.

ESTIMATE OF THE TOTAL NUMBER OF HOUSES CLASSIFIED ACCORDING TO USE															
Autonomous Communities	Total					Principal dwellings					Non-principal dwellings				
	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005
Andalucía	3,554,198	3,677,608	3,806,819	3,922,607	4,032,264	2,415,143	2,487,597	2,550,391	2,627,676	2,721,866	1,139,055	1,190,011	1,256,428	1,294,931	1,310,398
Aragón	657,555	672,438	687,679	699,563	713,854	443,205	456,501	467,581	477,332	483,093	214,350	215,937	220,098	222,231	230,761
Asturias (Principality of)	524,336	533,877	543,960	556,612	569,923	389,310	398,653	402,936	409,554	413,058	135,026	135,224	141,024	147,058	156,865
Balearic (Is)	504,041	516,757	529,088	539,826	551,480	305,431	313,067	326,506	342,694	354,300	198,610	203,690	202,582	197,132	197,180
Canaries	855,022	884,064	910,671	937,084	962,896	552,351	572,788	604,272	623,604	638,518	302,671	311,276	306,399	313,480	324,378
Cantabria	286,901	294,039	302,697	311,303	317,695	182,645	184,471	189,768	193,056	202,371	104,256	109,568	112,929	118,247	115,324
Castilla y León	1,455,050	1,487,057	1,514,294	1,543,748	1,576,866	889,197	903,424	913,205	925,654	939,881	565,853	583,633	601,089	618,094	636,985
Castilla-La Mancha	988,555	1,005,293	1,023,217	1,045,585	1,072,011	610,227	626,703	645,620	661,486	681,013	378,328	378,590	377,597	384,099	390,998
Cataluña	3,328,120	3,403,260	3,477,698	3,571,897	3,658,330	2,315,774	2,373,668	2,443,142	2,531,141	2,593,667	1,012,346	1,029,592	1,034,556	1,040,756	1,064,663
Valencian Community	2,558,691	2,628,135	2,692,389	2,767,763	2,862,658	1,492,744	1,555,439	1,615,149	1,674,859	1,739,047	1,065,947	1,072,696	1,077,240	1,092,904	1,123,611
Extremadura	575,284	584,471	596,487	606,080	616,274	366,893	374,231	382,303	385,971	390,741	208,391	210,240	214,184	220,109	225,533
Galicia	1,312,496	1,344,733	1,372,715	1,405,098	1,437,554	900,376	907,579	921,085	948,996	970,605	412,120	437,154	451,630	456,102	466,949
Madrid (Community of)	2,482,885	2,524,353	2,567,758	2,635,616	2,706,368	1,873,671	1,954,239	2,021,691	2,092,891	2,134,111	609,214	570,114	546,067	542,725	572,257
Murcia (Region of)	595,319	609,285	624,403	646,435	670,134	378,211	389,557	401,282	421,705	440,994	217,108	219,728	223,121	224,730	229,140
Navarra (F. Community of)	261,147	267,293	272,368	277,628	284,326	188,730	190,429	197,223	203,073	207,603	72,417	76,864	75,145	74,555	76,723
Basque Country	892,009	910,390	922,705	936,935	952,202	741,399	751,779	770,314	787,366	819,246	150,610	158,611	152,391	149,569	132,956
Rioja (La)	156,769	161,349	165,484	169,612	174,709	101,439	104,888	110,467	113,206	114,017	55,330	56,461	55,017	56,406	60,692
Ceuta y Melilla	45,381	47,024	48,490	49,576	50,298	37,280	36,572	37,988	40,300	40,039	8,101	10,452	10,502	9,276	10,259
Spain	**21,033,759**	**21,551,426**	**22,058,922**	**22,622,968**	**23,209,842**	**14,184,026**	**14,581,585**	**15,000,923**	**15,460,564**	**15,884,170**	**6,849,733**	**6,969,841**	**7,057,999**	**7,162,404**	**7,325,672**

Source: Ministry of Housing

As regards the development of the built surface area during the period 1990-2005, it can be seen that the built surface area in 2005, as compared with 1990, has multiplied by almost 2.5. In this period the majority of the surface area was covered by housing; for example, in 2005 it represented 98.3% as against that covered by tertiary sector buildings. This development can be analyzed in more detail from the municipal permits, using data from the Ministry of Public Works, which are given in the following table, for the period 1990-2005.

Table 9.2. Development of built surface areas

DEVELOPMENT OF BUILT SURFACE AREAS IN SPAIN (National total in thousand m2)			
Year	Total	Residential	Tertiary
1990	40,543	39,177	1,366
1991	36,566	35,780	786
1992	37,743	37,239	504
1993	36,337	35,675	662
1994	37,980	37,353	627
1995	45,012	44,029	983
1996	42,328	41,512	816
1997	48,070	47,257	813
1998	58,870	57,564	1,306
1999	66,586	64,911	1,675
2000	73,710	71,979	1,731
2001	67,215	65,129	2,086
2002	68,807	67,013	1,794
2003	79,936	77,946	1,990
2004	90,910	89,251	1,659
2005	98,506	96,895	1,611

Source: Ministry of Public Works.Municipal permits

It is estimated that the final energy consumption of the Buildings Sector rose in 2005 to 18,123 ktep, which represents 17% of final energy consumption (106,940 ktep). Of this consumption, 10,793 ktep related to energy consumption of the domestic sector, which represents 10% of national energy consumption. For its part, the consumption of the tertiary sector rose, in that same year, to 7,330 ktep; that is, 7% of the national total. This means that between 2000-2005 the final energy consumption of this sector increased by 5%.

Final energy consumption in the domestic sector is distributed, by use, in the following way for an average household: heating (41.7%), hot water (26.2%), lighting (9%) and air-conditioning (0.4%). The impact of air-conditioning, given its seasonal nature, does not today have a significant consumption value, although it contributes towards generation of peaks of demand for electricity, which contribute towards the cause of local problems in continuity of electricity supply in summer when external temperatures are much higher.

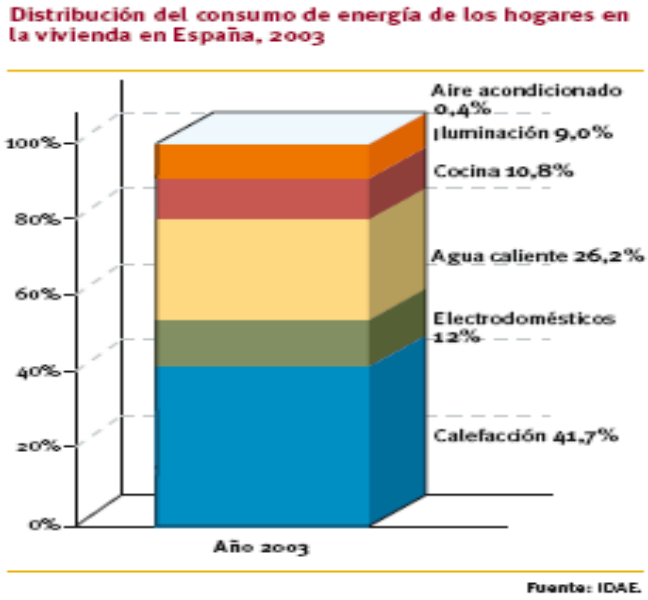
The remaining consumption for electrical appliances (12%) and cookers (10.8%) is analyzed in the section relating to Domestic Equipment. Logically, these percentages

varied from one climatic zone to another, the impact of heating being much less in warm zones and that of air-conditioning greater, and viceversa.

It should be emphasized, in this section, how thermal installations in houses (heating and hot water) represent two thirds of energy consumption in the home.

Also interesting is the comparison of distribution of energy consumption in heating an average Spanish home with that of a European home. The Spanish climate, less harsh in winter, accounts for the fact that the Spanish percentage of heating consumption, with respect to the total for the home, is 41.7% as against 67.9% for the European.

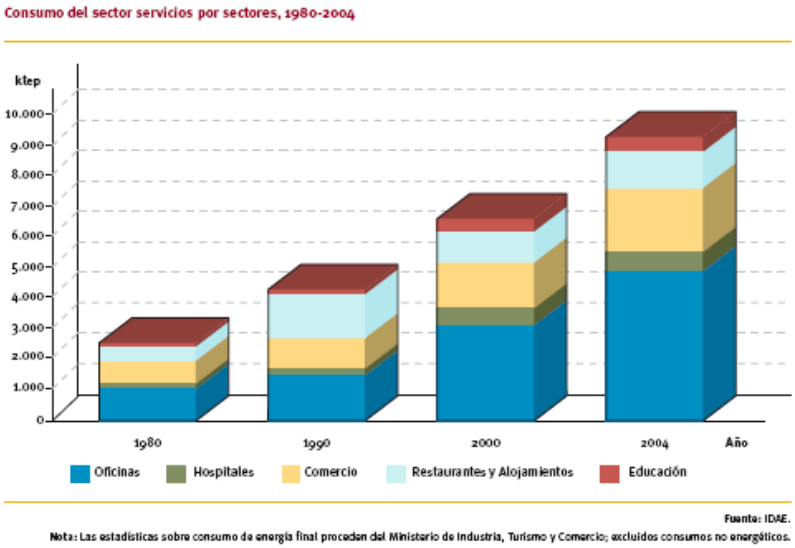
Graph 9.1. Distribution of consumption in homes



Key: Distribution of energy consumption in Spanish homes, 2003
Air-conditioning 0.4%
Lighting 9.0%
Cookers 10.8%
Hot water 26.2%
Electrical appliances 12%
Heating 41.7% Source: IDEA
Year 2003

As regards buildings with uses other than residential, those used for administrative purposes have the greatest impact on energy consumption in the tertiary sector, followed by buildings used for commerce, restaurants and accommodation, and health and education buildings.

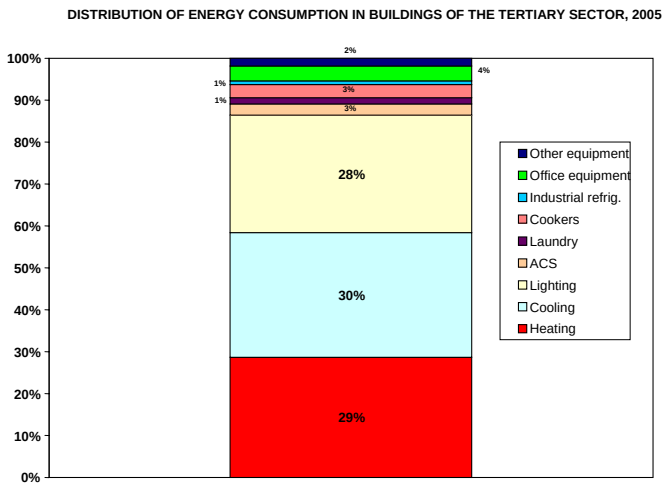
Graph 9.2.



Key: Consumption of the services sector, per sector, 1980-2004
Offices Hospitals Commerce Restaurants & Accommodation Education
Note: Final energy consumption statistics originate from Ministry of Industry, Trade and Tourism, excluding non-energy consumption.

Taking note of the distribution of consumption between sectors of the above buildings for the tertiary sector, and its specific distribution of consumption by use, the average distribution of energy consumption per use for the buildings of the tertiary sector is obtained by weighting and is given in the following graph.

Graph 9.3.



The three most significant consumers accounting for 87% of the sector's energy consumption are: cooling (30%), heating (29%) and lighting (28%). Office equipment (4%) and hot water (3%) follow by some distance.

As regards the regulatory framework concerning energy efficiency in buildings, in accordance with same, buildings must be planned, constructed, maintained and conserved such as to meet a series of basic requirements. Among these are the basic requirements of saving energy, as laid down in Law 38/1999 of 5 November on Building Planning (LOE).

This energy-saving requirement is developed in turn in the Technical Building Code (CTE) approved by Royal Decree 314/2006 of 17 March. The CTE contains five basic requirements in its 'Basic Energy-Saving Document'. Three of these five requirements specifically relate to this Action Plan. In fact, one of them relates to the limitation of the demand for energy for heating and cooling, and the other two determine the output for thermal installations and the internal lighting of buildings.

This new regulatory framework came into force in 2006, during the effective period of the 2005-2007 Action Plan, as a partial transposition of Directive 2002/91/EC on the energy efficiency of buildings. Approval is pending for the revision of the Regulation concerning Thermal Installations in Buildings (RITE) which will contain the obligation to carry out periodical inspections of energy efficiency in installations for heating, cooling and production of hot water.

Moreover, at the beginning of 2007, Royal Decree 47/2007 of 19 January was published, giving approval to the Basic Procedure for the Certification of Energy Efficiency in Newly Constructed Buildings, compliance with which becomes obligatory 9 months after its publication in the BOE (Official Bulletin). From that time on, new buildings above a certain size that are built or rehabilitated will be obliged to offer the buyer or user the energy rating of same, using a scale of 7 letters which ranges from Class A, for the most efficient, to Class G, for the least.

The above regulation, both with regard to the new minimum energy-efficiency requirements and the obligation to provide information to the buyer on the energy efficiency of the building by way of energy certification, introduces greater demands on this sector, the first results of which will begin to be seen during the effective period of the new 2008-2012 Action Plan.

Energy trends in the sector

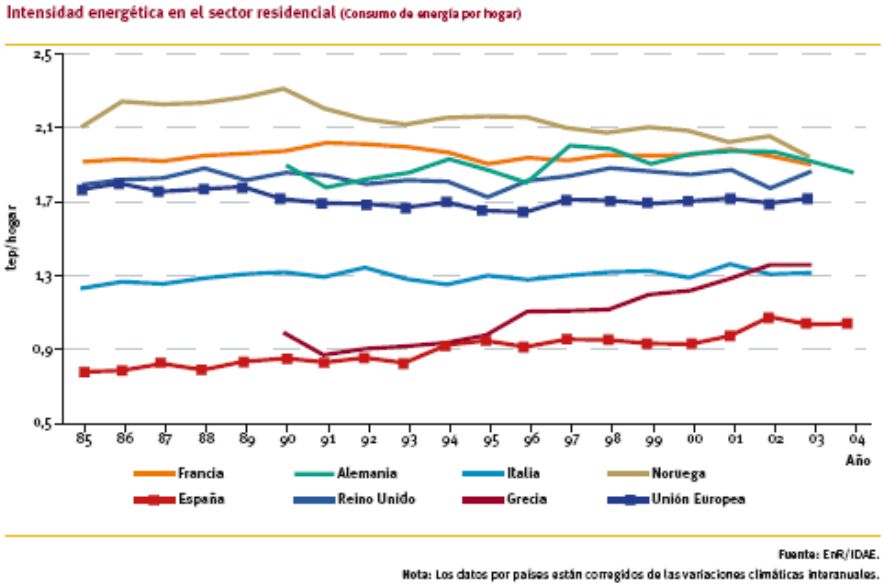
Analysis of all the statistical data available shows that growth in the surface area covered by buildings in Spain during the period 1990-2005 was 143%, that is to say, this sector experienced average annual growth during this period of 9.5%, while growth in final energy consumption was 4.8%, in the same period, i.e. the energy consumption of this sector is increasing by half the built surface area.

It should be borne in mind that the percentage of built surface area as housing is higher than the remaining uses, and only two out of three houses are intended as principal dwellings, many houses being used as secondary residences. Therefore, it can be concluded that the growth in energy consumption is not proportional to the growth in built surface area, which is why this variable cannot be taken into account as the sole figure in the prediction of consumption in this sector.

If we compare energy intensity in the Spanish residential sector with other representative countries of the European Union, we observe that the energy intensity of the residential sector expressed in tep/home in Spain is approximately 60% of the

European average, which corresponds closely to figures for other Mediterranean countries, such as Greece or Italy.

Graph 9.4.



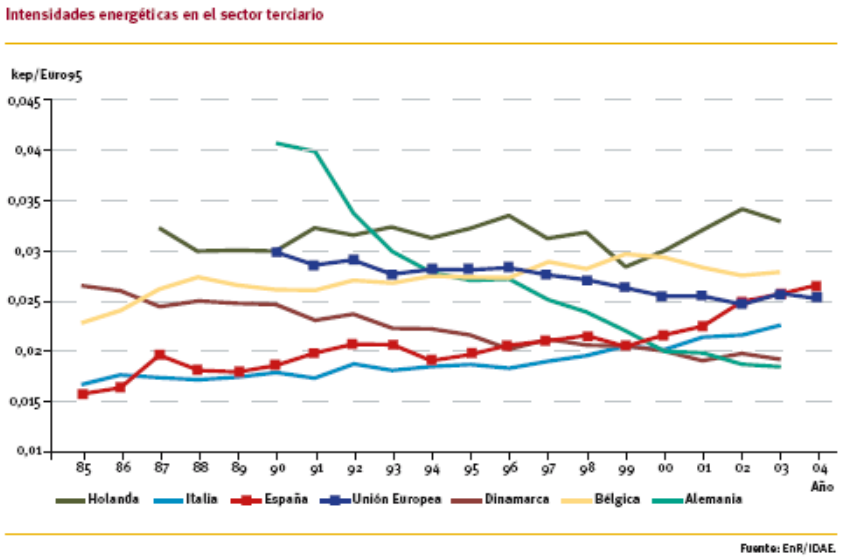
Key: Energy intensity in the residential sector (Energy consumption per home)

France	Germany	Italy	Norway
Spain	U.K.	Greece	European Union

Note: Data for countries are corrected by year-on-year climatic variations

If we compare the energy intensity in the tertiary sector and, therefore, of buildings of the tertiary sector with the European average, we observe that the values for energy intensity in the tertiary sector in Spain are within the European average.

Graph 9.5.



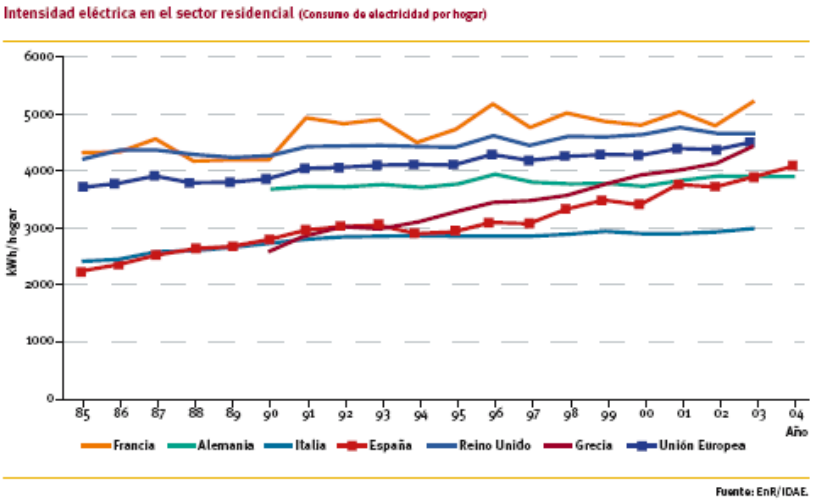
Key: Energy intensities in the tertiary sector

Holland Italy Spain European Union Denmark Belgium Germany

Both residential and domestic sectors share a common feature, irrespective of the energy intensity of the sector, in that their electricity intensity in both cases is high,

as can be seen from the following graphs. In the residential sector, it is slightly below the average of the European Union. One specific reason would be the Spanish climate. In cold climates the demand for heating is covered by centralized boiler installations which use fuel, such as natural gas and diesel. However, in a warm climate, such as in Spain, a high percentage of houses do not have fixed heating installations, individual or collective, and use appliances (in many cases electric radiators) which make the consumption of electricity for heating significant.

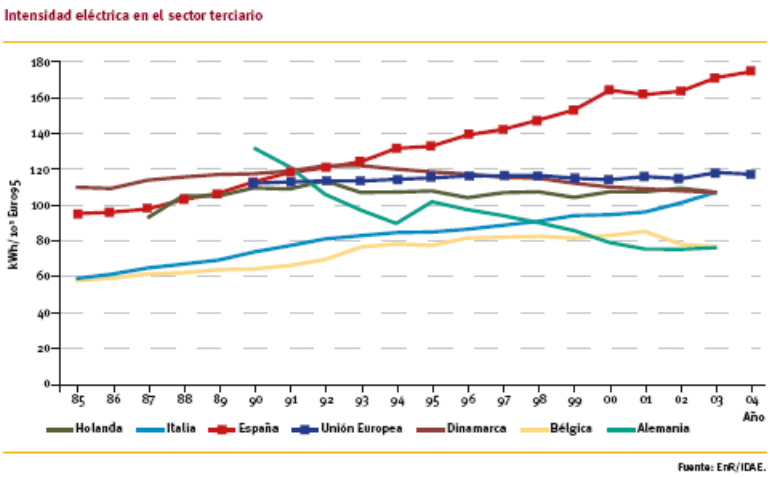
Graph 9.6.



Key: Electricity intensity in the residential sector (Electricity consumption per home)
France Germany Italy Spain U.K. Greece European Union

In the tertiary sector the electricity intensity is much higher than that for the residential sector. Climate also plays an important role here. A climate such as the Spanish climate makes the demand for cooling of buildings in the tertiary sector significant, while in cooler countries, demand is focussed on heating, which can be covered by fuel. However, in our country, for a good part of the year, it is necessary to use refrigeration technologies which require a high consumption of electricity.

Graph 9.7.



Key: Electricity intensity in the tertiary sector
Holland Italy Spain European Union Denmark Belgium Germany

Objectives

The assessment of the objectives of the new 2008-2012 Action Plan will be made on the basis of the E4 **with inclusion of actual data obtained from the sector between 2000 and 2006**. At a later date, an analysis will be carried out, including additional measures as part of energy saving and diversification, the final objective of which will be the reduction of emissions.

Finally, in this section, a comparison between both scenarios will be made.

a) Planning within the framework of the E4.

Definition of the objectives of the Saving and Energy Efficiency Action Plan (PAEE) for the period 2008-2012 must be based on the objectives established in due course in the E4 2004-2012 Strategy, and in the results of the previous PAEE 2005-2007.

In accordance with the above, the scenario set out for this sector for the period 2008-2012 is summarized in the following table:

Table 9.3. Scenario set out in the 2008-2012 Action Plan

(ktep)	2008	2009	2010	2011	2012	TOTAL
						2008/2012
Baseline Scenario E4	20,277	21,057	21,868	22,710	23,584	
Efficiency Scenario E4	19,528	20,052	20,425	21,193	21,811	
Saving Objective E4	749	1,005	1,261	1,517	1,773	6,305
% Saving on Baseline Scenario	3.7%	4.8%	5.8%	6.7%	7.5%	
Emissions of CO_2 avoided (kt.)	4,282	5,762	7,242	8,722	10,201	36,210

Source: IDAE

Consequently, in 2012 the annual saving to be achieved would be 1,773 ktep, equivalent to 7.5% of the consumption forecast in the Baseline Scenario of the E4. The cumulative saving in the period of the PAEE 2008-2012 would be 6,305 ktep.

The action measures considered as part of the E4 to achieve the estimated saving have as their objective the improvement of the energy efficiency of buildings and their fixed installations, as well as making more efficient use of same, aimed at existing buildings and new buildings. They are the following:

- Rehabilitation of the thermal envelope of existing buildings: the objective of this measure is to reduce the energy demand for heating and cooling in the existing buildings sector by application of energy-efficiency criteria in the rehabilitation of their thermal envelope.

- Improvement in the energy efficiency of existing thermal installations: the energy actions considered within this measure will be those that allow for a reduction in the consumption of conventional energy, by way of actions on their installations. Energy actions could mean replacement of heat-production or refrigeration equipment, replacement of fluid-movement equipment, use of free cooling systems through external air and recovery of heat from exhaust air.

- Improvement in the energy efficiency of existing internal lighting plants: energy actions included within this measure will be those that allow for a reduction in the consumption of conventional energy in the internal lighting of buildings, by way of actions on their plant. These actions could mean replacement of lights, bulbs and equipment, installation of switch control systems and regulation of light levels taking advantage of natural light, and a change of lighting system.

- Regulatory measures concerning the transposition of Directive 2002/91/EC on the energy efficiency of buildings: this measure, already implemented, consisted of promoting the approval of legislation and regulations with the aim of achieving transposition of the abovementioned directive.

b) Planning with additional effort associated with reduction of emissions.

The PAEE 2008-2012, in addition to achieving the energy-saving objectives laid down by the E4 2004-2012, would have to make a greater effort to achieve the objectives of the National Allocation Plan PNA 2008-2012. However, the PNA II does not assign a disaggregate objective for the Buildings Sector.

Achievement of the E4 as per the terms under which it was approved, not taking account of the later objectives incorporated by the PNA, means a final energy saving in 2012 of 1,773 ktep/year. From this figure, the PNA assumes incorporation of new measures the effects of which will be added to those indicated in the E4 itself. The analysis below shows the additional effort that will have to be made by this sector between the Efficiency Scenario of the E4 and the Objective Scenario of the PNA II.

Table 9.4.

	Baseline Scenario	Efficiency Scenario E4		E4+		Scenario Difference	
		2012	2008-2012	2012	2008-2012	2012	2008-2012
Final energy consumption (ktep)	23,584	21,811	103,191	21,194	101,560	-617	-1,631
Average growth (annual rate)	4.1%		2.6%		2.5%		-0.1%
Saving on Baseline scenario E4 (ktep)		1,773	6,305	2,390	7,936	617	1,631
Emissions avoided (ktCO_2)		7,581	26,972	10,625	35,540	3,034	8,575,932
Associated investments (k€)			7,893,545		13,469,477		5,575,932
Public support (k€)			516,405		803,671		287,266

In other words, this sector could contribute significantly to the achievement of the objectives of the PNA. These figures mean an additional saving in the buildings sector, on top of that forecast in the efficiency scenario of the E4, of 617 ktep/year in final energy; that is, an increase of 39% in the saving objectives of the E4. The additional measures proposed on top of those already laid down in the E4 are given in the following table:

Additional measures on top of those laid down in the E4:

- Measure: "Improvement of the energy efficiency of internal lighting plants in existing buildings". The energy objective laid down in the E4 is expanded. Specifically, it is proposed to replace 34 million bulbs in the residential sector and to take action on 30% of the lit surface area in the tertiary sector, as against the objectives of the E4 which were to replace 19 million bulbs and to act on 21% of the lit surface area.

- Measure: "Promotion of the construction of new buildings and rehabilitation of existing buildings with high energy rating". It is proposed that 17% of the new surface area constructed as buildings should have a high energy rating, Class A or B, for which a line of aid is provided.

- Measure: "Revision of the energy requirements in the building regulations". The requirements established in the Technical Building Code would be expanded. In addition, according to the provisions of the Directive 2002/91/EC, a basic procedure for energy certification of existing buildings will have to be approved by Royal Decree.

The scenario provided by the PAEE 2008-2012, taking account of the objectives of the E4 and the PNA II, would be that which is given in the following table for each year of this period.

Table 9.5. Scenario set out in the PAEE 2008-2012 and PNA (2008-2012)

	MEASURES	Action Plan 2008-2012					
		Investment	Public Support	Primary Energy Saving (ktep)		Emissions of CO2 avoided (ktCO2)	
		(Thousand Euro)		2012	2008-2012	2012	2008-2012
1	REHABILITATION OF THE ENVELOPE OF EXISTING BUILDINGS	2,677,295	175,150	606	2,176	1,458	5,232
2	IMPROVEMENT OF THE ENERGY EFFICIENCY OF THERMAL INSTALLATIONS OF EXISTING BUILDINGS	3,719,205	243,315	704	2,528	1,796	6,452
3	IMPROVEMENT OF THE ENERGY EFFICIENCY OF INTERNAL LIGHTING PLANT OF EXISTING BUILDINGS	2,694,681	176,292	1.396	5,010	4,999	17,937
4	PROMOTION OF CONSTRUCTION OF NEW BUILDINGS AND REHABILITATION OF EXISTING BUILDINGS WITH HIGH ENERGY RATING	3,969,362	208,914	658	1,973	1,774	5,322
5	REVISION OF ENERGY REQUIREMENTS IN THE BUILDING REGULATIONS	408,934	0	222	222	598	598
	TOTAL BUILDING	**13,469,477**	**803,671**	**3,585**	**11,908**	**10,625**	**35,540**

Note: Converstion factor used for the buildings sector: Primary E. = 1.5004 X Final E.

Source: IDAE

c) Differential assessment of the two plans

The inclusion of the objectives of the PNA II in the Buildings Sector requires an additional effort to the E4, as has been shown in the previous section. These new energy objectives mean:

- In measure 1, "Rehabilitation of the thermal envelope of existing buildings", the same objective is maintained as that laid down in the E4. It means, in itself, a very significant effort by taking action in 3.3% of existing buildings, when currently 0.2% of these buildings are being rehabilitated. The same public support is maintained as that for the E4.
- In measure 2, "Improvement of the energy efficiency of the thermal installations of existing buildings", the same objective as that provided for in the E4 is maintained. As in the previous measure, the E4 set out a very ambitious objective by taking action on 20% of thermal installations.
- In measure 3, "Improvement of the energy efficiency of internal lighting plant in existing buildings", the energy objective laid down in the E4 is expanded. Specifically, it is proposed to replace 34 million bulbs in the residential sector and to take action on 30% of the lit surface area in the tertiary sector, as against the objectives of the E4 which were to replace 19 million bulbs and to take action on 21% of the lit surface area.
- In measure 4, "Promotion of the construction of new buildings and rehabilitation of existing buildings with high energy rating", it is proposed that 17% of the surface area constructed as buildings should have a high energy classification, Class A or B, for which a line of aid is provided.
- Lastly, in measure 5, "Revision of energy requirements in building regulations", it is proposed to increase the requirements laid down in the Technical Building Code for new buildings or those which are rehabilitated. In addition, for existing buildings, and in accordance with the provision in Directive 2002/91/EC, it is proposed to approve by Royal Decree a basic procedure for energy certification of existing buildings.

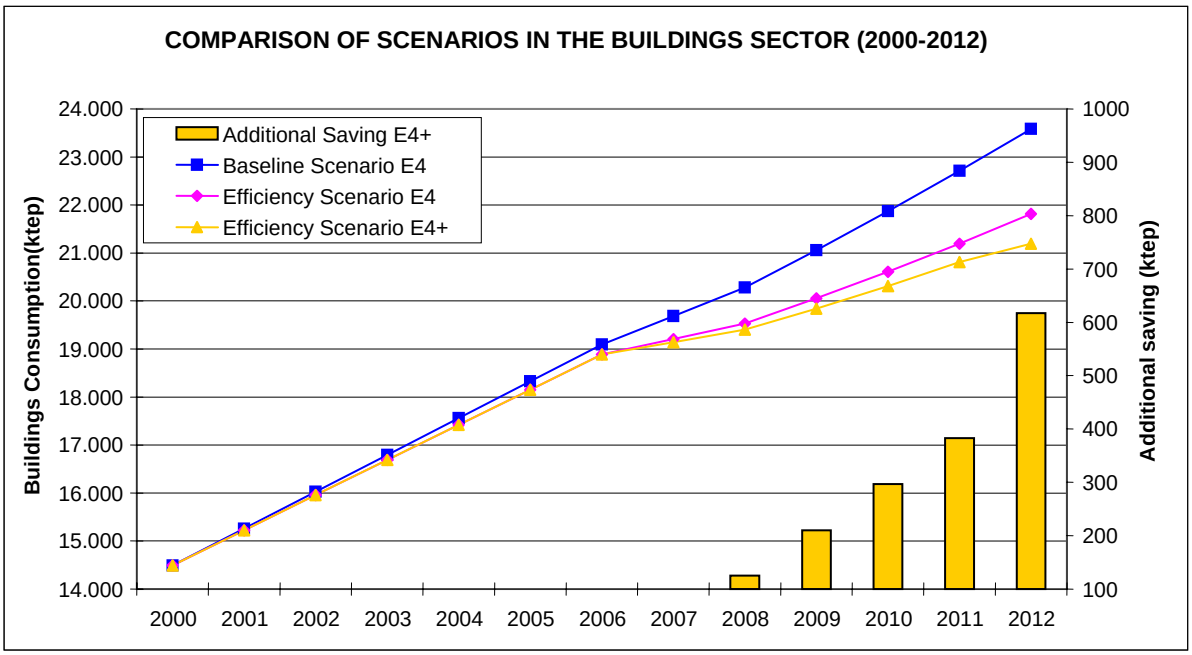
This additional boost to the measures defined in the previous Action Plan allows for a comparison to be made with the original objectives of the E4. The following table sets out these differences:

Table 9.6. Comparative Summary of E4 Corrected Efficiency Scenario and E4 + Efficiency Scenario (with additional measures)

	Efficiency Scenario E4		Scenario E4+		Scenario Difference	
	2012	2008-2012	2012	2008-2012	2012	2008-2012
Buildings Final Energy Consumption (ktep)	21,811	103,191	21,194	101,560	-617	-1,631
Average Consumption Growth		2.6%		2.5%		-0.1%
Savings on Baseline Scenario E4 (ktep)	1,773	6,305	2,390	7,936	617	1,631
Savings on Baseline Scenario E4 (%)	**5.8%**		**7.8%**			
• Measure 1	**23%**		**18%**			
• Measure 2	**26%**		**21%**			
• Measure 3	**29%**		**42%**			
• Measure 4	**22%**		**17%**			
• Measure 5	**0%**		**2%**			
Total Emissions Avoided ($ktCO_2$)	7,581	26,972	10,625	35,540	3,034	8,569
Associated Investments (k€)		7,893,545		13,469,477		5,575,932
Public Support (k€)		516,405		803,671		287,266

The difference between these comparative values can be seen in the following Table:

Graph 9.8.



In view of the objectives set out in the National Allocation Plan 2008-2012, application of these additional measures would translate into a greater reduction of CO_2 emissions in 2012, assessed as 8.6 Mt.CO_2, 32% more than the objectives defined by the E4 efficiency scenario.

9.2 Measures

MEASURE 1: Rehabilitation of the thermal envelope of existing buildings

Objective:

The objective of this measure is to reduce the energy demand in heating and cooling in the existing buildings sector by application of energy efficiency criteria in the rehabilitation of their thermal envelope.

Description:

The thermal envelope of the building means, for the purposes of application of this measure, that which makes up the enclosures of the building which separate the inhabitable areas from the external environment (air, land or another building) and the internal partitions which separate the inhabitable areas from the uninhabitable areas, which are in turn in contact with the external environment.

Energy actions concerning the thermal envelope may involve conventional and unconventional constructive solutions. Conventional constructive solutions mean those habitually used in buildings to reduce their energy demand, such as, for example, those which involve façades, covers, external carpentry, glazing and solar

shields. Unconventional constructive solutions are those usually known as 'bioclimatic architecture' measures, such as, for example: Trombe walls, parietodynamic walls, attached greenhouses, shading systems, natural ventilation, etc.

The minimum energy efficiency requirements to be met by the thermal envelope undergoing rehabilitation are those considered in the document HE1, Limitation of Energy Demand, of the Technical Building Code.

Improvement of the global energy efficiency of an existing building does not necessarily mean total renovation of the building, but rather that it may be limited to those parts which are more important for the energy efficiency of same and are suitably cost-effective.

In order to boost this measure for rehabilitation of the thermal envelope of buildings, the following actions will be carried out:

- A line of economic support will be created annually which will be managed by each Autonomous Community and will contribute towards the economic viability of this measure.
- Public Administrations will be encouraged to play an exemplary role in the energy renovation of their thermal envelope.
- A new Housing Plan will be drawn up, by the Ministry of Housing, aimed at the urban rehabilitation and regeneration of cities, in order to replace existing housing in certain areas of cities with a deficit in energy quality and efficiency with more efficient housing of better quality and with better urban spaces. At the same time that existing housing is improved, occupation of new land would also be avoided, which entails higher building and transport costs, as well as the use of a natural resource such as the land.

Responsibility and Collaborators:

Responsible:

Autonomous Communities.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE.

Costs, energy savings and CO_2 emissions avoided:

Table 9.9.

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	35,030	35,030	35,030	35,030	35,030	175,150
Energy savings (ktep)	176	233	290	347	404	1,450
CO_2 emissions avoided ($ktCO_2$)	635	841	1,046	1,252	1,458	5,232

MEASURE 2: Improvement of the energy efficiency of the thermal installations of existing buildings

Objective:

The objective of this measure is to reduce the energy consumption of the existing thermal installations of buildings.

Thermal installations mean climatization plants (heating, cooling and ventilation) and hot water production plants intended to meet the demand for the thermal comfort and wellbeing of people in existing buildings.

Description:

The energy actions considered within this measure will be those which allow for a reduction of conventional energy consumption, by way of actions on their installations. The energy actions may, as a guideline and not exhaustively, be the following:

- Replacement of heat-production and refrigeration equipment by other equipment selected for its higher energy output
- Replacement of equipment moving carrier fluids with other equipment with a higher energy output
- Use of free cooling systems through external air and heat recovery from exhaust air

The minimum energy-efficiency requirements to be met by the installation undergoing rehabilitation are those given in the current regulations.

In order to boost this measure for rehabilitation of the thermal installations of buildings, the following actions will be carried out:

- A line of economic support will be created annually which will be managed by each Autonomous Community and will contribute towards the economic viability of this measures.
- Public Administrations will be encouraged to play an exemplary role in the energy renovation of their thermal installations.
- The revision of the Regulation concerning Thermal Installations of Buildings (RITE), which governs the minimum energy-efficiency requirements of these installations, will incorporate the obligation imposed by Directive 2002/91/EC to inspect periodically the boilers and air-conditioning systems of buildings and the entire thermal installation when this is over 15 years old, and to give advice by way of recommendations to users on improving their energy output.

Responsibility and Collaborators:

Responsible:

Autonomous Communities.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE.

Costs, energy savings and CO_2 emissions avoided

Table 9.10.

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	48,663	48,663	48,663	48,663	48,663	243,315
Energy savings (ktep)	205	271	337	403	469	1,685
CO_2 emissions avoided ($ktCO_2$)	785	1,038	1,290	1,543	1,796	6,452

MEASURE 3: Improvement of the energy efficiency of internal lighting plants in existing buildings

Objective:

The objective of this measure is to reduce the energy consumption of existing internal lighting plants.

Description:

The energy actions included in this measure will be those which allow for a reduction of conventional energy consumption in the internal lighting of buildings by way of actions on their installations. These actions may, as a guideline and not exhaustively, be the following:

- Lights, bulbs and equipment: replacement of the whole set by another with lights with higher output, more efficient bulbs and adjustable electronic reactance which allows for reduction of the installed capacity in lighting, meeting the regulatory quality and visual-comfort requirements. In particular, the replacement of incandescent bulbs by low-consumption bulbs is under consideration.

- Switch control systems and regulation of lighting level: these will include motion-sensor control systems and regulation of lighting level according to the contribution of natural light, achieving an electricity saving as compared with plant without control or regulation.

- Change of lighting system: relocation of the light points using the above technologies so as to reduce electricity consumption as compared with the current lighting system.

The minimum energy-efficiency requirements to be met by the lighting plants undergoing rehabilitation are those considered in document HE3, Energy Efficiency of Lighting Plant, of the Technical Building Code.

In order to boost this measure for rehabilitation of the internal lighting plant of buildings, the following actions will be carried out:

- A line of economic support will be created annually which will be managed by each Autonomous Community and will contribute towards the economic viability of this measure.
- Public Administrations will be encouraged to play an exemplary role in the energy renovation of their internal lighting plant.

Responsibility and Collaborators:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE

Costs, energy savings and CO_2 emissions avoided:

Table 9.11.

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	35,258	35,258	35,258	35,258	35,258	176,292
Energy savings (ktep)	405	536	668	799	931	3,339
CO_2 emissions avoided ($ktCO_2$)	2,176	2,879	3,588	4,292	5,002	17,937

MEASURE 4: Promotion of construction of new buildings and rehabilitation of existing buildings with high energy rating.

Objective:

The objective of this measure is to promote and incentivize the construction of new buildings and rehabilitation of existing buildings with high energy rating.

Royal Decree 47/2007 of 19 January, which approves the Basic Procedure for the Certification of the Energy Efficiency of Buildings, establishes the obligation to make an energy-efficiency certificate available to buyers or users of buildings.

This affects all newly constructed buildings and the modification, alteration or rehabilitation of existing buildings, with a usable surface area of more than 1,000 m^2 where more than 25 percent of their total enclosures are renewed.

The energy-efficiency certificate will have to include objective information on the energy features of the buildings, such that their energy efficiency can be assessed and compared, with the aim of encouraging the promotion of buildings with high energy efficiency and investment in energy saving. The energy-efficiency rating assigned to the building is expressed by a scale of seven letters, from A (most efficient building) to G (least efficient building).

Description:

This measure deals with promoting the construction or rehabilitation of buildings which obtain the maximum energy rating, Classes A and B. In order to boost this measure, the following actions will be carried out:

- A line of economic support will be created annually for buildings which obtain a high energy rating, Classes A and B, which will be managed by each Autonomous Community and will contribute to the economic viability of this measure.
- Public Administrations will be encouraged to play an exemplary role in the construction and rehabilitation of their buildings and in those that they promote.
- A new Royal Decree will be approved which governs energy certification for existing buildings and complements Royal Decree 47/2007/CE for new buildings.
- In addition, the construction of buildings with a high energy rating may be incentivized, for example, by way of tax measures or an increase in the volume of development potential by the competent administrations.

Responsibility and Collaborators:

Responsible:

Autonomous Communities and Local Administration.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE.

Costs, energy savings and CO2 emissions avoided:

Table 9.12

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	41,783	41,783	41,783	41,783	41,783	208,914
Energy savings (ktep)	88	175	263	351	438	1,315
CO_2 emissions avoided ($ktCO_2$)	356	708	1,065	1,421	1,772	5,323

MEASURE 5: Revision of energy requirements in the building regulations

Objective:

The objective of this measure is to increase the requirements established in the Technical Building Code for new buildings or those which are rehabilitated. In addition, for existing buildings, according to the provision in Directive 2002/91/EC, it is proposed to approve by Royal Decree a Basic Procedure for Energy Certification of Existing Buildings.

Description:

Directive 2002/91/EC, on energy efficiency of buildings, states that the minimum energy-efficiency requirements for new and existing buildings set out in the regulations must be reviewed periodically at intervals of no more than 5 years, and where necessary, updated, with the aim of adapting them to the technical advances of the construction sector.

These minimum energy-efficiency requirements for buildings are contained in the Basic Energy-Saving Document of the Technical Building Code. During the effective period of this Plan, it will be reviewed through the body set up for this purpose by Royal Decree 315/2006, as is the Council for Sustainability, Innovation and Quality of Buildings, within which a working group will have to be created to analyze current requirements and propose new technically and economically viable requirements compatible with the targeted energy and environmental objectives.

Moreover, according to Directive 2002/91/EC, a procedure for energy certification of existing buildings will have to be approved which complements Royal Decree 47/2007, by which a basic procedure for certification of energy efficiency of newly constructed buildings and rehabilitated buildings is approved.

The deadline for these revisions to come into force is 1 January 2010 for the Technical Building Code, and 1 January 2009 for the energy certification of existing buildings. The above would begin to have effects attributable to energy saving in this plan, considering the time necessary for the materialization of the projects as from 2012, for new and rehabilitated buildings, as well as in existing buildings.

Responsibility and Collaboration:

Responsible:

Ministry of Housing and Ministry of Industry, Trade and Tourism.

Collaborators:

Autonomous Communities and IDAE.

Costs, energy savings and CO2 emissions avoided:

Table 9.13.

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	0	0	0	0	0	0
Energy saving (ktep)	0	0	0	0	148	148
CO_2 emissions avoided ($ktCO_2$)	0	0	0	0	598	598

9.3. Summary of costs and benefits by measure

Table 9.14.

	Measure	Energy Savings (ktep)						Emissions Avoided (ktCO)						Public Support (k€)						Investment (k€)					
		2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total
1	REHABILITATION OF THE ENVE LOPE OF EXISTING BUILDINGS	176	233	290	347	404	**1,450**	635	841	1,046	1,252	1,458	**5,232**	35,030	35,030	35,030	35,030	35,030	**175,150**	535,459	535,459	535,459	535,459	535,459	**2,677,295**
2	IMPROVEMENT OF THE ENERGY EFFICIENCY OF THERMAL INSTALLATIONS OF EXISTING BUILDINGS	205	271	337	403	469	**1,685**	785	1,038	1,290	1,543	1,796	**6,452**	48,663	48,663	48,663	48,663	48,663	**243,315**	743,841	743,841	743,841	743,841	743,841	**3,719,205**
3	IMPROVEMENT OF THE ENERGY EFFICIENCY OF INTERNAL LIGHTING PLANTS OF EXISTING BUILDINGS	405	536	668	799	931	**3,339**	2,176	2,882	3,587	4,293	4,999	**17,937**	35,258	35,258	35,258	35,258	35,258	**176,292**	538,936	538,936	538,936	538,936	538,936	**2,694,681**
4	PROMOTION OF CONSTRUCTION OF NEW BUILDINGS AND REHABILITATION OF EXISTING BUILDINGS WITH HIGH ENERGY RATING	88	175	263	351	438	**1,315**	355	710	1,064	1,419	1,774	**5,322**	41,783	41,783	41,783	41,783	41,783	**208,914**	793,872	793,872	793,872	793,872	793,872	**3,969,362**
5	REVISION OF ENERGY REQUIREMENTS IN BUILDING REGULATIONS	0	0	0	0	148	**148**	0	0	0	0	598	**598**	0	0	0	0	0	**0**	0	0	0	0	408,934	**408,934**
	Total sector	874	1,216	1,558	1,900	2,390	**7,936**	3,950	5,469	6,989	8,508	10,625	**35,540**	160,734	160,734	160,734	160,734	160,734	**803,671**	2,612,109	2,612,109	2,612,109	2,612,109	3,021,043	**13,469,477**

Table 9.15.

	Buildings Sector	ENERGY SAVINGS 2008-2012						EMISSIONS AVOIDED 2008-2012 (ktCO2)		
		FINAL (ktep)			PRIMARY (ktep)					
		DIRECT	OTHER ORIGINS	Final Total	DIRECT	OTHER ORIGINS	Final Total	DIRECT	OTHER ORIGINS	Final Total
1	REHABILITATION OF THE ENVELOPE OF EXISTING BUILDINGS	1,450	0	1,450	2,176	0	2,176	5,232	0	5,232
2	IMPROVEMENT OF THE ENERGY EFFICIENCY OF THERMAL INSTALLATIONS OF EXISTING BUILDINGS	1,685	0	1,685	2,528	0	2,528	6,452	0	6,452
3	IMPROVEMENT OF THE ENERGY EFFICIENCY OF INTERNAL LIGHTING PLANTS OF EXISTING BUILDINGS	3,339	0	3,339	5,010	0	5,010	17,937	0	17,937
4	PROMOTION OF CONSTRUCTION OF NEW BUILDINGS AND REHABILITATION OF EXISTING BUILDINGS WITH HIGH ENERGY RATING	1,315	0	1,315	1,973	0	1,973	5,322	0	5,322
5	REVISION OF ENERGY REQUIREMENTS IN BUILDING REGULATIONS	148	0	148	222	0	222	598	0	598
	Total sector	**7,936**	**0**	**7,936**	**11,908**	**0**	**11,908**	**35,540**	**0**	**35,540**

9.4 Economic benefits

- Energy origin

  Assessment ratio 1 tep of primary energy - 480 €

- CO_2 origin

  Assessment ratio 18 €/Tn CO_2

Table 9.16.

	Economic benefits (k€)					
	2008	2009	2010	2011	2012	Total
Energy origin	629,196	875,537	1,121,879	1,368,221	1,720,940	**5,715,773**
Origin CO_2 avoided	71,107	98,451	125,793	153,137	191,241	**639,729**
Total sector	700,303	973,988	1,247,672	1,521,358	1,912,181	**6,355,502**

9.5 Assessment of results.

Two indicators will be used, one for the residential sector and the other for the tertiary sector, which are traditional in this sector and are common to both the Buildings sector and the Domestic and Office Equipment sector. They are energy intensity in the residential sector and energy intensity in the tertiary sector. The data source is EnR (Renewable Energy)/IDAE.

- Energy intensity in the residential sector. It is expressed as energy consumption per home in tep/home. Its value for the baseline year of the E4 (2004) is 1.04 tep/hour.

- Energy intensity in the tertiary sector. It is expressed as energy consumption per employee. Its value for the baseline year of the E4 (2004) is 0.81 tep/employee.

BLOCK OF MEASURES	PARAMETERS	BASELINE SCENARIO	EFFICIENT SCENARIO E4	EFFICIENT SCENARIO E4+
A. EXISTING BUILDINGS	Tep/home and Tep/employee	0.91 Tep/home & 0.73 Tep/employee	0.84 Tep/home & 0.67 Tep/employee	0.82 Tep/home & 0.66 Tep/employee
B. NEW BUILDINGS	Auton. Community Energy Certificates	-	0% surf.area built	17% surf.area Built with Class A.

MEASURE 1: Rehabilitation of the thermal envelope of existing buildings

The indicator to be used for measuring the results of this measure will be the development of the annual energy consumption of buildings per unit of surface area, expressed as tep/m^2, by way of an indicator for the thermal envelope of the housing sector and another for the buildings of the tertiary sector, according to their uses (administrative, commercial, etc.).

As a specific indicator of the results of this Plan, the annual final energy saving will be used in buildings coming under same through the rehabilitation of their thermal envelope, expressed as tep of saving per unit of rehabilitated surface area.

MEASURE 2: Improvement of the energy efficiency of thermal installations of existing buildings

The indicators to be used for measuring the results of this measure will be the units of heating, climatization and hot-water production equipment sold according to the energy efficiency class of their energy label.

A second indicator will be the development of annual energy consumption for the climatization of buildings per unit of surface area, expressed in tep/m^2, by way of an indicator for the housing sector and another for the tertiary buildings sector, according to their uses (administrative, commercial, etc.).

As a specific indicator of the results of this Plan, the annual final energy saving will be used in buildings coming under same through the improvement of the energy

efficiency of their thermal installations, expressed as tep of saving per unit of surface area.

MEASURE 3: Improvement of the energy efficiency of the internal lighting plant in existing buildings.

The indicators to be used for measuring the results of this measure will be the units of lighting equipment sold according to the energy efficiency of its energy label.

A second indicator will be the development of annual energy consumption for the lighting of buildings per unit of surface area, expressed as tep/m^2, by way of an indicator for the housing sector and another for the tertiary buildings sector, according to their uses (administrative, commercial, etc.).

As a specific indicator of the results of this Plan, the annual final energy saving will be used in buildings coming under same through the improvement of the energy efficiency of their lighting plant, expressed as tep of saving per unit of surface area.

MEASURE 4: Promotion of the construction of new buildings and rehabilitation of existing buildings with high energy rating.

The measurement of the energy saving of this measure will be taken from the energy efficiency certificates governed by Royal Decree 47/2007 of 19 January, provided by the bodies officially appointed by the Autonomous Communities for their control. The indicator used will be the level of energy rating, expressed by the scale of seven letters, from A to G, according to the official scale of Annex II of Royal Decree 47/2007, according to the uses of the buildings. That is to say, number of constructed buildings rated according to their level of energy efficiency.

10. DOMESTIC AND OFFICE EQUIPMENT SECTOR

10.1. Sector Position

Context:

The Residential and Office Equipment Sector includes, for the purposes of this Saving and Energy Efficiency Action Plan, the energy consumption of electrical appliances, including air-conditioners for domestic use of up to 12 kW of power and cookers and ovens, and office equipment in general, both in the residential sector and in the remaining sectors.

The final energy consumption of this sector rose in 2005 to 4,100 ktep against a national total of 106,940 ktep, which represents 3.8% of national final consumption. Of this consumption, 55% relates to electrical appliances, 28% to consumption from cookers, 14% to office equipment and the remainder to small air-conditioning units.

From the official data available on equipment in Spanish homes, as considered in the National Statistical Institute's (INE) ongoing survey of family budgets, an analysis has been carried out of the penetration of electrical appliances, cookers, and other equipment in our homes, a summary of which is given in the following table.

Table 10.1.

	DEVELOPMENT OF DOMESTIC EQUIPMENT				
	2000	2001	2002	2003	2004
Population (millions)	40.5	41.117	41.838	42.717	43.198
Homes (millions)	13.086	13.468	13.843	14.187	14.528
Electric cooker	23.13%	26.07%	28.26%	32.26%	34.88%
Non-electric cooker	62.70%	60.68%	60.09%	58.37%	56.11%
Dual cooker	15.76%	14.97%	13.38%	11.20%	10.56%
Fridge	99.47%	99.52%	99.58%	99.73%	99.69%
Freezer	28.08%	28.28%	30.54%	31.41%	31.37%
Washing-machine	97.70%	97.82%	97.99%	98.26%	98.62%
Dishwasher	24.56%	25.90%	28.95%	30.91%	32.61%
Microwave	54.28%	60.20%	63.96%	68.72%	73.40%
TV	99.16%	99.23%	99.30%	99.53%	99.71%
HI-FI	59.83%	61.09%	62.08%	62.78%	64.43%
Video	72.23%	73.44%	75.07%	75.23%	75.54%
PC	30.54%	33.53%	36.38%	41.49%	45.00%

Source: INE ongoing survey of family budgets and our own work.

It can be seen that the rates for the main energy-consuming equipment in homes amount to almost 100% of houses, as fridges, cookers, washing-machines or televisions.

On the other hand, the percentage of homes that rely on some kind of air-conditioning equipment in 2004 amounted to 25% of homes, according to data produced by the IDAE from the INE information. However, its use is clearly seasonal, linked to the climate (reducing its maximum use to some three months of the year) with marked differences per geographical area.

Another piece of equipment that is becoming an essential item in the home is the computer, an item with a low output per unit but with a high number of hours of usage.

Equipment with higher energy consumption in the home, such as fridges, freezers, washing-machines, dishwashers and ovens, carry an energy label which informs the buyer of their energy features. On the Spanish market, there is a wide variety of these electrical appliances with a Class A energy label or higher, according to circumstances, for the entire range of outputs and prices. For example, the IDAE database on the most efficient electrical appliances has records for 2,292 fridges and freezers, 1,465 washing-machines and 1,116 dishwashers from category A or higher, as appropriate.

Energy trends in the sector

The translation of the above data into energy consumption assumes that the average annual final energy consumption in this sector in the period 2000-2004 was 4.4%. Given that the equipment that has the higher energy consumption is present in practically all homes, the possibilities for improvement in energy efficiency in this sector would mainly be in the replacement of existing equipment by other equipment with greater energy efficiency.

Table 10.2

	DEVELOPMENT OF DOMESTIC EQUIPMENT (milllon units)				
	2000	2001	2002	2003	2004
Electrical appliances (millions)	70.1	73.5	77.2	80.4	83.6
Cookers (millions)	13.3	13.7	14.1	14.4	14.8
Office equipment (million PC´s)	13.5	14.2	14.9	15.9	16.7
Air-conditioning units (millions)	2.2	2.2	2.3	2.9	3.6
Average annual growth of domestic and office equipment (%)	**5%**				

	DEVELOPMENT OF FORECAST CONSUMPTION (KTEP/YEAR)				
Electrical appliances (millions)	1,848.0	1,938.1	2,035.8	2,120.5	2,205.2
Cookers (millions)	1,130.0	1,164.5	1,197.0	1,227.9	1,254.0
Office equipment (million PC´s)	461.0	484.2	507.4	542.6	569.4
Air-conditioning units (millions)	23.0	23.4	23.7	30.7	37.6
Total forecast consumption	3,462.0	3,610.2	3,763.9	3,921.7	4,066.2
Average annual growth of energy consumption (%)	**4.4%**				

Source: INE ongoing survey of family budgets and our own work.

Objectives

Assessment of the objectives of the new 2008-2012 Action Plan will be made on the basis of the E4 **with inclusion of the actual known data for the sector between 2000 and 2006**. At a later date, an analysis, including additional measures as part of the energy saving and diversification, will be carried out, the final objective of which will be the reduction of emissions.

Finally, in this section, a comparison between both scenarios will be made.

a) Planning as part of the E4.

Definition of the objectives of this new Saving and Energy Efficiency Action Plan (PAEE) for the period 2008-2012 must be based on the objectives established at the time in the E4 2004-2012 Strategy and on the results of the earlier plan PAEE 2005-2007.

According to the above, the forecast scenario for this sector for the period 2008-2012 is summarized in the following table:

Table 10.3. Forecast Scenario for Domestic and Office Equipment Sector PAEE 2008-2012

(ktep)	2008	2009	2010	2011	2012	TOTAL 2008/2012
Baseline Scenario E4	4,247	4,353	4,462	4,573	4,687	
Efficiency Scenario E4	4,090	4,133	4,179	4,227	4,278	
Saving Objective E4	207	220	283	346	409	1,464
% Saving on Baseline Scenario	4.83%	5.05%	6.34%	7.56%	8.7%	
Emissions of CO_2 avoided (kt.)	1,370	1,919	2,463	3,009	3,556	12,317

Source: IDAE

Therefore, in 2012 the annual saving to be obtained would be 409 ktep, equivalent to 8.7% of the consumption forecast in the Baseline Scenario of the E4. The cumulative saving in the period of the PAEE 2008-2012 would be 1,419 ktep.

The action measures considered for obtaining this saving have as their objective the improvement of the energy efficiency of existing domestic and office equipment, as well as making more efficient use of same. Two measures are proposed for this:

- Renovation Plan for electrical appliances.
- Saving and Energy Efficiency Plan in Public Administrations.

The Renovation Plan for electrical appliances is aimed at incentivizing the withdrawal of existing electrical appliances, which have a higher energy consumption, replacing them with others of Class A or above. These plans will be organized by the Autonomous Communities and include the following electrical appliances: fridges, freezers, washing-machines and dishwashers. The Renovation Plans carried out during 2006 and 2007 have succeeded in that most of the electrical appliances marketed are of efficiency Class A and B, a trend moving towards Class A during the effective period of the new PAEE. It is considered advisable to maintain these plans for renovation of domestic equipment by accelerating the introduction of more efficient equipment, which would be slower if the plans did not exist. These plans will be more effective if they are properly reinforced by training, information and awareness-raising campaigns aimed at consumers and retailers of electrical appliances.

The second measure considers the implementation of specific plans for Saving and Energy Efficiency aimed at the Public Administrations, in accordance with the provisions of Directive 2006/32/EC. These plans will include actions directed at the improvement of energy management of buildings and their installations, and assessment of energy efficiency criteria in the purchases that they make. The launch of these plans must be made using the technical and human resources that the Public Administration currently relies on, since they are measures aimed at improving the energy management of existing buildings and installations, which is why it is considered that there is no need to assume an increase in public expenditure.

b) Planning with additional effort associated with reduction of emissions.

The PAEE 2008-2012, as well as achieving the energy-saving objectives laid down by the E4 2004-2012, would have to make a greater effort to achieve the objectives of the National Allocation Plan PNA 2008-2012. However, the PNA II does not assign a disaggregate objective for the Domestic and Office Equipment Sector.

Accomplishment of the E4 under the terms in which it was approved, not taking account of the later objectives incorporated in the PNA, means a final energy saving in 2012 of 409 ktep/year. From this figure, the PNA assumes the incorporation of new measures the effects of which will be added to those indicated in the E4 itself. The additional effort that this sector will need to make between the Efficiency Scenario of the E4 and the Objective Scenario of the PNA II is analyzed below.

Table 10.4.

	Baseline Scenario	Efficiency Scenario E4		E4+		Scenario Difference	
		2012	2008-2012	2012	2008-2012	2012	2008-2012
Final energy consumption (ktep)	22,327	4,278	20,907	4,190	20,593	-88	-314
Average growth (annual rate)	2.1%		1.3%		0%		-1.3%
Saving on Baseline Scenario E4 (ktep)		409	1,415	497	1,729	88	314
Emissions avoided (ktCO_2)		2,197	7,601	2,670	9,288	473	1,686
Associated investments (k€)			1,577,775		1,992,235		414,460
Public support (k€)			532,500		532,500		0

Source: IDAE

Therefore, the new saving objective of the PAEE 2008-2012, which takes account of the indications of the National Allocation Plan for the Domestic and Office Equipment Sector, assumes an energy saving to be reached in 2012, on top of the Baseline Scenario of the E4, of 497 ktep/year and a cumulative saving in the period 2008-2012 of 1,729 ktep, with a reduction of CO_2 emissions in the five-year period 2008-2012 of 9 Mt. CO_2 through direct energy savings.

These figures mean an additional saving in the Domestic and Office Equipment Sector, on top of that forecast in the efficiency scenario of the E4, of 88 ktep/year in final energy, that is, an increase of 22% in the saving objectives of the E4. The additional measure proposed on top of that already provided for in the E4 is given in the following table:

Additional measures on top of that already provided for in the E4:

- Measure: "Renovation Plan for Electrical Appliances": the energy objective laid down in the E4 is expanded. Specifically, it is proposed to replace 2.5 million electrical appliances per year with others with an energy label of A or higher, as compared with the E4 objectives which were to replace 2 million electrical appliances.

The scenario provided by the PAEE 2008-2012, taking account of the objectives of the E4 and the PNA II, would be that given in the following table for each year of this period.

Table 10.5. SCENARIO FORECAST IN THE PAEE 2008-2012 AND PNA (2008-2012)

MEASURES		Action Plan E4+ 2008-2012					
		Investment	Public Support	Primary Energy Saving (ktep)		Emissions of CO2 avoided (ktCO2)	
		(Thousand Euro)		2012	2008-2012	2012	2008-2012
1	RENOVATION PLAN FOR ELECTRICAL APPLIANCES	1,992,235	532,500	956	3,409	2,272	8,106
2	PLAN FOR EQUIPMENT AND EFFICIENT USE OF ENERGY IN PUBLIC ADMINISTRATION	0	0	167	497	398	1,182
TOTAL DOMESTIC EQUIPMENT AND BUILDINGS		1,992,235	532,500	1,123	3,906	2,670	9,288

Note: Conversion factor used for Domestic and Office Equipment Sector: Primary E. = 2.259 X Final E.

Source: IDAE

c) Differential assessment of plans

The inclusion of the objectives of the PNA II in the Domestic and Office Equipment Sector requires an additional effort to the E4, as has been shown in the previous section. These new energy objectives assume:

- With regard to the energy saving objective of the Renovation Plan for Electrical Appliances, the number of replaced electrical appliances forecast in the E4 of 2 million/year increases to 2.5 million/year, with energy label Class A or higher, with no increase in public support, taking into consideration the effect induced in the market by this type of campaign or renovation plan.

- The Saving and Energy Efficiency Plan for the Public Administration continues with the objectives laid down for the period 2008-2012.

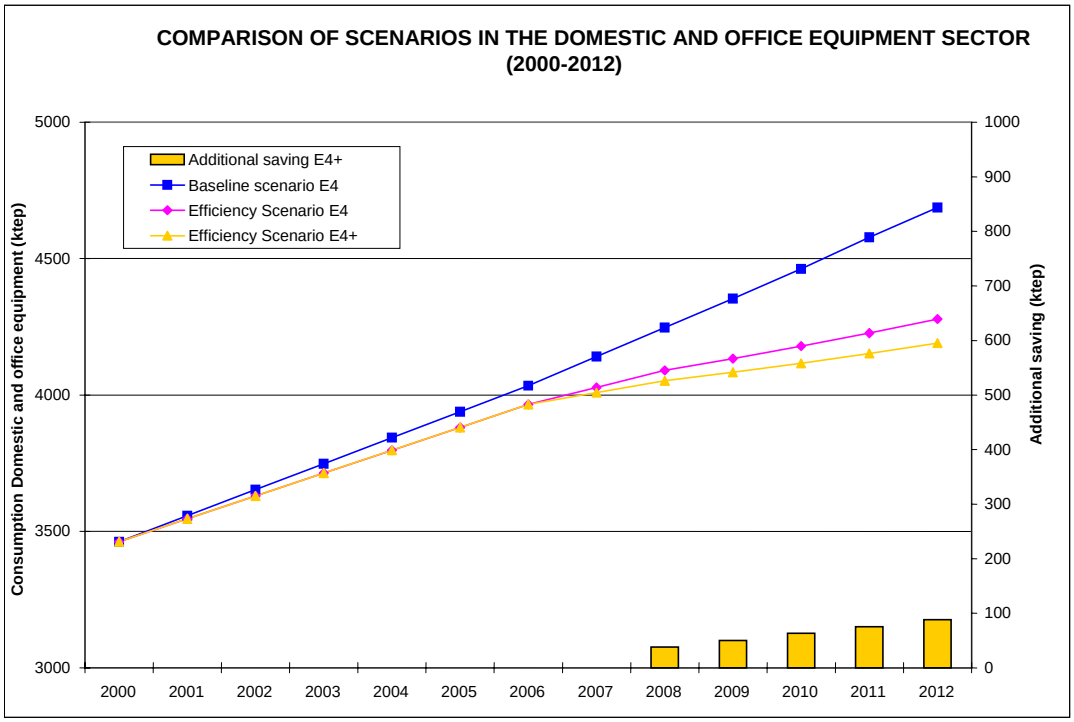
This additional boost to the measures defined in the previous Action Plan allows for comparison with the original objectives of the E4. The following table sets out these differences:

Table 10.6. SUMMARY OF COMPARISON OF E4 CORRECTED EFFICIENCY SCENARIO AND E4 + EFFICIENCY SCENARIO (with additional measures)

	Efficiency Scenario E4		Scenario E4+		Scenario Difference	
	2012	2008-2012	2012	2008-2012	2012	2008-2012
Final energy consumption Domestic and office equipment (ktep)	4,278	20,907	4,190	20,593	-88	-314
Average consumption growth		1.3%		0%		-1.3%
Savings on Baseline Scenario E4 (ktep)	409	1,415	497	1,729	88	314
Savings on Baseline Scenario E4 (%)	**6.4%**		**7.8%**			
• Measure 1	**85%**		**87%**			
• Measure 2	**15%**		**13%**			
Total Emissions avoided ($ktCO_2$)	2,197	7,601	2,670	9,288	473	1,686
Associated investments(k€)		1,577,775		1,992,235		414,460
Public support (k€)		532,500		532,500		0

The difference between these comparative values can be seen in the following Table:

Table 10.7.



In view of the objectives laid down in the National Allocation Plan 2008-2012, the application of these additional measures will translate into a greater reduction of CO_2 emissions in 2012 assessed as 1.68 Mt.CO_2, 22% more than the objectives defined in the efficiency scenario of the E4.

10.2. Measures

MEASURE 1: Renovation Plan for Electrical Appliances

Objective:

The objective of this measure is to promote the withdrawal of existing fridges, freezers, washing-machines and dishwashers, replacing them with new electrical appliances with energy label Class A or higher.

Description:

The obligation to provide information to buyers on the energy consumption of electrical appliances by way of the energy label came into force after 1995, which is why many of the electrical appliances currently in existence were acquired without this reference. This measure aims to promote the replacement of these electrical appliances with a low energy label by others with a better level of labelling available on the market.

In order to incentivize the replacement of electrical appliances with others of Class A or higher which operate more efficiently, it is proposed to continue with the implementation of the Renovation Plans in each Autonomous Community aimed at the replacement of the following electrical appliances: fridges, freezers, washing-machines and dishwashers.

The Renovation Plans implemented during 2006 and 2007 have allowed for electrical appliances marketed by the manufacturers to be concentrated for the most part in the efficiency Classes A and B, a trend which is moving towards Class A during the effective years of the new plan. The final objective is that the buyer should not find electrical appliances on the market that are not from Class A.

For this reason, it is considered that the energy-saving objective proposed may be achieved by maintaining an economic incentive which pushes the buyer, in making their decision to buy, towards more energy-efficient equipment by way of these Renovation Plans. Taking into consideration, at the same time, the effect that these plans have on the market, inducing technological improvement in equipment and as a result the concentration of an offer at the end of 2012 of Class A electrical appliances. Included in this measure are information and training campaigns for both buyers and retailers of electrical appliances.

Responsibility and collaborators:

Responsible:

Responsibility for design and execution of the Renovation Plans for electrical appliances lies with each Autonomous Community.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE

Costs, energy savings and CO_2 emissions avoided:

Table 10.8.

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	106,500	106,500	106,500	106,500	106,500	532,500
Energy savings (ktep)	181	241	302	362	423	1,509
CO_2 emissions avoided (ktCO_2)	972	1,295	1,622	1,945	2,272	8,106

MEASURE 2: Saving and Energy Efficiency Plans in Public Administrations

Objective:

According to Directive 2006/32/EC of 5 April 2006, concerning the efficiency of the final use of energy and energy services, the public sector must play an exemplary role with regard to the improvement of its energy efficiency.

Specifically, the public sector should adopt measures for improvement of energy efficiency, focussing on the most cost-effective measures and those which generate the greatest energy savings within the shortest time possible. These measures will be adopted at the appropriate level, either national, regional or local.

This Directive quantifies the national guideline objective for saving final energy as 9% for the ninth year of application of same. In the PAEE 2006-2012, an objective has been set to reach this percentage of energy saving for the public sector in 2012.

Description:

For this, the Public Administrations will establish specific action plans which allow this objective to be reached, adopting the most appropriate measures according to their particular needs and which will be, as the Directive lays down, at least two of those set out in Annex VI of same.

These savings may lead to an improvement in the energy management of buildings and their installations: follow-up of energy consumption and its variations, protocol for start-up and shutdown of the most energy-consuming installations (climatization, lighting and computer equipment, etc.). Also for training, information and awareness-raising campaigns, both for users and managers of public buildings. Another aspect to be considered will be assessment of the energy-efficiency criterion at the time of awarding contracts for new work or renovation of buildings and installations, as well as for the purchase of energy-consuming or energy-transforming equipment.

The launch of these plans must be carried out using the technical and human resources on which the Public Administration currently relies, since they are measures aimed at improving the energy management of existing buildings and installations, which is why it is considered that there is no need to assume an increase in public expenditure.

According to the Directive in Article 5, responsibility for the administration, management and application of these Public Administration Plans will have to be assigned to one or various existing or new organizations. In the case of the State General Administrations, it would be assigned to the IDAE, while in the remaining Administration, it could be to the Regional and Local Energy Agencies.

Responsibility and Collaborators:

Responsible:
State, Autonomous and Local Administration.

Collaborators:
Ministry of Public Administration and Ministry of Industry, Trade and Tourism/IDAE.

Costs, energy savings and CO_2 emissions avoided:

Table 10.9.

	2008	2009	2010	2011	2012	TOTAL
Public support (k €)	0	0	0	0	0	0
Energy savings (ktep)	14	29	44	59	74	220
CO_2 emissions avoided ($ktCO_2$)	75	156	236	317	398	1,182

10.3 Summary of costs and benefits by measure

Table 10.10.

	Measure	Energy savings (ktep)						Emissione avoided(ktCO $_2$)						Public support (k€)						Investment (k€)					
		2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total
1	RENOVATION PLAN FOR ELECTRICAL APPLIANCES	181	241	302	362	423	**1,509**	970	1,296	1,621	1,947	2,272	**8,106**	106,500	106,500	106,500	106,500	106,500	**532,500**	398,447	398,447	398,447	398,447	398,447	**1,992,23$**
2	PLAN FOR EQUIPMENT AND EFFICIENT USE OF ENERGY IN PUBLIC ADMINISTRATION	14	29	44	59	74	**220**	75	156	236	317	398	**1,182**	0	0	0	0	0	**0**	0	0	0	0	0	**0**
	Total sector	195	270	346	421	497	**1,729**	1,045	1,451	1,858	2,264	2,670	**9,288**	106,500	106,500	106,500	106,500	106,500	**532,500**	398,447	398,447	398,447	398,447	398,447	**1,992,23$**

Table 10.11.

	Domestic and office equipment sector	ENERGY SAVINGS 2008-2012						EMISSIONS AVOIDED 2008-2012 (ktCO2)		
		FINAL (ktep)			PRIMARY (ktep)					
		DIRECT	OTHER ORIGINS	Final Total	DIRECT	OTHER ORIGINS	Final Total	DIRECT	OTHER ORIGINS	Final Total
1	RENOVATION PLAN FOR ELECTRICAL APPLIANCES	1,509	0	1,509	3,409	0	3,409	8,106	0	8,106
2	PLAN FOR EQUIPMENT AND EFFICIENT USE OF ENERGY IN PUBLIC ADMINISTRATION	220	0	220	497	0	497	1,182	0	1,182
	Total sector	**1,729**	**0**	**1,729**	**3,906**	**0**	**3,906**	**9,288**	**0**	**9,288**

10.4 Economic benefits

- Energy origin

  Assessment ratio 1 tep of primary energy – 480 €

- CO_2 origin

  Assessment ratio 10€/Tn CO_2

Table 10.12.

	Economic benefits (k€)					
	2008	2009	2010	2011	2012	Total
Energy origin	210,970	292,954	374,938	456,923	538,907	**1,874,692**
Origin CO_2 avoided	10,452	14,514	18,575	22,637	26,699	**92,877**
Total sector	223,430	309,477	395,524	481,571	567,618	**1,967,569**

11- INDUSTRY SECTOR

11.1.- Sector Position

Context

The study carried out in the Industry Sector must be considered from two points of view. The first is the overall study of the Manufacturing Industry sector and, the second, the detailed study of the Activity Groupings of which it is composed.

The Activity Groupings studied are as follows:

Food, Drink and Tobacco
Textiles, Leather and Footwear
Wood, Cork and Furniture
Cardboard, Paper and Printing
Chemicals
Non-metallic Minerals
Transport Equipment
Metallurgy and Metal Products
Machinery and Mechanical Equipment
Electrical, Electronic and Optical Equipment

These Activity Groupings represent 92% of the Total Final Energy Consumption of the Manufacturing Industry Sector, excluding Oil Refining and Processing of Nuclear Fuels.

Consequently, the Industry Sector, being integrated with a set of Activity Groupings, behaves very differently in the consumption of energy, some of the groupings being intensive in energy consumption and with a significant energy cost impact on their production costs, and others, in which the impact of the energy cost on the production costs is of little importance. Accordingly, energy-saving actions, both from the viewpoint of improvement of existing installations and investment in equipment which has optimized energy outputs, as has occurred historically, have mainly affected those Activity Groupings intensive in energy consumption, as against the rest, which are affected when a substantial change to their productive system is necessary for reasons relating to production or new markets.

On the other hand, it is necessary to bear in mind that some of the Activity Groupings intensive in energy consumption, such as Non-Metallic Minerals, Cardboard, Paper and Printing, and Iron and Steel, apply to the National Plan for Assignment of Greenhouse-gas Emission Rights 2005 – 2007 (PNAI).

The Activity Groupings mentioned above, together with those industrial combustion facilities with a nominal thermal output above 20MW, are included in the scenario for assignment of activities subject to the emission-trading scheme of the National Plan for Assignment of Greenhouse-gas Emission Rights 2008 – 2012 (PNAII), which considers, among other things, application of the saving measures of the E4, which is why the expected trend in energy consumption of the Activity Groupings and combustion facilities should be within that laid down in the Strategy.

As mentioned in the National Plan for the Assignment of Greenhouse-Gas Emission Rights 2008 – 2012 (PNAII), within combustion facilities with a nominal thermal output over 20MW, facilities may be found which might belong to the Chemical, Food, Ceramics, Non-ferrous Metallurgy, Textiles, Gypsum, and Timber Industries, among others.

In Directive 2006/32/EC relating thereto, the Activity Groupings (sections 3 to 9 of Law 1/2005) and combustion facilities with a nominal output over 20MW found in the Industrial Sector cannot be taken into account in the saving objectives indicated by the directive.

Energy trends in the sector

In order to carry out the analysis of energy behaviour in the Industry Sector, it is not only necessary to take account of the absolute values and growth of Final Energy consumption, but also, for the same period, the movement of the Industrial Production Index (IPI) and GVA at basic prices, base 2000, constant prices.

In this respect, and as can be seen from the following table, the growth in Final Energy consumption was greater than the growth of IPI corrected for the purposes of the timetable, and consequently, the consumption of energy per unit of production in terms of IPI has increased.

Table 11.1. Development of Total Final Energy Consumption and Industry Sector IPI

	2000	2001	2002	2003	2004	2005
Final Energy Consumption Ktep	34,117	34,668	34,914	36,981	37,354	38,135
Actual growth according to period		1.62%	1.16%	2.72%	2.29%	2.25%
IPI Base 2000	100.3	98.8	98.9	100.3	101.9	102.6
Actual growth according to period		-1.51%	-0.68%	0.01%	0.40%	0.46%

Considering Energy Intensity in monetary terms (ktep/M€2000), defined as the quotient between final energy consumption and GVA at basic prices, base 2000, constant prices, the following results are obtained:

Table 11.2. Energy Intensity tep/M€2000 period 2000-2005

	2000	2001	2002	2003	2004	2005
Energy Intensity Ktep/M€	155.25	150.35	149.72	158.72	161.81	164.69
Year-on-year growth		-3.16%	-0.42%	6.01%	1.94%	1.78%
Growth according to period		-3.16%	-1.80%	0.74%	1.04%	1.19%

The Industry Sector in the period 2000-2005 had a final energy consumption lower than that originally forecast in the Baseline Scenario of the E4, even lower than in the Efficiency Scenario of the same Strategy. Nevertheless, this consumption of energy has not reduced the energy intensity of the Sector since, on the contrary, it

has been increasing, going from 2000 with a value of 155.3 tep/M€2000 to 2005 with a value of 164.7 tep/M€2000, which involves an average annual growth in the period 2000 - 2005 of 1.2 %.

The development of total final energy consumption for the Activity Groupings studied in the E4 is given in the following table, in which it can be seen that all the Activity Groupings have increased energy consumption in the period 2000-2005 except for: Textiles, Leather and Footwear, Chemical Industry and Transport Equipment.

Table 11.3. Final Energy Consumption Development in Activity Groupings

Final Energy Consumption Ktep	2000	2001	2002	2003	2004	2005	Average Annual Growth Rate 2005-2000
Food, Drink and Tobacco	2,433	2,499	2,948	3,017	3,043	2,877	3.4%
Textiles, Leather and Footwear	1,167	922	992	977	990	957	-3.9%
Wood, Cork and Furniture	724	490	515	541	538	775	1.4%
Cardboard, Paper and Printing	2,047	1,791	2,108	2,617	2,358	2,522	4.3%
Chemicals	9,219	9,204	9,643	9,577	9,105	8,481	-1.7%
Non-metallic Minerals	6,947	7,359	5,818	6,981	6,468	7,211	0.7%
Transport Equipment	892	874	857	1,017	1,008	847	-1.0%
Metallurgy and Metal Products	6,469	7,148	7,048	7,394	8,314	7,081	1.8%
Machinery and Mechanical Equipment	265	343	305	354	357	356	6.1%
Electrical, Electronic and Optical Equipment	193	250	222	258	260	260	6.1%

Source: IDAE

In relation to the Industry Production Index (IPI) base 2000 for the Activity Groupings studied in the E4, it can be seen that some have increased their production in the period 2000-2005, as occurred with Cardboard, Paper and Printing, Food, Drink and Tobacco, Chemical Industry and Non-metallic Mineral, but the remainder reduced their production.

Table 11.4. Variation IPI Base 2000 period 2000-2005

IPI base 2000	2000	2001	2002	2003	2004	2005	Average annual growth rate 2000-2005
Food, Drink and Tobacco	100	100	105	107	109	111	2.0%
Textiles, Leather and Footwear	100	97	89	94	95	89	-2.2%
Wood, Cork and Furniture	100	86	86	86	88	86	-3.0%
Cardboard, Paper and Printing	100	98	107	108	113	115	2.9%
Chemicals	100	101	104	108	107	107	1.3%
Non-metallic Minerals	100	101	100	102	102	105	0.9%
Transport Equipment	100	96	94	97	99	94	-1.2%
Metallurgy and Metal Products	100	96	98	100	102	104	0.9%
Machinery and Mechanical Equipment	100	93	86	87	91	88	-2.5%
Electrical, Electronic and Optical Equipment	100	93	86	87	91	88	-2.5%

For the Activity Groupings studied in the E4 the Energy Intensity values for the period 2000-2005 are the following:

Table 11.5. **Development of Energy Intensity tep/M€2000 at Constant Prices of the Activity Groupings of the Industry Sector**

	2000	2001	2002	2003	2004	2005	Average annual growth rate		
							2000-2005	2000-2002	2002-2005
Food, Drink and Tobacco	172.3	176.6	211.2	210.5	214.1	200.8	3.1%	10.7%	-1.7%
Textiles, Leather and Footwear	156.8	124.6	143.0	142.4	156.6	161.1	0.5%	-4.5%	4.0%
Wood, Cork and Furniture	289.3	196.5	204.7	213.9	212.5	307.5	1.2%	-15.9%	14.5%
Cardboard, Paper and Printing	218.6	188.8	214.3	265.1	234.2	244.1	2.2%	-1.0%	4.4%
Chemicals	375.6	319.2	386.7	392.1	421.4	461.1	4.2%	1.5%	6.0%
Non-metallic Minerals	871.0	863.8	677.5	812.5	721.4	788.9	-2.0%	-11.8%	5.2%
Transport Equipment	77.5	75.3	71.5	82.3	82.7	70.8	-1.8%	-4.0%	-0.3%
Metallurgy and Metal Products	371.7	391.4	387.9	394.1	451.4	365.7	-0.3%	2.2%	-1.9%
Machinery and Mechanical Equipment	35.9	43.1	38.4	45.0	43.5	43.5	3.9%	3.4%	4.2%
Electrical, Electronic and Optical Equipment	26.4	32.9	32.5	37.2	38.4	38.8	8.0%	10.9%	6.1%

As can be seen, all the Activity Groupings have increased their energy intensity in the period, except for Non-metallic Minerals, Transport Equipment, and Metallurgy and Metal Products which have decreased. The notable increases of the activity groupings Electrical, Electronic and Optical Equipment, Chemicals, and Food, Drink and Tobacco should be highlighted. This behaviour is due to the fact that the increase in final energy consumption was greater than the increase in GVA, so much so that for Electrical, Electronic and Optical Equipment the average annual growth of final energy consumption in the period 2000 – 2005 was 6.1%, while GVA growth was -1.7%. In the Chemical Industry, final energy growth was 5.2% and GVA 1% approximately, and in Food, Drink and Tobacco, 3.4 % and 0.3 % respectively.

Energy consumption 2004-2007

The development of the Industry Sector and of each one of the Activity Groupings up to 2007, taking account of actual consumption up to 2005 and the values deduced from the updated baseline scenario, are the following:

Table 11.6. Development of Final Energy Consumption

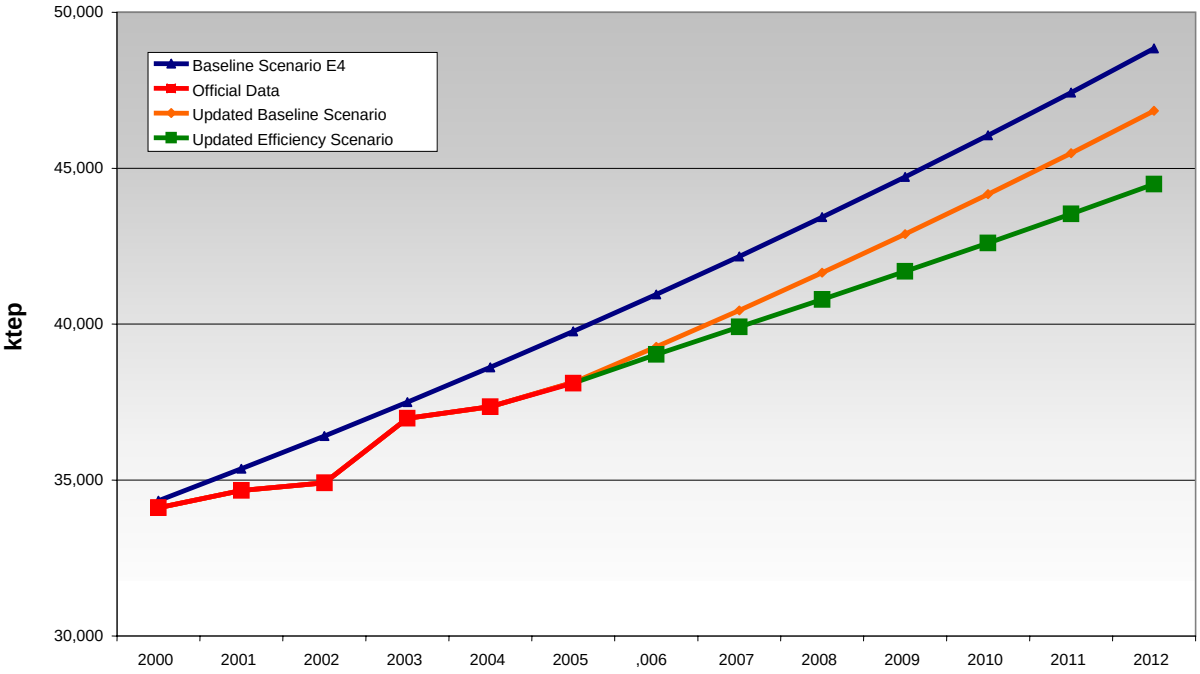
Final Energy Consumption Ktep	2004	2005	2006	2007
Food, Drink and Tobacco	3,043	2,877	2,991	3,109
Textiles, Cork and Footwear	990	957	1,001	1,046
Wood, Cork and Furniture	538	775	811	850
Cardboard, Paper and Printing	2,358	2,522	2,609	2,699
Chemicals	9,105	8,481	8,736	8,998
Non-metallic Minerals	6,468	7,211	7,310	7,411
Transport Equipment	1,008	847	884	922
Metallurgy and Metal Products	8,314	7,081	7,271	7,466
Machinery and Mechanical Equipment	357	356	368	379
Electrical, Electronic and Optical Equipment	260	260	268	276
Total Industry	37,354	38,135	39,271	40,441

Objectives

In view of the actual energy consumption of the Industry Sector in the period 2000 – 2005 and the Baseline Scenario of the E4, a projection of Final Energy Consumption up to 2012 has been made, starting from the actual energy consumption of the year 2005 and an annual growth rate of energy consumption, equal to that forecast in the baseline scenario of the E4, of 2.98%, giving rise to an updated Baseline Scenario. From this scenario, through application of the saving measures laid down in the Strategy, a new updated Efficiency Scenario is obtained, which maintains the saving potential defined in the strategy.

As can be seen in the graph, there are two clearly differentiated behaviours: one relating to the difference in energy consumption between the baseline scenario of the E4 and the updated baseline scenario, and the other relating to the application of the energy saving measures on top of the updated baseline scenario, the updated efficiency scenario being obtained.

Graph 11.7. Development of the updated Baseline Scenario and updated Efficiency Scenario Industry Sector



The development of the Industry Sector estimated for the period 2008-2012 is given in the followng table in which achievement of the objectives laid down in the updated Efficiency Scenario has been assumed.

Table 11.7. Objectives of Action Plan 2008-2012 Industry Sector

	2007	2008	2009	2010	2011	2012	Period 2008 - 2012
Final Energy Consumption (kte)	39,908	40,795	41,692	42,604	43,534	44,485	
Average growth of consumption	2.98%	2.98%	2.98%	2.98%	2.98%	2.98%	2.98%
Saving (ktep)	532	851	1,195	1,561	1,947	2,351	7,904
Difference Baseline Scenario E4/ updated Baseline Scenario	1,732	1,783	1,836	1,890	1,946	2,004	9,460
Total	2,265	2,635	3,031	3,451	3,893	4,355	17,364
Emissions avoided (kt CO_2)	6,885	8,009	9,214	10,491	11,834	13,238	52,786
Associated investment (k€)	267,772	292,862	315,606	336,186	354,808	371,657	1,671,119
Public Support (k€)	61,336	64,964	69,964	74,488	78,582	82,286	370,284

In relation to the possibility of increasing the energy-saving measures (on top of those already considered in the E4) with the aim of increasing reduction of CO_2 emissions, this alternative is not possible in the Industry Sector given that, as has been seen earlier, in the period 2000 – 2005 Energy Intensity increased. This increase may be due to the fact that market demand has increased for products that require more energy consumption in their manufacture, installation of energy-consuming equipment to reduce the impact on the environment or extra-large installations for products demanded by the market.

Taking account of the Baseline Scenario of the E4, the updated baseline and the updated Efficiency Scenario, the following results are obtained with respect to energy saving, reduction of CO_2 emissions, investment associated with the energy-saving measures and Public Support for implementation of same.

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Table 11.8. Summary of Scenarios Action Plan 2008-2012

	Baseline Scenario E4		Updated Efficiency Scenario		Scenario E4+		Scenario Difference	
	2012	2008-2012	2012	2008-2012	2012	2008-2012	2012	2008-2012
Final Energy Consumption (ktep)	48,840	230,475	44,485	213,111	44,485	213,111	0	0
Average growth in consumption		2.98%		2.19%		2.19%		
Saving (ktep)			2,351	7,904	2,351	7,904	0	0
Difference Baseline Scenario E4/Updated Baseline Scenario (ktep)			2,004	9,460	2,004	9,460	0	0
Savings on Baseline Scenario E4 (ktep)			4,355	17,364	4,355	17,364	0	0
% of Saving			8.92%	7.53%	8.92%	7.53%		
Total Emissions Avoided (ktCO_2)			14,839	59,165	14,839	59,165	0	0
Associated Investments (k€)			371,657	1,671,119	371,657	1,671,119	0	0
Public Support (k€)			82,286	370,284	82,286	370,284	0	0

As can be seen, in the Industry Sector there is no Scenario E4+, but the structure of the table has been maintained so as to be consistent with the remaining Sectors.

The estimate of the development of the saving through application of energy-saving measures from each of the Activity Groupings set out in the Strategy, for the period 2008 – 2012, is given in the following table, assuming achievement of the objectives laid down in the updated Efficiency Scenario.

Table 11.9. Objectives of Action Plan 2008-2012. Industrial Activity Groupings

Period 2008 -2012			
	Saving ktep	Average growth in consumption	Emissions avoided $KtCO_2$
Food, Drink and Tobacco	1,393	3.9%	4,234
Textiles, Leather and Footwear	41	4.5%	125
Wood, Cork and Furniture	74	4.7%	224
Cardboard, Paper and Printing	86	3.5%	262
Chemicals	1,418	3.0%	4,312
Non-Metallic Minerals	1,253	1.4%	3,808
Transport Equipment	86	4.3%	261
Metallurgy and Metal Products	1,511	2.7%	4,592
Machinery and Mechanical Equipment	20	3.2%	61
Electrical, Electronic and Optical Equipment	15	3.2%	44
Average	590	3.44%	1,792

Assessment of results

Proposed Indicators

According to Directive 2006/32/EC, in order to be able to understand the development of energy consumption in the Industry Sector, as well as in each of the Activity Groupings studied, it is necessary to define a series of indicators, the main feature of which is reliability of their content, as well as ease of measurement and follow-up. For this, the official statistics should be used relating to energy consumption, production and Gross Value Added.

In the case of the Industry Sector, the ***INDICATOR*** proposed is the **Average annual reduction of the specific consumption** of total final energy, thermal final energy and electrical final energy. Specific consumption is defined as the quantity of energy consumed per physical production unit or by Gross Value Added at basic prices, base 2000, constant prices.

The rate of reduction expressed depends on the growth rate of energy consumption, that is why, in order to reach the energy-saving objectives of the Action Plan 2008 – 2012 and thereby those of the E4, as well as to be able to assess the behaviour of the Industry Sector, the rates of reduction in Specific Consumption will have to be the following.

Table 11.10.Indicators for Development of Energy Saving 2005 - 2012

	Rate of Average Annual Growth in Energy Consumption	Average Annual Rate of Reduction in Specific Consumption for the period 2005-2012		
		Total Final Energy	Thermal Energy	Electrical Final Energy
Total Industry	**2.98%**	**0.72%**	**0.91%**	**0.32%**

For the average annual growth rate of energy consumption established for the period 2005 – 2012 given in the table above, and taking as a base the Specific Consumption of the year 2005 defined as the quotient between the total final energy consumption of that year and the Gross Value Added of the same year (at basic prices, base 2000, constant prices), the values for Specific Consumption for the Industry Sector in the period of the Action Plan 2008 – 2012 would have to be the following, if the forecast energy saving objectives were achieved.

Table 11.11. Specific Consumption of Objective (tep/M€2000) Action Plan 2008 - 2012

Tep Total Final Energy /M€2000	2005	2008	2012
Industry Sector	**200.2**	**195.9**	**190.2**

Follow-up results

Assessment and follow-up of results of the launch of the actions proposed in the Action Plan 2008 – 2012, in relation to the indicators given above, will be derived from the official statistical information, as well as from the data that the sectors themselves send to the Administration, particularly to the Ministry of Industry, Trade and Tourism and the Ministry of Economy and Finance.

11.2.- Measures in the Industry Sector

MEASURE 1: Voluntary Agreements

Objective

- To encourage the industries of the sector to adopt energy-saving measures.

- To oblige Business Associations and Industries to reach the detected energy-saving potential per Sector.

Description

The Voluntary Agreement should be an instrument which obliges Business Associations and the Administration to achieve energy objectives without detriment to business competitiveness.

The following should be considered as essential points in the Voluntary Agreement:

- Saving potential detected and possible achievement of same. (Commitment from Business Associations with Administration).
- Explicit linking of the businesses of the subsector or branch of activity considered.
- Lines of finance for energy-saving incentives and possibility of giving preference to formally linked businesses.
- Follow-up of the objectives laid down in the Voluntary Agreement.

Responsibility and collaboration

Responsible: Ministry of Industry, Trade and Tourism/IDAE

Collaborators: Business Association and IDAE

Actions

- The Ministry of Industry, Trade and Tourism will determine the different contents of the Voluntary Agreements

- IDAE will collaborate in determining the Voluntary Agreement with regard to energy-saving potential, in creating the Voluntary Agreement with the Business Association and the annual follow-up of the Voluntary Agreement.

- The Business Associations will prepare and carry out the follow-up of annual surveys

Public Support (k€)

This measure does not entail economic costs.

Planning

In the period 2008 - 2012, it is intended to make, together with the Business Associations, the maximum number of Voluntary Agreements.

Energy saving and reduction of emissions

The signing of Voluntary Agreements does not directly involve generation of energy savings.

MEASURE 2: Energy Audits

Objective

- To determine energy-saving potential in the businesses in which it is carried out.
- To encourage the making of the decision to invest in Energy Saving.
- To determine benchmarking of audited productive processes.

Description

The implementation of Energy Audits is an instrument which allows for the detailed and exhaustive study of the productive processes, and more specifically the main energy-consuming equipment.

It is therefore possible to discover the energy consumption of installations, to determine the basic energy parameters of the process and its equipment, as well as to note deviations with respect to energy consumption that there may be in relation to the energy standard of the Sector.

Moreover, the investment necessary for implementation of the detected measures will be determined, as well as the return on these investments and the viability of same.

Responsibility and collaboration

Responsible: Ministry of Industry, Trade and Tourism/IDAE

Collaborators: Autonomous Communities, Business Associations, Businesses

Actions

It falls to the Ministry of Industry, Trade and Tourism/IDAE, as those responsible for the measure, to coordinate all the actions arising from application of same.

- To introduce in future periods (2008-2012) the aid mechanisms of the administration in order to cofinance the cost of the Energy Audits proportionally at 75% Administration and 25% the Industry in which the Energy Audit is carried out.

  The estimated total number of Energy Audits in the period 2008 – 2012 is 260.

Public Support (k€)

For determination of the cost, an average cost per Audit of 14,600 € (of which 75% would be Public Support) has been taken into consideration.

Table 11.12. Public Support (K€)

2008	2009	2010	2011	2012	TOTAL
570	570	570	570	570	2,850

The total cost of the measure for the period 2008-2012 rises to 3.79 M€, of which 2.85 M€ relates to Public Support. The remainder of the cost of this measure relates to the contribution made by the industrialist in whose business the Energy Audits are carried out.

Planning

Throughout the entire period, to establish the budget item for the Execution of Energy Audits in the Industry Sector.

Energy Saving and Reduction of Emissions

Energy Audits do not generate energy saving, although they will determine the potential for energy saving and investment associated with the measures presented for each of the sectors studied.

MEASURE 3: Public Aid Programme

Objective

- To facilitate the economic viability of investments of the Industry Sector in energy saving with the aim of reaching the energy-saving potential detected.

Description

To establish the Support mechanisms necessary for financing Energy-Saving Projects so as to reach the energy objectives established in the Energy Efficiency Strategy 2004-2012.

Responsibility and collaboration

Responsible: Ministry of Industry, Trade and Tourism/IDAE

Collaborators: Autonomous Communities

Actions

- It falls to the Ministry of Industry, Trade and Tourism, as those responsible for the measure, to define and coordinate all actions arising from application of the measure considered in the agreements signed with the Autonomous Communities.

Public Support (k€)

Table 11.13. Public Support (k€)

2008	2009	2010	2011	2012	TOTAL
64,394	69,394	73,918	78,012	81,716	367,434

The total investment of the measure for the period 2008-2012 rises to 1,671 M€, of which 367.43 M€ relates to Public Support. The remainder of the cost of this measure relates to the investments that must be made by industries so that they can carry out Energy-Saving Projects.

These estimates of public expenditure relate to the expenses of the Ministry of Industry, Trade and Tourism itself, in order to carry out the actions described above.

Planning

In 2008-2012

To draw up the management mechanisms of the line of finance for Investments in Energy-Saving Projects.

Energy Saving and Reduction of Emissions

Table 11.14.

	Thermal E Saving	Electrical E Saving	Final E Saving	Emissions avoided CO2	Public Support	Total Investment
	ktep	MWh	Ktep	kt of CO2	M€	M€
2008	774	898,091	851	2,588	64,394	292,102
2009	1,086	1,260,562	1,195	3,632	69,394	314,846
2010	1,419	1,646,664	1,561	4,744	73,918	335,426
2011	1,770	2,054,150	1,947	5,918	78,012	354,048
2012	2,138	2,480,985	2,351	7,148	81,716	370,897
TOTAL	**7,187**	**8,340,452**	**7,904**	**27,029**	**367,434**	**1,667,319**

MEASURE 4: Inclusion of a specific assessment of energy impact on the entire Industry project.

Objective

Within the Environmental Impact Study, a specific assessment of the energy impact will have to be included in order to ensure that new equipment and installations, or those replacing others, use the best technology available to achieve the optimum indicators in terms of energy efficiency.

Description

As part of the Environmental Impact Study, to include the energy impact assessment section so that when the Environmental Impact Study is approved by the competent bodies, the best of the specific energy consumptions are taken into consideration and/or the use of the best technology available with regard to energy efficiency is justified, identifying, where appropriate, the impact.

Responsibility and collaboration

Responsible: Ministry of Environment

Actions

- It falls to the Ministry of Environment to define and coordinate all the actions necessary for application of the measure.

Public Support (k€)

This measure entails no economic costs.

Planning

Definition of procedure	2007-2008
Processing	2008
Introduction	2009-2012

Energy saving and reduction of emissions

This measure does not directly involve generation of energy savings.

11.3.- Summary of costs and benefits by measure

	Final Energy Saving (ktep)						Emissions Avoided CO2 (ktCO2)						Public Support (k€)						Total Investment (k€)					
	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total
Voluntary Agreements																								
Energy Audits													570	570	570	570	570	2,850	760	760	760	760	760	3,800
Public Aid Programme	851	1,195	1,561	1,947	2,351	7,904	2,900	4,071	5,317	6,633	8,011	26,932	64,394	69,394	73,918	78,012	81,716	367,434	292,102	314,846	335,426	354,048	370,897	1,667,319
Energy Impact Assessment																								
Total	851	1,195	1,561	1,947	2,351	7,904	2,900	4,071	5,317	6,633	8,011	26,932	64,964	69,964	74,488	78,582	82,286	370,284	292,862	315,606	336,186	354,808	371,657	1,671,119

Economic Benefits

The results to be considered as an economic benefit through primary energy saving of 480 €/tep of saving, and through reduction of emissions of CO_2 of 18 €/t CO_2, are given in the following table:

Table 11.16.

	2008	2009	2010	2011	2012	TOTAL
Energy Origin (k€)	582,313	817,320	1,067,649	1,331,842	1,608,580	5,407,704
Origin CO_2 avoided (k€)	52,203	73,270	95,711	119,396	144,204	484,784
TOTAL (k€)	**634,516**	**890,590**	**1,163,361**	**1,451,238**	**1,752,784**	**5,892,488**

12. PUBLIC SERVICES SECTOR

12.1. Public Services Sector Position

Context

The Public Services Sector is considered, within the energy context, through public lighting and public water supply installations, meaning by public lighting the illumination of highways, roads and streets, and ornamental lighting; and by water supply, those installations for drinking water and supply to municipalities and those for purification of waste water.

The following can be highlighted as problems in this sector:

- the diversity and autonomy of its public stakeholders
- the non-existence, at national level, of regulations which establish a minimum for energy efficiency for this type of installation
- the high economic investment necessary to apply corrective measures for energy efficiency

Energy trends in the sector

The sector's consumption of energy rose to 671 ktep in 2004. By subsector, public lighting consumed 296 ktep, of which 95% relates to installations owned by Councils, and the water subsector consumed 375 ktep, the majority of these installations also being in public ownership.

This energy consumption is distributed in the sector as follows: public lighting (42%), traffic lights (2%), water purification (40%), water supply (14%) and drinking water (2%).

On the basis of this division, in which public lighting has a high impact, a growing increase in consumption is deduced, justified by the extra equipment introduced by Councils through their new urban action plans associated with the substantial increase in property construction.

In the same measure, there is a growth in this sector of energy consumption associated with the extra equipment introduced by the Councils through policies adopted for the purification of waste water, which have translated into the introduction of numerous waste-water purification stations throughout the country.

Given the intended use of installations included in the Public Services sector, it makes sense to use as a reference index the specific value of energy consumption based on the number of inhabitants, and by this means we can see the energy trends in the sector in its main areas of consumption.

Public Lighting

Table 12.1.

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004
Electrical Energy Consumption in Public Lighting (kWh/inhabitant year)	67	68	69	71	73	75	76	77	78

Water Treatment

Table 12.2.

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004
Electrical Energy Consumption in Drinking Water, Supply and Purification (kWh/inhabitant year)	71	78	85	91	96	99	103	106	110

Objectives:

Two energy scenarios are considered in the E4: the Baseline Scenario and the Energy Efficiency Scenario.

The foreseeable development of energy consumption in the public sector took us, according to the Baseline Scenario, to a consumption of 808 ktep in 2012.

The application of the measures proposed in the Strategy would allow for achievement, in 2012, of an energy saving of 19% on top of the Baseline Scenario; that is to say, the E4 considers it possible to reach a potential energy saving estimated at 154 ktep. The objective, although ambitious, is both technically and economically feasible.

As a result of the measures considered in the Strategy, the average year-on-year growth rate in the period 2000-2012 is reduced from the 2.6% of the Baseline Scenario (without measures) to the 0.8% of the Efficiency Scenario.

Nevertheless, the energy-saving objectives associated with the measures of the E4 for all the energy-consuming sectors are not sufficient to achieve the objectives laid down in the National Allocation Plan (PNA II).

Accordingly, a set of additional measures were drawn up to reduce emissions associated with the activity of these sectors, by way of a new E4+ Efficient Scenario which considers these additional measures.

The additional effort is based preferentially on increasing the economic, regulatory, technical, awareness-raising and information efforts, and the aid necessary to elevate the final objectives of the measures themselves, with the aim of obtaining higher energy savings and, consequently, a greater reduction of emissions.

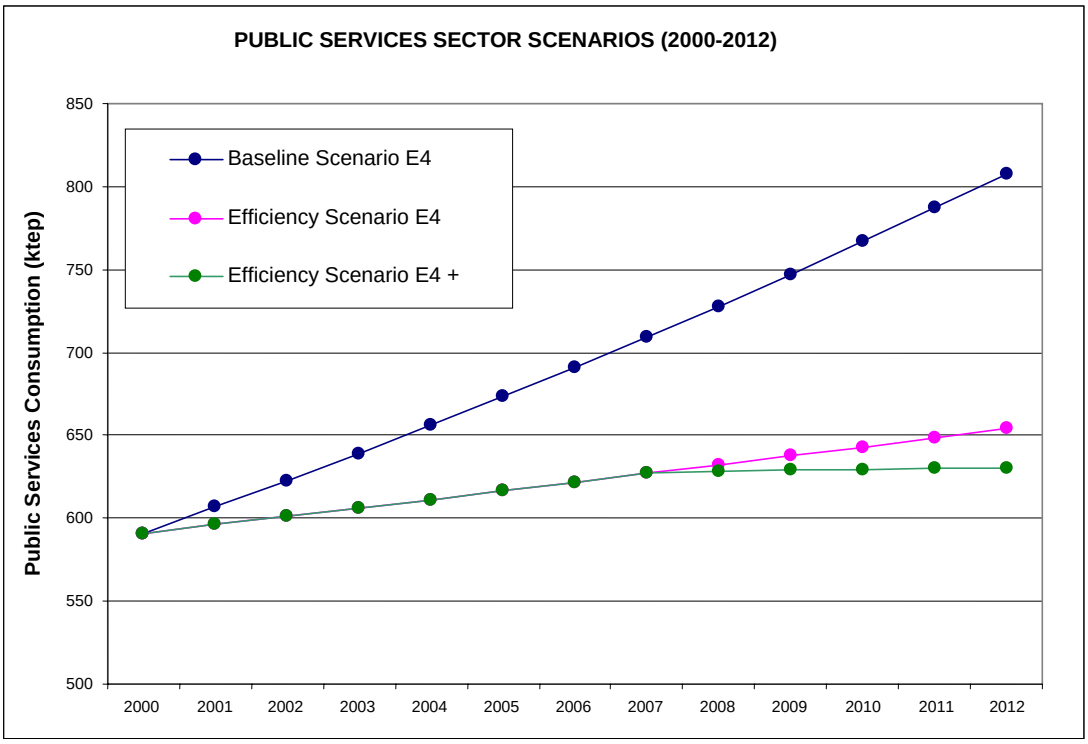
The separate scenarios are represented in the following table:

Table 12.3. DIFFERENCE IN SCENARIOS, BASELINE, E4 AND E4+

	Baseline Scenario		E4 Efficiency Scenario		E4+ Scenario		Scenario Difference	
	2012	2008-2012	2012	2008-2012	2012	2008-2012	2012	2008-2012
Public Services Consumption (ktep)	808	3,837	654	3,215	630	3,146	-24	-69
Average Growth in Consumption		2.1%		0.7%		0%		
Direct Savings (ktep)					178	691		
Induced Savings (ktep)					0	0		
Total Saving on Baseline Scenario E4 (ktep)			154	622	178	691	24	69
Savings on Baseline Scenario E4 (%)			19.1%	16.2%	22.0%	18.0%		
Total Emissions Avoided (ktCO_2)			827	3,341	956	3,712	128	370
Associated Investments (k€)				871,000		1,351,489		480,489
Public Support (k€)				61,000		89,216		28,216

The difference between these comparative values can be seen in the following Table:

Table 12.4.



12.2 Measures in the Public Services Sector

MEASURE 1: Improvement of the energy efficiency of current external public lighting plant.

Objective:

The object of this measure is to promote the replacement of existing external public lighting equipment, based on obsolete technologies, with other up-to-date and more efficient equipment.

Responsibility and Collaboration:

Responsible:

Ministry of Industry, Trade and Tourism and Autonomous Communities

Collaborators:

Local Administration.

Savings (ktep)

Table 12.5.

2008	2009	2010	2011	2012	Total
63.4	76.6	91.8	106.8	123.1	**461.7**

CO_2 Avoided (kt)

Table 12.6.

2008	2009	2010	2011	2012	Total
340.4	411.0	492.4	572.7	660.2	**2,476.7**

MEASURE 2: Implementation of analyses, feasibility studies and audits for improvement of the energy efficiency of installations.

Objective:

The object of this measure consists of implementation of energy audits, at shared cost, and aimed at the public sector, **Councils, Public Companies or Private Concessionaires** of these Public Services.

Description:

Implementation of energy audits in order to discover the degree of energy efficiency of current public lighting plant and water treatment plant in the various municipalities, as well as implementation of feasibility studies for adaptation and renovation of existing installations in the Public Services sector, moving towards new technologies with greater savings and efficiency.

Responsibility and Collaboration:

Responsible:

Autonomous Communities and Local Administration

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE.

Savings (ktep)

Table 12.7.

2008	2009	2010	2011	2012	Total
N/A	N/A	N/A	N/A	N/A	

CO_2 Avoided (kt)

Table 12.8.

2008	2009	2010	2011	2012	Total
N/A	N/A	N/A	N/A	N/A	

MEASURE 3: Running of energy training courses for municipal technicians which allow for improvement of the energy efficiency of municipal installations.

Objective:

To manage the running of energy training courses for municipal technicians and maintenance managers of municipal installations, which allow for improvement of energy efficiency by dealing with installations using new, more efficient technologies.

Description:

Implementation of an Information and Training Day on Municipal Energy Management in each Autonomous Community, with direct invitations to each Municipal Council with more than 5,000 inhabitants, and by way of inducement to the remaining municipalities.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Public Administration/IDAE and Local Administration.

Savings (ktep)

Table 12.9.

2008	2009	2010	2011	2012	Total
N/A	N/A	N/A	N/A	N/A	

CO_2 Avoided (kt)

Table 12.10.

2008	2009	2010	2011	2012	Total
N/A	N/A	N/A	N/A	N/A	

MEASURE 4: Improvement of the energy efficiency of current plants for drinking water, supply, purification of waste water and desalination.

Objective:

To promote the replacement of existing technologies currently in plants for drinking water, supply, purification and desalination of water by other more efficient technologies.

Improvement of the energy efficiency of current installations for Water Desalination Plants by introducing Energy Recuperators (Pressure Recuperators).

To promote the replacement of current membranes that are between 5 and 8 years old by others based on newer and more efficient technologies for Reverse-Osmosis Water Desalination Plants.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE and Local Administration.

Savings (ktep)

Table 12.11.

2008	2009	2010	2011	2012	Total
36.6	41.6	46.2	50.4	54.9	**229.7**

CO_2 Avoided (kt)

Table 12.12.

2008	2009	2010	2011	2012	Total
197.0	223.7	248.0	271.1	294.2	**1,235.1**

12.3 Summary of costs and benefits by measure

Table 12.13.

	Measure	Energy Savings (ktep)						Emissions Avoided ($ktCO_2$)						Public Support (k€)						Investment (k€)					
		2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total
1	Public lighting plant	63.4	76.6	91.8	106.2	123.1	**461.7**	340.4	411.0	492.4	572.7	660.2	**2,476.7**	9,453	10,398	11,343	12,290	13,234	56,718	144,496	158,941	173,385	187,861	202,291	866,974
2	Energy studies and audits	---	---	---	---	---	**---**	---	---	---	---	---	---	240	180	120	60	0	600	240	180	120	60	0	600
3	Training for municipal technicians	---	---	---	---	---	**---**	---	---	---	---	---	---	120	80	40	0	0	240	0	0	0	0	0	0
4	Water treatment plant	36.6	41.6	46.2	50.4	54.9	**229.7**	197.0	223.7	248.0	271.1	294.2	**1,235.1**	6,060	6,280	6,344	6,438	6,536	31,658	92,632	95,994	96,973	98,409	99,907	483,915
	TOTAL	100	118	138	157	178	**691**	537	635	740	844	954	3,712	15,873	16,938	17,847	18,788	19,770	89,216	237,368	255,115	270,478	286,330	302,198	1,350,889

12.4 Economic benefits

– Energy origin

Assessment ratio 1 tep of primary energy – 480 €

– CO_2 origin

Assessment ratio 10€/Tn CO_2

Table 12.14.

M€	2008	2009	2010	2011	2012	Total
Energy origin	120.0	142.5	165.5	188.5	214.5	**831**
Origin CO_2 avoided	9.7	11.4	13.3	15.2	17.2	**67**
Total	129.7	153.9	178.8	203.7	231.7	898

12.5 Proposed indicators

It is proposed to use two indicators, one for each subsector, to understand the degree of energy intensity of same:

- Energy intensity in the Public Lighting subsector. This is expressed as the energy consumption of this service per number of citizens provided for, expressed as kWh/inhabitant. Its value for the baseline year of the E4 (2004) is 78 kWh/inhabitant year.

- Energy intensity in the water subsector. This is expressed as the energy consumption of this service per number of citizens provided for, expressed as kWh/inhabitant. Its value for the baseline year of the E4 (2004) is 110 kWh/inhabitant year.

Within the saving objectives established in this Action Plan, and taking into consideration the current growth in the municipal equipment of these public services, the energy intensity of these two subsectors must be reduced for the year 2012 by 3.5% for the public lighting subsector and 4.1% for the water subsector, resulting in the following values:

MEASURES	PARAMETERS	BASELINE SCENARIO 2004	E4 + SCENARIO 2012
IMPROVEMENT OF THE ENERGY EFFICIENCY OF THE CURRENT EXTERNAL PUBLIC LIGHTING PLANTS	kWh/inhabitant year	78	75
IMPROVEMENT OF THE ENERGY EFFICIENCY OF EXISTING INSTALLATIONS FOR DRINKING WATER, SUPPLY AND PURIFICATION OF WASTE WATER AND DESALINATION	kWh/inhabitant year	110	105

13. TRANSPORT SECTOR

13.1 Sector Position

a) Context and Energy Trends

In terms of energy consumption, the transport sector continues to maintain a close relationship with growth in general economic activity. In fact, one of the basic objectives of the measures considered in the 2005-2007 Action Plan was to disconnect this consumption from economic growth by way of actions which encourage activity associated with transport, using more efficient modes and more rational means from the energy consumption viewpoint.

Transport remains, with 36% of total final energy consumption, as the primary consumer sector above industry and the remaining sectors grouped according to various uses. In addition, practically 100% of fuels for transport originate from oil derivatives.

By analyzing some of the cases given in the Saving and Energy Efficiency Strategy (E4), it can be seen that the development of the transport sector between 2000 and 2005 has been moderate compared with the scenarios forecast in 2003, with actual growth of 3.7% as against the growth forecast in the Baseline and Efficiency Scenarios, as reflected in the following table:

Table 13.1. Summary of Current Position as against E4 Scenarios in Transport

(Ktep)		2000	2005		Growth 2005/2000	
			As per E4	Actual data	As per E4	Actual data
Baseline Scenario	Energy consumption	32,272	40,409	38,695	4.6%	3.7%
Efficiency Scenario	Energy consumption	32,272	39,642	38,695	4.2%	3.7%
Saving achieved	Energy saving	--	767	1,714		

Source: E4 2004-2012. Energy in Spain Report. SGE, 2006.

In 2006, demand for transport by road continued to grow (+3.1%) but at rates lower than those for previous years, with a notable growth in the demand for car diesel (+5.5%) being supported by the increase in the activity of transport of goods and the growth in the number of private cars using diesel. There is a continuation of the accelerated drop in consumption of petrol (-4.5%), as indicated by the dieselization of new registrations, while the increase for kerosene was 4.4%. The road transport sector continues to maintain a clear lead over the remaining modes of transport.

Similarly, the transport sector, as that responsible for the emission of 32% of greenhouse gases (especially CO_2), is facing a significant challenge over the next few years in that the country must meet international commitments.

b) Strategy with additional effort associated with the reduction of CO_2 emissions (E4+)

The Spanish Strategy for Climate Change and Clean Energy and the National Allocation Plan concerning greenhouse-gas emission rights 2008 – 2012 (PNA II) are two very important milestones for the transport sector and demand that, within the planning of the objectives in the 2008-2012 Action Plan, a requirement for a set of additional measures be introduced to increase the objectives of the E4 in reducing the emissions of the sector.

The Action Plan (E4+) 2008-2012, with additional measures to promote saving and energy efficiency in transport, will contribute towards achieving the objectives laid down by application of 15 measures.

Table 13.2. 2008-2012 ACTION PLAN OF THE E4+ (with Additional Measures)
TRANSPORT SECTOR MEASURES

	MEASURES	Action Plan E4+ 2008-2012					
		Investment	Public Support	Primary Energy Saving (ktep)		CO2 Emissions Avoided (ktCO2)	
		(Thousand Euro)		2012	2008-2012	2012	2008-2012
1	URBAN MOBILITY PLANS	1,626,244	241,926	1,504	5,021	4,830	16,122
2	TRANSPORT PLANS FOR BUSINESSES	200,490	36,453	501	1,674	1,610	5,374
3	GREATER PARTICIPATION OF COLLECTIVE MEANS IN TRANSPORT BY ROAD	26,458	26,458	301	1,004	966	3,224
4	GREATER PARTICIPATION OF RAILWAYS	14,569	14,569	1,203	4,017	3,864	12,898
5	GREATER PARTICIPATION OF MARITIME TRANSPORT	14,796	14,796	201	669	644	2,150
6	MANAGEMENT OF TRANSPORT INFRASTRUCTURES	7,136	7,136	2,507	8,368	8,050	26,870
7	MANAGEMENT OF ROAD TRANSPORT FLEET	20,549	20,549	501	1,674	1,610	5,374
8	MANAGEMENT OF AIRCRAFT FLEET	1,430	1,430	100	335	322	1,075
9	EFFICIENT DRIVING OF PRIVATE VEHICLES	8,640	8,640	602	2,008	1,932	6,449
10	EFFICIENT DRIVING OF LORRIES AND BUSES	5,613	5,613	602	2,008	1,932	6,449
11	EFFICIENT TRANSPORT IN THE AVIATION SECTOR	5,318	5,318	100	335	322	1,075
12	RENOVATION OF ROAD TRANSPORT FLEET	6,031	6,031	501	1,674	1,610	5,374
13	RENOVATION OF AIRCRAFT FLEET	1,453	1,453	100	335	322	1,075
14	RENOVATION OF MARITIME FLEET	2,709	2,709	100	335	322	1,075
15	RENOVATION OF PRIVATE CARS	32,795	32,795	1,203	4,017	3,864	12,898
	TOTAL TRANSPORT	**1,974,230**	**425,874**	**10,028**	**33,472**	**32,200**	**107,481**

Explanation: Assessment of the investments set out in the table does not include the transport and equipment infrastructures, only the extra costs arising from the launch of the measures on conventional technologies are given. Public support has been calculated on the basis of the costs that the administrations have to take on in order to overcome the detected barriers.

These measures constitute the same conceptual scheme as the 2005-2007 Action Plan, but with a higher level of requirement in the launch and achievement of same, concentrating the management efforts on reducing modes of transport offering less efficiency and with greater effects on the environment (road transport). Equally, the objectives of the Plan include a greater effort to be made for penetration of biofuels in transport, as well as other alternative fuels, increasing the level of participation to nearly 8% by 2012.

In accordance with the creation of new requirements to fulfil obligations regarding CO_2 emissions, a new scenario has been established in 2012 of greater efficiency than that laid down in the E4, which considers the sector as being characterized by a constant reduction in growth of energy consumption (- 0.5% per annum) on top of the value of the previous year, from the growth forecast in 2008 of the corrected efficiency scenario of the E4 (+2.25%). Achievement of these objectives would lead to the following data:

Table 13.3. SCENARIO PROVIDED FOR IN THE E4+ ACTION PLAN (2008-2012)

(ktep)		2008	2009	2010	2011	2012	TOTAL 2008/2012
Baseline Scenario E4		45,611	47,312	49,077	50,908	52,807	
Efficiency Scenario +		42,016	42,751	43,286	43,610	43,719	
Final E. Saving Objective		3,595 7.9%	4,561 9.6%	5,791 11.8%	7,297 14.%	9,087 17.2%	30,332
Emissions of CO2 avoided	Through saving	12,739	16,162	20,522	25,858	32,200	107,481
	Through Biofuels				970	2,980	3,950
Total (kt. CO2)		**12,739**	**16,162**	**20,522**	**26,828**	**35,180**	**111,431**

The new saving objective of the 2008-2012 Action Plan, which takes account of the additional measures for the transport sector, assumes achievement of an energy saving in 2012, on top of the baseline scenario of the E4, of **9,087 ktep/year (17.21% saving)** and a cumulative saving in the period 2008-2012 of **30,332 ktep,** equivalent to 90% of expected consumption for the sector in 2008.

The reduction of CO_2 emissions in the five-year period 2008-2012 would be **107.5 Mt. CO_2** through direct energy savings and **3.95 Mt. CO_2** through increase in biofuels, being **35.2 Mt. CO_2** in 2012.

The costs associated with the development of the 2008-2012 Action Plan, including these additional measures, will basically be aimed at removing the economic barriers, modifying consumption habits, communication and training measures, and some legislative actions that will gradually incorporate measures focussed on modifying the market in favour of more efficient vehicles.

In this respect, the new Action Plan gives special attention to the development of certain **legislative measures** the launch of which is considered a determining factor for the achievement of the set objectives: among these actions, attention is drawn to the **final development of the basic regulations concerning sustainable urban mobility** and the **modification of taxation of private vehicles according to their energy efficiency and emissions**.

This additional boost to the measures defined in the previous Action Plan and consideration of the results known to date (2000-2006 data) allow for a comparison with the original objectives of the E4. These differences are set out in the following table:

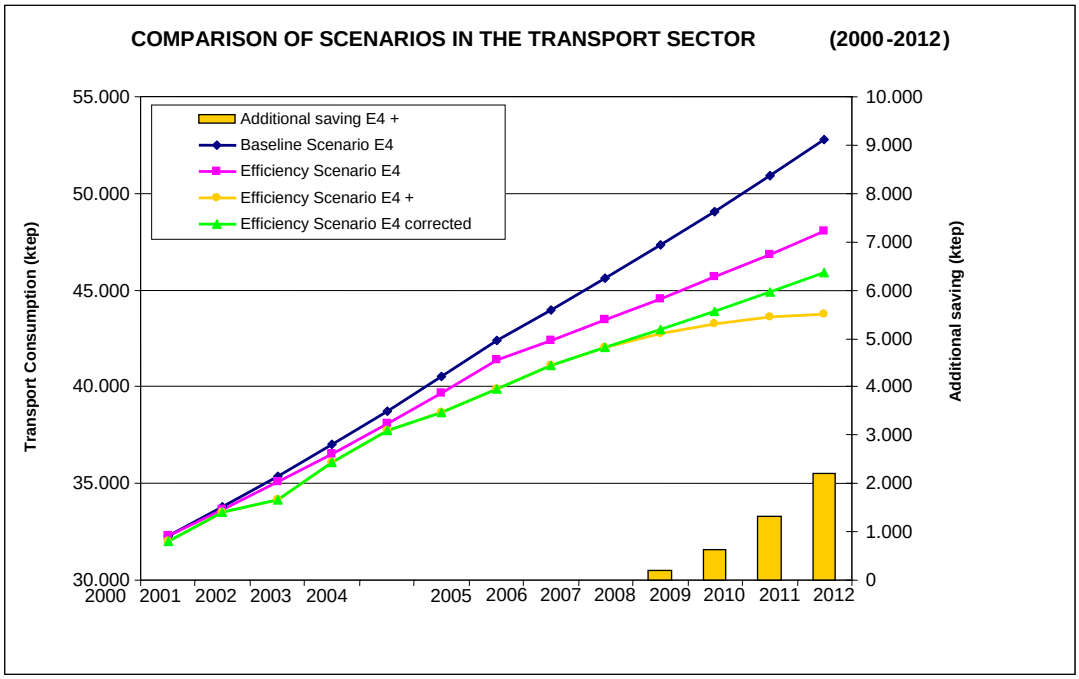
Table 13.4. Comparative Summary of E4 Corrected Efficiency Scenario and E4+ Efficiency Scenario (with additional measures)

	Baseline Scenario E4	Efficiency Scenario E4 corrected		Scenario E4+		Scenario Difference	
	2012	2012	2008-2012	2012	2008-2012	2012	2008-2012
Final energy consumption Transport (ktep)	52,807	45,929	219,756	43,719	215,382	-2,210	- 4,374
Average consumption growth	3.73%		2.25%		1.25%		-1.00%
Savings on Baseline Scenario E4 (ktep)	--	6,877	25,959	9,087	30,332	2,210	4,373
Percentage saving on Baseline Scenario E4	--	**13.0%**	**10.6%**	**17.2%**	**12.3%**		
• Measures for change of mode		**33%**		**37%**			
• Measures for efficient use of means		**50%**		**44%**			
• Measures for more efficient means		**17%**		**19%**			
Emissions avoided through energy saving	--	24,368	91,984	32,200	107,481	7,832	15,498
Emissions avoided through biofuels	--	0	0	2,980	3,950	2,980	3,950
Total Emissions avoided (ktCO_2)	--	24,368	91,984	35,180	111,431	10,812	19,448
Associated investment (k€)	--		1,288,354		1,892,718		604,364
Public support (k€) (*)	--		290,354		408,291		117,937

(*) Public support for biofuels is not assessed.

The difference between these comparative values can be seen in the following Table:

Table 13.5.



The inclusion of a set of additional measures in the transport sector **means a significant economic and social impact** through the changes in trend that these measures must involve and the opportunities presented for the agents of same. From changes in the private-car market towards vehicles of greater efficiency, to changes in behaviour towards more sustainable means of transport, passing through modifications to public infrastructure policies which favour more efficient modes of transport, not forgetting the important contribution of the information and training campaigns that will be carried out.

The new energy objectives of this scenario involve **increasing the savings forecast in the E4 for the year 2012 by 32% and the objectives for reduction of emissions of CO_2 by 44%,** with the resulting public effort that is required to meet this challenge. The efficiency scenario of the E4, would allow for forecast growth in energy consumption in the sector, strong in the period 2000-2006 and moderate between 2006 and 2012, with variations in harmony with the current trend and growth of GDP.

Lastly, a **set of indicators relating to the sector** has been defined which will allow for assessment of the behaviour of the sector according to certain quantifiable parameters relating to the launch of the various measures.

Table 13.6:

BLOCK OF MEASURES	PARAMETERS		BASELINE SCENARIO (see Note)	EFFICIENCY SCENARIO E4	EFFICIENCY SCENARIO E4+
TRANSPORT SOCIO-ECONOMIC INDICATORS	Investment in infrastructures by mode of transport (AGE) (1)	Road	38.6%	25.2%	25.2%
		Rail	39.8%	43.7%	43.7%
		Pipelines		2.3%	2.3%
		Ports	7.0%	9.4%	9.4%
		Airports	11.1%	6.3%	6.3%
		Urban environment	3.5%	13.1%	13.1%
		% Bus lanes out of total network	8.7%	25.4%	35.2%
	Development of energy-sustainable infrastructures	% Alternative buses out of Total buses	23.6%	48.9%	60.1%
		% Metropolitan population less than 300 m from public transport stop	75.1%	84.7%	85.4%
		% Journeys to work without car	36.9%	59.1%	63.8%
		Deterrent parking spaces	74,876	150,193	208,199
		Density of bicycle lanes (km/million inhabitants)	77.6	113	161

BLOCK OF MEASURES	PARAMETERS		BASELINE SCENARIO	EFFICIENCY SCENARIO E4	EFFICIENCY SCENARIO E4+
A. MODAL CHANGE	Intercity passenger/km modal division (1)	Road – Private Vehicle	76.1%	77.5%	73.9%
		- Collective Vehicle	14.0%	12.6%	15.0%
		Rail	5.2%	6.1%	7.0%
		Maritime	0.4%	0.3%	0.6%
		Aviation	4.3%	3.5%	3.5%
	Intercity tonne/km modal div. (1)	Road	84.2%	85.2%	82.0%
		Rail	3.9%	4.5%	6.0%
		Maritime	11.9%	10.3%	12.0%
	No of urban journeys modal division	Car	38.52%	35.0%	32.0%
		Public Transport	17.34%	19.0%	20.0%
		On foot	39.05%	40.0%	41.0%
		Other	5.10%	6.0%	7.0%
	Urban passengers/km modal div.	Private vehicle	84.4%	80.0%	77.0%
		Bus	8.6%	12.0%	14.0%
		Metro	7.0%	8.0%	9.0%
	Reduction of journeys of a distance less than 1 km. (Transfer from private vehicle to movement on foot or by bicycle in urban environment			20%	30%

Table 13.7

BLOCK OF MEASURES	PARAMETERS		BASELINE SCENARIO	EFFICIENCY SCENARIO E4	EFFICIENCY SCENARIO E4+
B. MOST EFFICIENT USE OF MEANS	Increase of occupancy factor for private cars in towns		-	11%	14%
	Increase in occupancy factor for vans, lorries and buses		-	10%	15%
	Efficient driving by professional drivers	Beginners	-	75%	90%
		Experts	-	50%	75%
	Efficient driving by private-car drivers	Beginners	-	100%	100%
		Experts	-	10%	20%

BLOCK OF MEASURES	PARAMETERS		BASELINE SCENARIO	EFFICIENCY SCENARIO E4	EFFICIENCY SCENARIO E4+
C. IMPROVEMENT OF ENERGY EFFICIENCY BY MEANS OF TRANSPORT	Average consumption of private cars	2008 (petrol)	6.4 l/100 km	5.8 l/100 km	5.8 l/100 km
		2008 (diesel)	5.9 l/100 km	5.2 l/100 km	5.2 l/100 km
		2012 (petrol)	6.2 l/100 km	5.1 l/100 km	4.9 l/100 km
		2012 (diesel)	5.7 l/100 km	4.7 l/100 km	4.5 l/100 km
	Reduction of specific consumption of rail transport against baseline scenario		-	5%	10%
	Reduction of specific consumption of air transport against baseline scenario		-	5%	10%
	Reduction of specific consumption of maritime transport against baseline scenario		-	5%	10%

Assessment of results from the launch of the measures laid down in the 2008-2012 Action Plan, on the basis of the abovementioned indicators and other general values for energy consumption in the sector, will derive from the statistical and annual publications of the various administrations, particularly those of the Ministries of Public Works, Environment, Industry, Trade and Tourism, and the Ministry of the Interior.

Similarly, achievement of the objectives laid down in the 2008-2012 Action Plan in the transport sector will imply a set of advantages. First, the reduction of external dependency, almost absolute for transport with regard to oil and its derivatives. Secondly, in economic terms, both energy saving and the reduction of polluting emissions have a significant economic impact, quantifiable in the following table:

Table 13.8.

Measure	Economic Savings Action Plan (2008-2012) Transport (k€)					
	2008	2009	2010	2011	2012	Total
Energy origin	1,904,257	2,415,935	3,067,632	3,865,295	4,813,332	16,066,451
Origin CO_2 avoided	229,304	290,918	369,392	482,906	633,244	2,005,764
Total	2,133,561	2,706,853	3,437,024	4,348,201	5,446,576	18,072,215

Note: Costs used. 1 tep = 480 €. 1 tCO_2 = 18 €.

Other advantages arising from these results would be improvement of energy competitiveness through improved energy efficiency (an important factor in Spain as compared with the surrounding countries) which will consequently have an impact on the creation of risk and the improvement of the quality of life through reduction of private mobility in urban environments and emissions themselves.

13.2. Measures in the Transport Sector

Measures for Modal Change

MEASURE 1: Urban Mobility Plans

Objective:

The objective of this measure is to take action on urban mobility in order to achieve important changes in modal division, with greater participation of more efficient means of transport, in detriment to the use of the private vehicle with low occupancy, and to promote the use of modes that do not consume fossil fuels, such as walking on foot and the bicycle.

Mobility plans were initially created for towns with more than 100,000 inhabitants, and **in this second stage, they will be extended to towns with more than 50,000 inhabitants (approximately 120),** which are those obliged to rely on a public transport service.

Description:

Urban mobility plans are integral actions which encourage municipal managers to achieve more energy-efficient and less polluting mobility, in addition to improving citizens' quality of life.

Given the complexity of urban mobility and all its implications, the process for improving transport efficiency in this domain has to be dealt with inclusively. Urban mobility plans should include not only policies offering better means of collective transport but also regulation in the use of the private vehicle, above all that with low occupancy. Similarly, account must be taken of criteria concerning town-planning, parking and infrastructures which do not increase traffic in sensitive areas.

The preparation of a sustainable mobility plan requires a methodology of participation and social awareness, publicity and education by the local authorities, detailed analysis of the original position and the proposals, gradual

introduction of measures with assessment of results, and pilot, educational and promotional exercises.

Mobility plans also require a municipal management team which guarantees participation of citizens and business organizations, lends help and support for strictly technical actions and prepares the necessary regulations. These plans must be assessed periodically to confirm that an increase in journey efficiency has been produced, as well as a lesser role for the private vehicle and greater participation of more efficient modes in overall mobility.

The cost of the measure does not generally include the cost of infrastructures, although it does consider support for investments in individual projects and actions as part of agreements with municipalities.

The elements which form part of an urban mobility plan, in terms of both organization and infrastructure, include the following:

- Modal interchanges
- Parking regulation and payment
- Payment for the use of infrastructures
- Areas with traffic restrictions
- Promotion of mobility on foot and by bicycle
- Offer of better quality collective means
- Flexible transport services, adapted to demand
- Logistical centres to regulate loading and unloading
- Teleworking
- Car-sharing centres

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE, Ministry of Environment, Ministry of Economy and Finance, Ministry of Public Works and Local Administration.

Actions (Responsibility and Planning):

Table 13.7.

Action	Responsible	Period
Drafting and application of regulations concerning mobility.	ENVIRONMENT	2008
Establishment of a system for distribution of public aid to urban transport according to the level of introduction of sustainable urban mobility measures/plans and increase in current subsidies. Granting of these subsidies to councils using established energy efficiency/sustainability criteria.	MINISTRY OF ECONOMY AND FINANCE	2009-2012
Reinforcement of the system of economic and technical support to councils for the introduction of urban mobility plans, mainly for individual infrastructure studies and projects (bicycle lanes, pedestrian areas, modal interchanges, fast lanes for vehicles with high occupancy, etc.).	AUTONOMOUS COMMUNITIES	2008-2012
	MINISTRY OF PUBLIC	

Promotion of agreements with councils and autonomous communities to undertake investment.	WORKS	2008-2012
Preparation and application of municipal orders consistent with sustainable mobility plans.	MUNICIPALITIES	2009-2012
Development of a training and dissemination plan aimed at municipal technicians and managers of Autonomous Communities.	MINISTRY OF INDUSTRY, TRADE AND TOURISM/IDAE	2008-2009
Development of institutional campaigns supporting a new urban mobility, including giving rewards and awards to exemplary projects.	MINISTRY OF INDUSTRY, TRADE AND TOURISM/IDAE	2008-2012

Costs (k€):

Table 13.8.

2008	2009	2010	2011	2012	Total
28,674	36,379	46,192	58,203	72,478	241,926

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.9.

2008	2009	2010	2011	2012	Total
595	755	959	1,208	1,504	5,021

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.10.

2008	2009	2010	2011	2012	Total
1,911	2,424	3,078	3,879	4,830	16,122

MEASURE 2: Transport Plans in Businesses and Activity Centres

Objective:

To introduce transport plans in all businesses and activity hubs with more than 200 workers, with the aim of reducing the number of journeys by private vehicle with low occupancy when moving from home to place of work/study.

Description:

Transport plans in businesses or activity hubs (industrial estates, hospitals, educational centres, etc) are organizational actions, accompanied by provision of infrastructures, promoted by activity hubs with the support of the Administration, to achieve a change in the model of journeys to/from the workplace: from the current model based on the predominance of the private vehicle to another based on greater use of collective means and on the increase of occupants in the private vehicle.

The preparation of a transport plan requires an initial study in order to know, among other things, what form of movement all workers select, the activity hub's policy as regards transport of workers and parking of vehicles, and the public transport infrastructure that serves the centre. At a later date, the actions of the plan have to be launched, aimed at increasing the energy efficiency of movements as a result of less use of the private car.

Typical actions of a transport plan include, among others:

- Company buses or shuttle buses at interchanges or metro or train stations
- Car-sharing
- Promotion of bicycle and walking
- New parking policy which does not encourage use of private vehicle
- Adaptation of collective public transport systems

The implementation of a transport plan has to rely on the determined support of the activity hub, which will manage it through the transport coordinator, the transport authorities – to adapt the collective transport infrastructures – and the trade unions.

The activity hub will have to direct its aid system for transport towards the promotion of more efficient means, with measures that have to be supported by all the workers.

The transport plans offer important benefits to the activity hub, including significant reduction of parking space provision, improvement of accessibility and punctuality of employees, better security and a more positive social and environmental image for the centre. In the same way, the advantages for workers are varied: safer journeys at lower cost and less stress, improvement in health and quality of life, increase in travel options for those who do not own a car, etc.

Responsibility and Collaboration:

Responsible:
Autonomous Communities.

Collaborators:
Ministry of Industry, Trade and Tourism/IDAE, Ministry of Environment, Ministry of Economy and Finance, Ministry of Public Works and Local Administration.

Actions (Responsibility and Planning):

Table 13.11.

Action	Responsible	Period
Study for drafting, where necessary, legislation making it obligatory to introduce integral transport plans in businesses and activity hubs with more than 200 workers.	MINISTRY OF EMPLOYMENT	2008-2009
Development of institutional campaigns to support a new type of mobility from home to place of work/study, including rewards and awards for exemplary projects.	MIN. INDUSTRY, TRADE & TOURISM/IDAE	2009-2010
Development of a promotional and training plan.	MIN. INDUSTRY, TRADE & TOURISM/IDAE	2008-2009
Development of current options of tax benefits for businesses/activity hubs which introduce a sustainable transport plan for their workers.	MINISTRY OF ECONOMY & FINANCE	2011-2012
Establishment of the obligation to submit a transport plan prior to granting a business licence.	AUTONOMOUS COMMUNITIES	2012

Costs (k€):

Table 13.12.

2008	2009	2010	2011	2012	Total
4,321	5,481	6,960	8,770	10,921	34,948

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.13.

2008	2009	2010	2011	2012	Total
198	252	320	403	501	1,674

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.14.

2008	2009	2010	2011	2012	Total
637	808	1,026	1,293	1,610	5,374

MEASURE 3: Greater Participation of Collective Means in Road Transport

Objective:

To achieve greater modal participation of collective means of road transport, as against participation of the private vehicle.

Description:

The private vehicle is, currently, dominant in the modal division of transport of passengers by road, although its energy intensity (energy consumed per passenger/km) is greater than that of the collective means. In order to achieve increased participation of the latter, the measure proposed is aimed at improving both the transport infrastructures and the quality of service. For example, using the following types of measure:

- New modal interchanges, in order to minimize journey and transfer times between the different networks and thereby guarantee rapid and reliable connections between the various means of transport.

- Specific lanes for collective transport, which offers advantages over individual transport at access points to the major cities.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works/Autonomous Communities.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE, local administration.

Actions (Responsibility and Planning):

Table 13.15.

Action	Responsible	Period
Establishment of an integrated national road transport system, with continuous updating of databases and use of the latest information technology to provide a quality service to passengers.	PUBLIC WORKS	2008-2009

Costs (k€):

Table 13.16.

2008	2009	2010	2011	2012	Total
3,136	3,978	5,052	6,365	7,926	26,458

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.17.

2008	2009	2010	2011	2012	Total
119	151	192	242	310	1,004

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.18.

2008	2009	2010	2011	2012	Total
382	485	616	776	966	3,224

MEASURE 4: Greater Participation of Railways in Intercity Transport

Objective:

To achieve greater modal participation of railways in intercity transport.

Description:

The railway has a very low share in the carriage of passengers (5%) and goods (4%), although it is more efficient than road transport. The bid for an improvement in the participation of the railway, both in intercity passenger transport and that of goods, is a priority objective of the strategic planning of the State General Administration.

In order to increase the quota of this means of transport, it is necessary to internalize the actual costs of the road and improve the quality of the service and infrastructures, especially in order to encourage the combined transport of goods. The liberalization of the sector also has to contribute towards achievement of these objectives.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Collaborators:

Ministry of Industry, Trade and Tourism/IDAE.

Actions (Responsibility and Planning):

Table 13.19.

Action	Responsible	Period
Establishment of a national information system on rail transport, with continuous updating of databases with quality criteria to provide information to the passenger, using new information technology.	PUBLIC WORKS (AUTONOMOUS COMMUNITIES)	2008-2012
Study of economic systems of compensation for energy discharged to the network using regenerative brake.	ECONOMY AND FINANCE	2010-2012
Creation of tools for combined transport management and support for individual experiments.	PUBLIC WORKS	2009-2011

Costs (k€):

Table 13.20.

2008	2009	2010	2011	2012	Total
1,727	2,191	2,782	3,505	4,365	14,569

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.21.

2008	2009	2010	2011	2012	Total
476	604	767	966	1,203	4,017

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.22.

2008	2009	2010	2011	2012	Total
1,529	1,939	2,463	3,103	3,864	12,898

MEASURE 5: Greater Participation of Maritime Mode in the Carriage of Goods

Objective:

To achieve greater modal participation of the maritime sector in the carriage of goods.

Description:

Maritime transport contributes towards improving overall energy efficiency of the carriage of goods if it is properly combined with land-based transport, especially the railways and for certain cargoes in particular.

In order to make it more attractive and competitive with other means of transport, it is necessary to improve the design of its infrastructures and services, mainly by way of agreements with businesses of the sector, individual studies, audits and projects, and aid instruments.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.23.

Action	Responsible	Period
Development of agreements with shippers and operators in order to promote the maritime mode.	PUBLIC WORKS	2008-2012
Implementation of individual studies, audits and projects.	AUTONOMOUS COMMUNITIES	2008-2010
Definition of aid instruments for maritime transport taking account of internalization of costs of other means.	ECONOMY AND FINANCE	2010-2012
Preparation of a plan for the promotion of dry ports and short-sea shipping; study of the current position and plan for creation of new infrastructures.	PUBLIC WORKS	2009-2010

Costs (k€):

Table 13.24.

2008	2009	2010	2011	2012	Total
1,754	2,225	2,825	3,560	4,433	14,796

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.25.

2008	2009	2010	2011	2012	Total
79	101	128	161	201	669

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.26.

2008	2009	2010	2011	2012	Total
255	323	410	517	644	2,150

Measures for More Efficient Use of Means of Transport

MEASURE 6: Transport Infrastructure Management

Objective:

To improve management of existing transport infrastructures with the aim of achieving greater energy efficiency in the use of means, both in the carriage of passengers and goods.

Description:

In order to optimize infrastructure management, it is necessary to carry out integral studies of the interchange networks and logistical centres, as well as economic management systems for use of infrastructures.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Collaborators:

Ministry of the Interior/DGT and Autonomous Regions Administration.

Actions (Responsibility and Planning):

Table 13.27.

Action	Responsible	Period
Study for the establishment, where necessary, of a general system for economic management of infrastructures, both for private vehicles and for collective transport and goods vehicles.	ECONOMY AND FINANCE	2009-2012
Preparation of improvement proposals to optimize the management of passenger interchange networks and logistical centres for goods, based on studies and comprehensive analysis of existing infrastructures.	PUBLIC WORKS/AUTONOMOUS COMMUNITIES	2008-2010
Development of promotion and information campaigns on a national scale concerning reserved lanes (for public transport and vehicles with high occupancy), passenger interchanges, logistical centres for goods, appropriate design of roads and measures for speed reduction which allow for optimization of traffic flows and promotion of the use of more efficient means.	MIN. INDUSTRY, TRADE & TOURISM/IDAE	2010-2012
Development of individual projects and dissemination of results so that they may serve as an example for general adoption.	MIN. INDUSTRY, TRADE & TOURISM/IDAE	2009-2011
Implementation of control campaigns for strict application of the speed limits specified in the urban and intercity environment, and of the traffic regulations in general.	MUNICIPALITIES/DGT	2011-2012

Costs (k€):

Table 13.28.

2008	2009	2010	2011	2012	Total
846	1,073	1,363	1,717	2,138	7,136

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.29.

2008	2009	2010	2011	2012	Total
992	1,258	1,598	2,013	2,507	8,368

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.29.

2008	2009	2010	2011	2012	Total
3,185	4,041	5,130	6,465	8,050	26,870

MEASURE 7: Road Transport Fleet Management

Objective:

To improve road transport fleet management in order to achieve a reduction in the specific consumption per tonne or passenger carried.

Description:

With this measure, it is hoped to encourage general use of new data communication applications and other fleet management tools by all road transport companies, whether for the carriage of goods or collective transport of passengers.

This objective will be reached mainly through promotion and training programmes, as well as support systems for businesses which have introduced fleet management using energy-efficiency criteria.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Public Works, Ministry of Industry, Trade and Tourism/IDAE.

Actions (Responsibility and Planning):

Table 13.31.

Action	Responsible	Period
Definition and award of an appropriate accreditation to all those businesses which have set up a fleet management system within their organization. This accreditation may be combined with that relating to the renovation of fleets, considered in **Measure 12:** *Renovation of Road Transport Fleet*.	PUBLIC WORKS	2011-2012
Establishment of minimum fleet management criteria for the granting of licences to businesses offering collective carriage of passengers and goods.	PUBLIC WORKS	2010-2011
Promotion of new technologies and studies of technological demand.	MIN. OF INDUSTRY, TRADE & TOURISM/IDAE	2009-2011
Promotion of integrated logistical centres.	PUBLIC WORKS	2010-2012

Costs (k€):

Table 13.32.

2008	2009	2010	2011	2012	Total
2,436	3,090	3,924	4,944	6,156	20,549

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.33.

2008	2009	2010	2011	2012	Total
198	252	320	403	501	1,674

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.34.

2008	2009	2010	2011	2012	Total
637	808	1,026	1,293	1,610	5,374

MEASURE 8: Aircraft Fleet Management

Objective:

To optimize the air traffic system and obtain operational improvements from airline companies.

Description:

Within the framework of this measure, it is hoped to encourage improvements in aircraft fleet management through agreements with airline companies which give consideration to improving their procedures, optimization of the air traffic systems, operations and equipment of aircraft, and reduction of 'tankering' (supply of fuel using purely economic and not energy consumption criteria).

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.35.

Action	Responsible	Period
Creation of specialized groups which will work with the airline companies and airport operators to identify and introduce fleet management improvements.	PUBLIC WORKS	2008-2010
Economic support for the overall cost of light aircraft and planes if they replace engines with others that are more efficient (e.g. which may involve a change of fuel - leaded petrol for diesel, etc.).	PUBLIC WORKS/MIN. OF INDUSTRY, TRADE & TOURISM	2008-2012
Development of framework agreements with the sector for effective introduction of all the proposed improvements.	PUBLIC WORKS	2010-2012
Promotion of improvements in air traffic systems, in collaboration with various European programmes, including:	PUBLIC WORKS	2009-2011
Promotion of operational and legislative improvements concerning alternative airports.	PUBLIC WORKS	2011-2012
Promotion of improvements in aircraft equipment:	PUBLIC WORKS	2010-2012
Reduction of tankering by way of agreements with companies concerning the tankering limit.	PUBLIC WORKS	2009-2012
Promotion of improvements in airline company procedures so that they take account of energy-efficiency criteria.	PUBLIC WORKS	2010-2012
Development of promotion and training campaigns concerning optimization of air traffic and operational improvements.	PUBLIC WORKS	2010-2012

Costs (k€):

Table 13.36.

2008	2009	2010	2011	2012	Total
169	215	273	344	428	1,430

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.37.

2008	2009	2010	2011	2012	Total
40	50	64	81	100	335

The estimates of energy savings are for energy use, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.38.

2008	2009	2010	2011	2012	Total
127	162	205	259	322	1,075

MEASURE 9: Efficient Driving of Private Vehicle

Objective:

To introduce efficient driving techniques for both new and expert drivers of private cars.

Description:

The measure includes a set of actions aimed at disseminating the techniques of '*efficient driving*' to all drivers of private vehicles, for both new drivers (through the teaching system for obtaining a driving licence) and expert drivers (through practical courses).

The measure also considers the gradual installation of onboard computers with cruising-speed control and consumption meter in all new private cars, mainly through voluntary agreements with manufacturers.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Interior/DGT, Ministry of Industry, Trade and Tourism/IDAE

Actions (Responsibility and Planning):

Table 13.39

Action	Responsible	Period
Drafting of agreements with manufacturers to promote the installation of onboard computers with cruising-speed control and consumption meter in all new private cars.	MIN. OF INDUSTRY, TRADE & TOURISM/IDAE	2008-2010
Development of an energy labelling system for tyres consistent with the EU Action Plan.	MIN. OF INDUSTRY, TRADE & TOURISM/IDAE	2008-2010
Formal introduction of efficient driving techniques in driving exams and retraining of drivers.	MINISTRY OF INTERIOR/DGT	2008-2010

Costs (k€):

Table 13.40.

2008	2009	2010	2011	2012	Total
1,024	1,299	1,650	2,079	2,588	8,640

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.41.

2008	2009	2010	2011	2012	Total
238	302	383	483	602	2,008

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.42.

2008	2009	2010	2011	2012	Total
764	970	1,231	1,551	1,932	6,449

MEASURE 10: Efficient Driving of Lorries and Buses

Objective:

To introduce efficient driving techniques for both new and expert drivers of industrial vehicles.

Description:

With the proposed measure, the new driving techniques will be disseminated among all drivers of industrial vehicles (lorries and buses), for both new drivers (through the teaching system for obtaining a driving licence) and for expert drivers (through training and practical courses).

The measure also considers the establishment of a recognized system of quality certification of businesses dedicated to the carriage of passengers and goods by road, depending on the training in efficient driving of their drivers.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Interior/DGT. Ministry of Industry, Tourism and Trade/IDAE and Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.43.

Action	Responsible	Period
Introduction of efficient driving techniques in the teaching system and assessment for obtaining a driving licence for industrial vehicles.	MINISTRY OF INTERIOR/DGT	2008-2010
Development of campaigns for dissemination of efficient driving techniques to the professional drivers sector.	MIN. OF INDUSTRY, TRADE & TOURISM/IDAE,	2008-2010
Development of regulations for introduction of efficient driving in the transposition of Directive 2003/59 on training of professional drivers, in collaboration with the Ministry of the Interior/DGT.	MINISTRY OF INTERIOR/DGT	2008-2009
Economic support for plans for training in efficient driving for lorry and bus drivers throughout the national territory.	AUTONOMOUS COMMUNITIES	2008-2009
Establishment of a recognized system for quality certification of businesses dedicated to the carriage of passengers and goods, depending on the training in efficient driving of their drivers.	PUBLIC WORKS	2008-2010

Costs (k€):

Table 13.44.

2008	2009	2010	2011	2012	Total
665	844	1,072	1,350	1,682	5,613

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.45.

2008	2009	2010	2011	2012	Total
238	302	383	483	602	2,008

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.45.

2008	2009	2010	2011	2012	Total
764	970	1,231	1,551	1,932	6,449

MEASURE 11: Efficient Driving in the Aviation Sector

Objective:

To introduce aircraft piloting techniques which allow for substantial energy savings to be achieved in the aviation sector.

Description:

This measure consists of the introduction in the aviation sector of more energy-efficient piloting of aircraft, for which the preparation of training tools, the promotion of courses for pilots of all airline companies and support to same are considered, as well as the signing of agreements with companies for introduction of pilot-training protocols in their procedures.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.46.

Action	Responsible	Period
Preparation of tools to support efficient piloting of aircraft.	PUBLIC WORKS	2008-2010
Support for training courses in efficient piloting for pilots.	PUBLIC WORKS	2010-2012
Promotion of efficient piloting courses among air transport companies.	PUBLIC WORKS	2009-2010
Development of agreements with airline companies for the introduction of training protocols for pilots in their procedures.	PUBLIC WORKS	2009-2010

Costs (k€):

Table 13.47.

2008	2009	2010	2011	2012	Total
630	800	1,015	1,279	1,593	5,318

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.48.

2008	2009	2010	2011	2012	Total
40	50	64	81	100	335

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.49.

2008	2009	2010	2011	2012	Total
127	162	205	259	322	1,075

Measures for Improvement of Energy Efficiency of Vehicles

MEASURE 12: Renovation of Road Transport Fleet

Objective:

To introduce more efficient vehicles in fleets for collective transport of passengers and goods.

Description:

The measure hopes to achieve an appropriate renovation of the road transport fleet, and thereby increase the energy efficiency of this sector. This Action Plan proposes promotion and training actions, the development of information systems concerning fuel consumption, as well as fleet studies and audits. The Plan also considers economic support compatible with legal limitations.

The measure is aimed at modernizing the fleet using criteria for adapting the services of vehicles to the operational needs of businesses.

Responsibility and Collaboration:

Responsible:

Autonomous Communities

Collaborators:

Ministry of Industry, Tourism and Trade/IDAE. Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.50.

Action	Responsible	Period
Development of regulations which favour more energy-efficient vehicles, with average age limits of fleets.	PUBLIC WORKS	2009-2011
Establishment of minimum fleet quality for the granting of licences and accreditations to businesses offering collective transport of passengers and goods.	PUBLIC WORKS	2011-2012
Provision of technical assistance and economic support for adequate fleet composition.	PUBLIC WORKS	2011-2012
Preparation of an information system on fuel consumption of industrial vehicles and collective transport which will be able to include an energy label similar to that for private vehicles.	MIN. OF INDUSTRY, TRADE & TOURISM/IDAE	2011-2012

Costs (k€):

Table 13.51.

2008	2009	2010	2011	2012	Total
715	907	1,151	1,451	1,807	6,031

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.52.

2008	2009	2010	2011	2012	Total
198	252	320	403	501	1,674

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.53.

2008	2009	2010	2011	2012	Total
637	808	1,026	1,293	1,610	5,374

MEASURE 13: Renovation of Aircraft Fleet

Objective:

To introduce more efficient aircraft in the fleets of air transport companies.

Description:

The measure aims to accelerate renovation of the oldest and less energy-efficient fleets by way of agreements with the airline companies in order to study and introduce this renovation using energy-efficient criteria.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.54.

Action	Responsible	Period
Promotion of agreements with aircraft operators to study potential reduction of consumption and costs of an appropriate fleet renovation and to commission this renovation.	PUBLIC WORKS	2008-2011

Costs (k€):

Table 13.55.

2008	2009	2010	2011	2012	Total
172	218	277	349	435	1,453

These estimates relate to economic support and expenditure of the various administrations for carrying out actions described above.

Energy (ktep):

Table 13.56.

2008	2009	2010	2011	2012	Total
40	50	64	81	100	335

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided(kt):

Table 13.57.

2008	2009	2010	2011	2012	Total
127	162	205	259	322	1,075

MEASURE 14: Renovation of Maritime Fleet

Objective:

To introduce more efficient vessels in shipping company fleets.

Description:

The measure aims to promote agreements with maritime operators with the aim of studying the potential reduction of consumption and costs of an appropriate fleet renovation in order to commission this renovation at a later date.

Responsibility and Collaboration:

Responsible:

Ministry of Public Works.

Actions (Responsibility and Planning):

Table 13.58.

Action	Responsible	Period
Promotion of agreements with the maritime operators in order to study the potential reduction of consumption and costs of an appropriate fleet renovation and to commission this renovation.	PUBLIC WORKS	2008-2011

Costs (k€):

Table 13.59.

2008	2009	2010	2011	2012	Total
321	407	517	652	811	2,709

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy (ktep):

Table 13.60.

2008	2009	2010	2011	2012	Total
40	50	64	81	100	335

These estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.61.

2008	2009	2010	2011	2012	Total
127	162	205	259	322	1,075

MEASURE 15: Renovation of Private Cars

Objective:

To modernize private cars in Spain so as to take advantage of the greater energy efficiency of new vehicles.

Description:

Currently, there are much more energy-efficient private vehicles on the market than the majority of vehicles in circulation.

In order to benefit from the advantages of the lower consumption of modern vehicles, renovation of cars will be encouraged by way of systems supporting the acquisition of more efficient vehicles and modifications to the Plan Prever (Forecast Plan) and to the tax system which assesses acquisition and use of private cars for tax purposes in order to link them to the vehicle's fuel consumption.

Responsibility and Collaboration:

Responsible:

Autonomous Communities.

Collaborators:

Ministry of Economy and Finance, Ministry of Health and Consumer Affairs and Autonomous Regions Administration. Ministry of Industry, Tourism and Trade/IDAE.

Actions (Responsibility and Planning):

Table 13.62.

Action	Responsible	Period
Modification of the tax system which assesses acquisition and use of private cars for tax purposes in order to link them to vehicle energy consumption, keeping the overall tax cost equivalent to the current cost.	ECONOMY AND FINANCE	2008-2012
Development of regulatory instruments which allow for incorporation of energy-efficiency criteria in the purchasing process for private and industrial vehicles of public administrations.	MIN. OF INDUSTRY, TRADE & TOURISM/IDAE	2008-2012
Implementation of inspections to verify the correct application of the new decree which amends Royal Decree 837/2002 concerning labelling of cars, in collaboration with the Ministry of Health and Consumer Affairs and the Autonomous Communities.	AUTONOMOUS COMMUNITIES	2010-2012

Costs (k€):

Table 13.63.

2008	2009	2010	2011	2012	Total
3,887	4,931	6,262	7,890	9,825	32,795

These estimates relate to economic support and expenditure of the various administrations for carrying out the actions described above.

Energy savings (ktep):

Table 13.64.

2008	2009	2010	2011	2012	Total
476	604	767	966	1,203	4,017

The estimates of energy savings are for energy uses, in the form of petrol and diesel.

Emissions of CO_2 avoided (kt):

Table 13.65.

2008	2009	2010	2011	2012	Total
1,529	1,939	2,463	3,103	3,864	12,898

Consideration of the penetration of biofuels in road transport

The Renewable Energy Plan (2005-2010) will mean a significant increase in participation of these technologies in the overall energy supply and, in particular, biofuels in the consumption of the transport sector.

According to the objectives of the Plan, consumption of biofuels of 2,200 ktep can be forecast in 2010 (a figure equivalent to 5.83% of fuel energy consumption according to the objective laid down by Directive 2003/30/EC), and taking into consideration a linear increase reaching 10% in 2016, it can be estimated that in 2012 the penetration of biofuels will be around 8%, which would mean the following trend in the period 2008-2012:

Table 13.66.

Year	2008	2009	2010	2011	2012
New forecasts for consumption of biofuels (ktep/year)	1,067	1,465	2,200	2,526	3,203

As a result of this variation in objectives concerning the Renewable Energy Plan in 2012, the additional consumption of biofuels can be assessed as 1,003 ktep, with the following annual increase:

Table 13.67.

Year	2008	2009	2010	2011	2012
Increase in consumption of biofuels as against the Efficiency Scenario of the E4 (ktep/year)	0	0	0	326	1,003

With respect to public support relating to the promotion and penetration of biofuels in the transport sector, it was considered that this is not attributable to the 2008-2012 Action Plan of the E4.

Emissions of CO_2 avoided ($ktCO_2$/year) through increase in objectives:

Table 13.68.

2008	2009	2010	2011	2012	Total
0	0	0	970	2,980	3,950

Under the auspices of the Renewable Energy Plan (2005-2010) and Directive 2003/30/EC concerning promotion of biofuels, there is provision for the drafting of a Royal Decree obliging the system operators to include a certain percentage of biofuels in the products that they market. The obligatory percentages will have to be determined according to the production capacities of these biofuels in Spain and the specified objectives.

13.3. Summary of Costs and Benefits by measure

Table 13.69.

	Measure	Primary Energy Saving (ktep)						Emissions Reduction ($ktCO_2$)						Public Support (k€)						Associated Investments (k€)					
		2008	2009	2010	2011	2012	*Total*	2008	2009	2010	2011	2012	*Total*	2008	2009	2010	2011	2012	*Total*	2008	2009	2010	2011	2012	*Total*
1	Urban Mobility Plans	595	755	959	1,208	1,504	**5,021**	1,911	2,424	3,078	3,879	4,830	**16,122**	36,289	48,385	48,385	48,385	60,482	**241,926**	243,937	325,249	325,249	325,249	406,561	**1,626,244**
2	Transport Plans for Businesses	198	252	320	403	501	**1,674**	637	808	1,026	1,293	1,610	**5,374**	5,468	7,291	7,291	7,291	9,113	**36,453**	30,074	40,098	40,098	40,098	50,123	**200,490**
3	Greater Participation of Collective Means in Road Transport	119	151	192	242	301	**1,004**	382	485	616	776	966	**3,224**	3,969	5,292	5,292	5,292	6,614	**26,458**	3,969	5,292	5,292	5,292	6,614	**26,458**
4	Greater Rail Participation	476	604	767	966	1,203	**4,017**	1,529	1,939	2,463	3,103	3,864	**12,898**	0	1,457	2,185	3,642	7,285	**14,569**	0	1,457	2,185	3,642	7,285	**14,569**
5	Greater Maritime Participation	79	101	128	161	201	**669**	255	323	410	517	644	**2,150**	0	1,480	2,959	4,439	5,918	**14,796**	0	1,480	2,959	4,439	5,918	**14,796**
6	Management of Transport Infrastructures	992	1,258	1,598	2,013	2,507	**8,368**	3,185	4,041	5,130	6,465	8,050	**26,870**	1,070	1,427	1,427	1,784	1,427	**7,136**	1,070	1,427	1,427	1,784	1,427	**7,136**
7	Management of Road Transport Fleet	198	252	320	403	501	**1,674**	637	808	1,026	1,293	1,610	**5,374**	3,082	4,110	4,110	5,137	4,110	**20,549**	3,082	4,110	4,110	5,137	4,110	**20,549**
8	Management of Aircraft Fleet	40	50	64	81	100	**335**	127	162	205	259	322	**1,075**	0	0	286	500	643	**1,430**	0	0	286	500	643	**1,430**
9	Efficient Driving of Private Vehicle	238	302	383	483	602	**2,008**	764	970	1,231	1,551	1,932	**6,449**	2,592	2,592	1,728	1,296	432	**8,640**	2,592	2,592	1,728	1,296	432	**8,640**
10	Efficient Driving of Lorries and Buses	238	302	383	483	602	**2,008**	764	970	1,231	1,551	1,932	**6,449**	1,684	1,684	1,123	842	281	**5,613**	1,684	1,684	1,123	842	281	**5,613**
11	Efficient Driving in Aviation Sector	40	50	64	81	100	**335**	127	162	205	259	322	**1,075**	0	0	1,064	1,861	2,393	**5,318**	0	0	1,064	1,861	2,393	**5,318**
12	Renovation of Road Transport Fleet	198	252	320	403	501	**1,674**	637	808	1,026	1,293	1,610	**5,374**	1,809	1,809	1,206	905	302	**6,031**	1,809	1,809	1,206	905	302	**6,031**
13	Renovation of Aircraft Fleet	40	50	64	81	100	**335**	127	162	205	259	322	**1,075**	0	0	291	508	654	**1,453**	0	0	291	508	654	**1,453**
14	Renovation of Maritime Fleet	40	50	64	81	100	**335**	127	162	205	259	322	**1,075**	0	0	542	948	1,219	**2,709**	0	0	542	948	1,219	**2,709**
15	Renovation of Private Cars	476	604	767	966	1,203	**4,017**	1,529	1,939	2,463	3,103	3,864	**12,898**	6,559	9,839	6,559	4,919	4,919	**32,795**	6,559	9,839	6,559	4,919	4,919	**32,795**
	Values for the 15 Measures	3,967	5,033	6,391	8,053	10,028	**33,472**	12,739	16,162	20,522	25,858	32,200	**107,481**	62,522	85,365	84,446	87,745	105,791	**425,874**	294,776	395,036	394,117	397,421	492,880	**1,974,230**
	Additional results for biofuels										970	2,980													
	TOTAL TRANSPORT SECTOR MEASURES	3,967	5,033	6,391	8,053	10,028	**33,472**	12,739	16,162	20,522	26,828	35,180	**111,431**	62,522	85,365	84,446	87,745	105,791	**425,874**	294,776	395,036	394,117	397,421	492,880	**1,974,230**

13.4. Economic benefits

Table 13.70.

Measure	Economic Benefit (k€)					
	2008	2009	2010	2011	2012	Total
Energy origin	1,904,257	2,415,935	3,067,632	3,865,295	4,813,332	16,066,451
Origin CO_2 avoided	229,304	290,918	369,392	482,906	633,244	2,005,764
Total	2,133,561	2,706,853	3,437,024	4,348,201	5,446,576	18,072,215

14. ENERGY TRANSFORMATION SECTOR

14.1. Energy Transformation Sector Position

Context

The Energy Transformation sector includes all those activities consisting of the conversion of primary energy into final energy, suitable for use in end-user sectors. The following sectors are included within these activities:

- ✓ Oil Refining. This may be made up of a limited number of major companies that carry out the conversion of oil as primary energy into energy products for use by the various consumer sectors.
- ✓ Electricity Generation. This is made up of a significant number of companies whose activity is electricity production from hydraulic resources, fossil fuels and nuclear fuel as primary energy.
- ✓ Cogeneration. A sector made up of a considerable number of companies of various sizes which operate in various sectors of activity and which transform primary energy in the form of natural gas or other fuels into final energy in the form of usable thermal energy (heat/refrigeration) and electricity and/or mechanical energy for use in the sectors with which they are associated.

The set of saving and energy-efficiency measures laid down in the E4 for the Energy Transformation sector assume an annual cumulative saving objective at the end of the period 2004 – 2012 of 1,494 ktep, distributed between the sectors according to the following table:

Table 14.1. Objectives of the E4 for primary energy saving in the Energy Transformation Sector

Area	Energy saving (ktep) according to the E4 in 2012
Oil Refining	576.5
Electricity Generation	767.5
Cogeneration Systems	Energy efficiency improvement: 150
TOTAL	**1,494**

The E4 for the Cogeneration sector adopted the forecast installed capacity as indicated in the Electricity and Gas Sectors Plan 2002 – 2011, that is, an increase of 1,700 MWe in the period 2004 - 2011. Nevertheless, the 2005 – 2007 Action Plan establishes an objective for increasing installed capacity with respect to that proposed originally by the E4, setting an objective for total installed capacity at the end of 2012 of 9,215 MWe. The above would mean an energy saving for new installed cogenerations for 2012 with respect to the E4 of 340.5 ktep, which amounts to a saving objective for the entire Energy Transformation sector of 1,834.5 ktep.

The measures identified for execution of the 2005 – 2007 Action Plan consisted of Joint Committees in the Oil Refining and Electricity Generation sectors, and implementation of feasibility studies, energy audits and development of the cogeneration potential in the latter sector.

On the other hand, the 2008 – 2012 National Allocation Plan (PNA 2008 – 2012) catalogues, among others, Energy Transformation activities as part of the allocation of emission rights. Since it is the second edition, this Plan establishes an average annual allowance using a lesser quantity of emission rights in proportion to the expected production in each sector. In this way, while Energy Transformation activities have an average annual allowance in the period 2005 – 2007 of 113.65 million tonnes of CO_2, in the period 2008 – 2012 there is provision for an average annual allowance of 82.35 million tonnes of CO_2, which represents a 27% emission reduction.

The PNA 2008 - 2012 takes into consideration for its energy-saving forecasts the measures and policies in force in the period 2008 – 2012 (E4, PER 2005-2010, PEIT, EU Directives). Nevertheless, the gradual reduction in the amount of the emission allowance requires an additional effort, in the face of which identification of measures and potential energy savings in addition to those of the E4 is necessary. In this context, a review of the current position of the Energy Transformation sectors is required, as well as identification of possible additional measures on top of that which is laid down in the E4.

Energy trends in the sector

The analysis of the current position was carried out taking as a reference the scenarios for trends in consumption and energy saving laid down in the E4 prepared and approved in 2003. Owing to the different features and nature of the various activity sectors included under Energy Transformation, it is necessary to carry out a special analysis for each of these.

Oil Refining

According to the data published by the Oil Product Strategic Reserve Corporation (CORES), internal consumption of oil products shows a variation in 2006 as compared with 2005 of -1.2%, with an average increase in the period 2003 – 2006 of 0.98%. The E4 estimated a trend in internal demand for oil products with average annual growth of 3.05% up to 2006 and 2.62% up to 2012. In light of the data available, it can be seen that the actual growth was less than that forecast in the E4.

As regards raw material processed in refineries and net production of oil products, Spanish refineries in 2006 offered a processed quantity of 61.94 million tonnes of oil, which represents a 1.7% increase as compared with the same figure for 2005. Moreover, net production rose in 2006 to 57.17 million tonnes, with an increase with respect to 2005 of 1.5%. These figures are given in the following table:

Table 14.2. Quantity of crude processed and net production in refineries

Year	Quantity of crude processed		Net production	
	Kt	Year-on-year variation	Kt	Year-on-year variation
2003	57,964	-0.8%	53,553	+1.2%
2004	60,060	+3.6%	55,567	+3.7%
2005	60,889	+1.4%	56,292	+1.3%
2006	61,945	+1.7%	57,170	+1.5%

Source: CORES

On the basis of the above information, it can be seen that, in spite of the moderate growth in internal consumption of oil products, net production shows a significant increase, with an average increase in the period 2003 – 2006 of 2.2%.

With regard to consumption peculiar to centres, the following table gives these data as from 2003 with year-on-year variations produced.

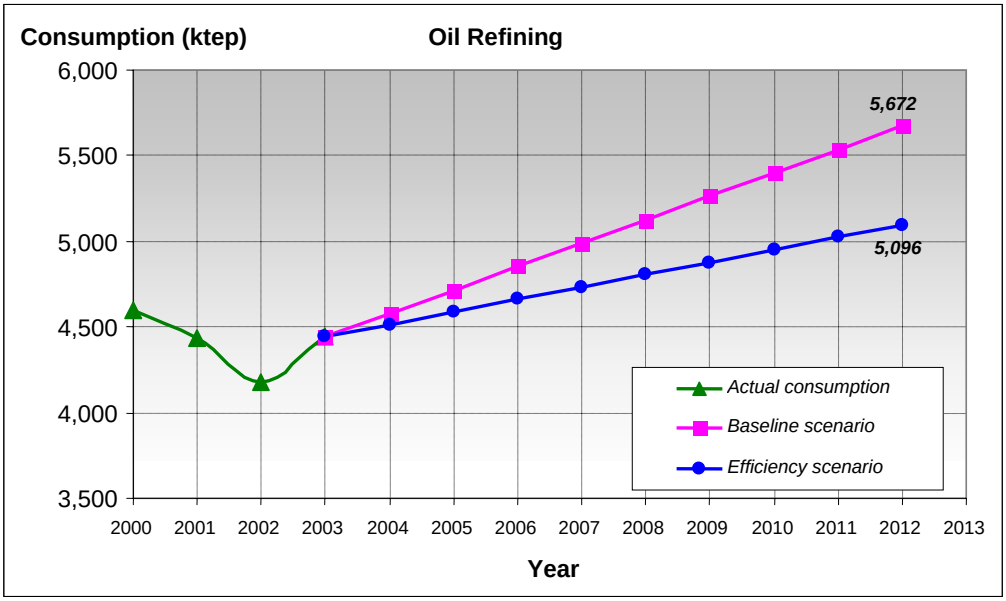
Table 14.3. Consumption peculiar to oil refineries.

Year	Consumption in refineries (ktep)	Ratio production - primary energy consumed	Year-on-year variation
2003	4,443	92.3%	-
2004	4,634	92.2%	+4.2%
2005	4,593	92.4%	-0.8%
2006	4,565	92.6%	+0.6%

Source: Spanish Association of Oil Product Operators (AOP)

The average value of year-on-year increase in the period 2003 – 2006 for their own consumption is 0.9%. The baseline scenario of the E4 forecast consumption for 2012 of 5,672 ktep, while the efficiency scenario also provided for in the E4 assumes achievement of a saving for 2012 of 576.5 ktep, which translated into consumption terms means 5,096 ktep. From the actual data for crude consumption and losses up to 2006, the following graph is obtained, which shows possible future paths of development up to the baseline and efficiency scenarios in 2012:

Graph 14.1.



The comparison of the actual position of consumption with respect to the scenarios laid down in the E4 is made by adapting these scenarios for each year according to the source of the distilled crude, actual net production of refineries, share of the various oil products in total net production and increased own consumption through environmental requirements. The following table shows the saving achieved with respect to the baseline scenario as from 2003.

Table 14.4. Comparison of consumption with respect to Efficiency Scenario.

Year	Own Consumption (ktep)	Adapted baseline scenario (ktep)	Adapted efficiency scenario (ktep)	Saving with respect to baseline scenario (ktep)
2003	4,443	4,443	4,443	-
2004	4,634	4,664	4,600	30
2005	4,593	4,812	4,684	219
2006	4,565	4,840	4,648	275

In 2006, a saving of 275 ktep was achieved, which means an increase in this saving of 83 ktep on top of the efficiency scenario. On the basis of this, the Oil Refining sector shows a current consumption position in line with achievement of the objectives of the E4.

Electricity Generation

Energy consumption employed in the transformation of primary energy into final energy in the form of electricity depends on the hydraulicity of each year, such that, according to the operating regime of the hydroelectric power stations, the greater or lesser use of thermal power stations is modified. 2004, and above all 2005, was a year of low hydraulicity, which led to greater use of thermal power stations, and

consequently higher energy consumption. For their part, nuclear power stations experienced more maintenance shutdowns in 2005 than in 2003 and 2004, which is why their consumption was lower in 2005.

The following table shows consumption up to 2005 in hydroelectric power stations, nuclear power stations and thermal power stations using coal, fuel and natural gas:

Table 14.5.

Type	Consumption (ktep)			
	2003	2004	2005	Average annual increase
Hydroelectric	942	725	463	-29.9%
Nuclear	11,009	11,337	10,271	-3.4%
Thermal using coal, fuel and natural gas	14,552	15,889	17,969	11.1%
TOTAL	26,503	27,951	28,703	4.1%

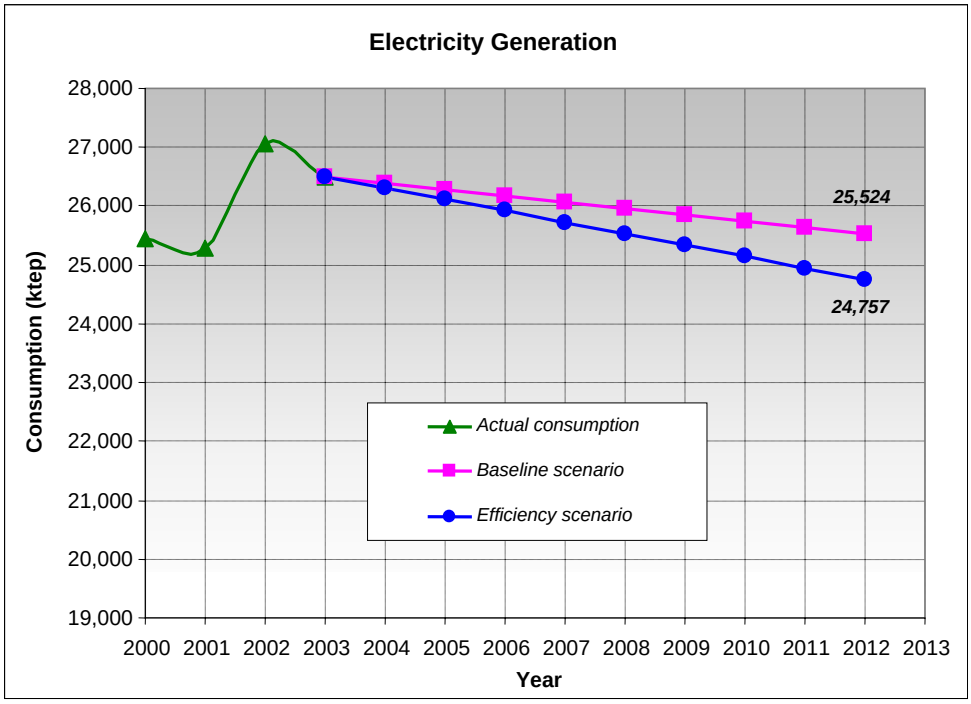
As regards efficiency in the operation of electric power stations, that is, the ratio between electricity generated and primary energy used, from 2003 a slight increase in this efficiency can be seen in the case of thermal power stations using coal, fuel and natural gas. The latter is due to the introduction of combined-cycle natural gas power stations. The Electricity Generation sector maintained this ratio at around 39% as indicated in the following table.

Table 14.6.

Type	Ratio final energy - primary energy		
	2003	2004	2005
Hydroelectric	77.8%	77.7%	77.9%
Nuclear	31.7%	31.6%	31.5%
Thermal using coal, fuel and natural gas	37.4%	39.0%	40.0%
TOTAL	39.3%	39.1%	39.0%

The baseline scenario of the E4 gives for 2012 Electricity Generation consumption of 25,524 ktep, while the efficiency scenario also provided for in the E4 assumes achievement of a saving for 2012 of 767.5 ktep, which translated into consumption terms means 24,757 ktep. The following graph shows the paths of development for consumption from the verified figure for 2003 up to 2012, according to the baseline and efficiency scenarios of the E4:

Graph 14.2.



The comparison of the actual position of consumption with respect to the scenarios laid down in the E4 in this case has also been made by adapting these scenarios for each year according to the participation of the various types of electricity production plant (mixed generation), actual net production of generating plant and increased own consumption through environmental requirements in conventional terms. The following table shows the saving achieved with respect to the baseline scenario from 2003.

Table 14.7. Comparison of consumption with respect to the Efficiency Scenario

Year	Consumption (ktep)	Adapted baseline scenario (ktep)	Adapted efficiency scenario (ktep)	Saving with respect to baseline scenario (ktep)
2003	26,502	26,502	26,502	-
2004	27,951	28,309	28,223	358
2005	28,703	28,889	28,719	186

In 2006, a saving of 186 ktep was achieved, which assumes an additional 16 ktep on top of the objective of the efficiency scenario for this year. According to the above, the Electricity Generation sector offers a current consumption position in line with achievement of the objectives of the E4.

Cogeneration

The trend in installation of new cogeneration plants in Spain over the last few years has been closely linked to the conjunction of prices for electricity discharged to the grid regulated by the special regime and the prices of fuels, especially with regard to natural gas. The latest data available indicate quite limited growth in cogeneration as can be seen in the following table:

Table 14.8. Development of installed capacity under special regime with respect to 2003

Year	New installed capacity under special (MWe)	New installed capacity with respect to 2003 (MWe)
2004	176	176
2005	76	252
2006	116	368

Source: CNE

The new total installed capacity at the end of 2006, taking 2003 as a reference, is 368 Mwe, with an average annual increase in the 2004 – 2006 of 1.97%, which means low current growth for cogeneration systems. Without taking into consideration waste treatment cogenerations (group 'd' of the special regime), the number of new cogenerations installed with respect to 2003 is only 201 MWe, to which is added the fact that in 2005 there was actual stagnation of installed capacity. The following table shows the effect of stagnation of cogeneration in the industrial sector in the period 2004 – 2006.

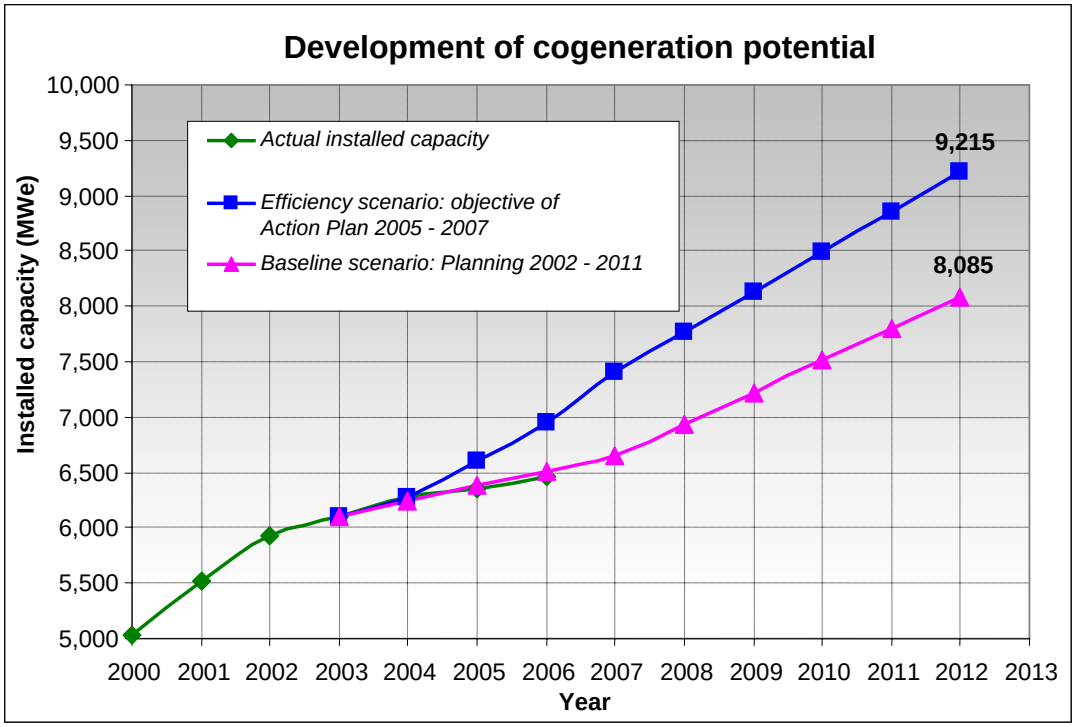
Table 14.9. Development of installed capacity under special regime, group 'a'

Year	Installed capacity under special regime group 'a' (MWe)
2004	126
2005	8
2006	67

Source: CNE

The baseline scenario of the E4 with regard to installed capacity is identified with that indicated in the Gas and Electricity Sectors Plan 2002 – 2011, with the same growth for 2012 as for 2011, which assumes an increase in installed electrical capacity in 2011 with respect to 2003 of 1,700 MWe. On the other hand, the 2005 – 2007 Action Plan established an increase in additional capacity on top of the E4 of 350 MW at the end of 2006. The current installed capacity position is a long way from the abovementioned objectives, as can be seen from the following graph.

Graph 14.3.



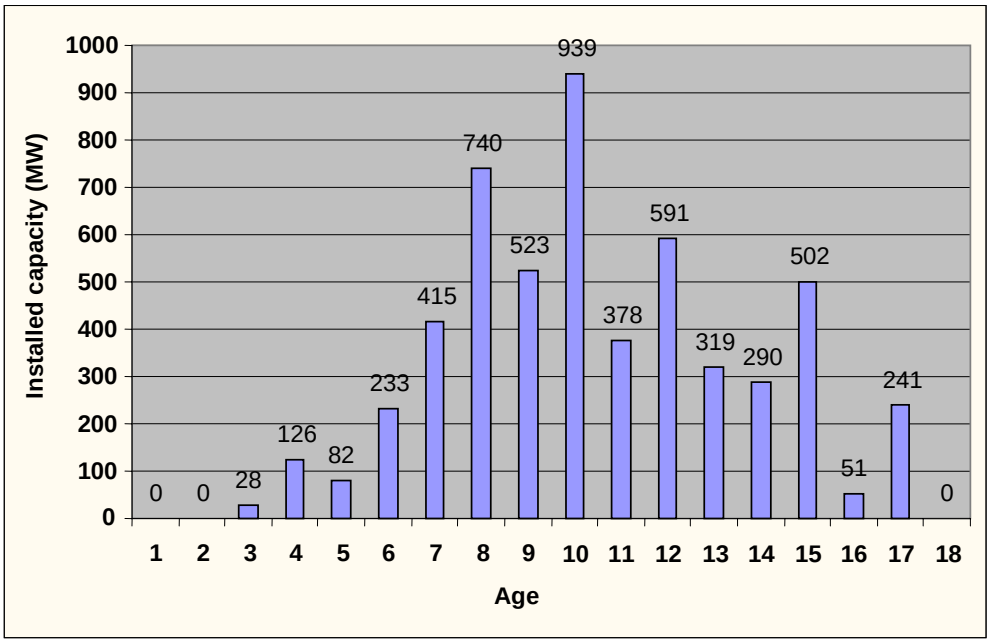
It can be seen that the development of actual installed capacity is closer to the baseline scenario of the E4 than the ambitious objectives for development of cogeneration potential introduced by the 2005 – 2007 Action Plan. The possible causes of the current growth rate are basically due, on the one hand, to the delay in establishing the legislative framework introduced by Royal Decree 661/2007 of 25 May, by which electricity production under the special regime is regulated, and on the other hand, to the lack of correlation between the purchase price of fuel and the sale price of the electricity produced. In the same way, the recent approval of Royal Decree 616/2007 of 11 May concerning promotion of cogeneration, which introduces to our legal system the concepts identified in Directive 8/2004/EC, is relevant.

It is hoped that the recent regulation, both administrative and economic, of the special regime in cogeneration will produce a strong boost to future development of potential. Nevertheless, and in view of the above graph, the objective of 9,215 MWe installed in 2012 is not considered as a reasonable scenario for future development.

With regard to improvement of the energy efficiency of existing cogenerations, this efficiency is linked to the modernization and/or replacement of the main items of equipment according to their useful life. This useful life depends on various factors relating to the technology used and hours of operation of the installation. As a representative figure, a durability of 100,000 hours of operation could be considered with an overhaul at 60,000 hours, which, when associated with an average annual operation of around 6,200 hours, means a useful life of some 16 years.

The attached graph shows the age of the existing cogenerations, it being estimated for the year 2012 that there will be 2,146 MWe with 16 years or more.

Graph 14.4. Age of cogeneration plants.
It should be noted that in 2007 there are 939 MW with 10 years of operation.



Produced by us from CNE data

Currently, there has been no significant modernization due to the non-existence of a significant number of cogenerations with obsolescence considered as sufficient for undertaking complete modernization of a cogeneration system (16 years).

Objectives

Oil Refining

The current consumption position of Oil Refining plants, according to the above, allows for optimism in achievement of the objective of the E4 for the year 2012, which is why the saving objective of 576.5 ktep is maintained.

In terms of emissions of CO_2 avoided, the specified saving means a reduction of 1,729 thousand tonnes of CO_2 as the cumulative annual value for 2012.

With regard to measures for achieving these objectives, the present Plan proposes the continuation of the Joint Committee as an inducement and supervisor of actions for improvement of energy efficiency.

Electricity Generation

In this sector, the current situation coincides with the path to achievement of the efficiency scenario, which is why it is feasible to maintain the saving objectives defined by the E4 of 767.5 ktep. Accordingly, the following table sets out the objectives for 2012 for each area of activity in Electricity Generation.

Table 14.10.

Area	Primary energy saving (ktep)	Emissions of CO_2 avoided (kt)
Hydroelectric	242.85	567
Nuclear	297.3	694
Thermal	227.3	531
TOTAL	767.5	1,792

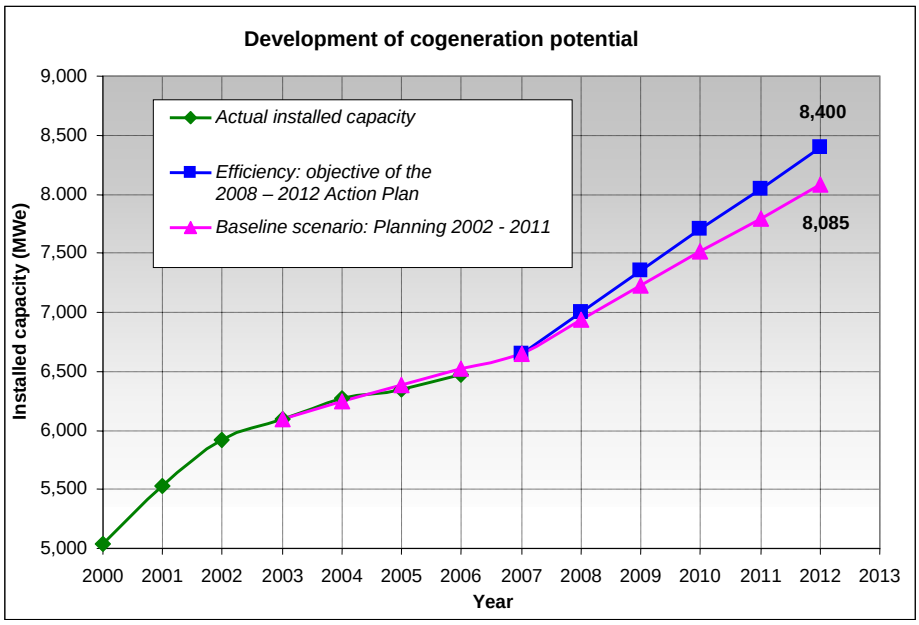
As a measure for Electricity Generation, in this case it is also proposed to continue with the Joint Committees already proposed by the Action Plan.

Cogeneration

With regard to new cogeneration potential and taking account of the current trend and its comparison with the objective of the 2005 – 2007 Action Plan, the present Plan proposes an increase in installed capacity with respect to the reference position, defined in the Electricity and Gas Sectors Plan 2002 – 2011, such that in 2012 the figure of **8,400 MWe** is reached, which constitutes the efficiency scenario for the new cogeneration potential. This means an increase of 315 MWe with respect to the reference position, with an associated cumulative annual energy saving of 95 ktep at the end of the period of the present Plan. These savings avoid the emission of 221 thousand tonnes of CO_2.

The following graph indicates the expected trend according to the new objective and its comparison with the reference position:

Graph 14.5. Projection of installed capacity according to the 2008-2012 Action Plan and its comparison with the Baseline Scenario



For the achievement of these objectives, it is proposed to implement three measures: Feasibility studies (measure already initiated in the previous Action Plan), Promotion of new installations in non-industrial activities (measure also initiated in the previous Action Plan) and Promotion of small-capacity cogeneration, a new measure introduced in the present Action Plan:

- ***Feasibility studies***. Implementation of studies which determine the technical, economic and administrative feasibility of the applicability of a cogeneration system
- ***Promotion of new installations in non-industrial activities***. Promotion of the introduction of new cogeneration systems by way of various institutional actions which allow for a significant increase in the share of these plants in non-industrial sectors
- ***Promotion of small-capacity cogeneration***. Implementation of projects for demonstration and execution of small capacity cogeneration installations, these being understood as cogeneration systems with electrical capacity no greater than 150 kWe, as well as drafting of regulations to govern the administrative aspects of low voltage connection. This measure may have been aimed at the development of cogeneration potential in the tertiary, residential and commercial sector.

Moreover, in the modernization of existing cogeneration plants, an expansion of the energy-saving objective laid down in the E4 is proposed by increasing the primary-energy saving for 2012 from 150 ktep to 363 ktep. This increase would take advantage of the significant potential for modernization of existing cogeneration plants of 16 years or more. This primary-energy saving objective means that in 2012 40% of cogeneration plants over 16 years old will have been modernized.

The chronological development provided for during the period 2008 – 2012 of the saving associated with the modernization of cogeneration plants is reflected in the following table:

Table 14.11.

Objective for energy-efficiency saving in cogeneration plants (ktep)				
2008	2009	2010	2011	2012
100	178	222	272	363

For achievement of the energy-efficiency objectives in cogeneration plants, two measures are proposed: energy audits in existing plants (a measure already initiated in the previous Action Plan), and a Renovation Plan for existing plants, a new measure introduced in the present Action Plan:

- ***Energy audits***. Individualized audit-type studies in order to obtain information relating to the potential for improvement both from the energy-efficiency and operational point of view vis-à-vis the electrical system in operational cogeneration systems. In the same way, they will assess the technical, economic and administrative feasibility of cogeneration modernization

- ***Renovation Plan for existing plants***. Replacement of installed cogeneration equipment with the aim of adapting it to the needs of the production process, technical improvements and even the current regulatory position. This measure will take advantage of the knowledge acquired in the various Autonomous Communities in carrying out energy audits in 2005, 2006 and 2007

Assessment of scenarios

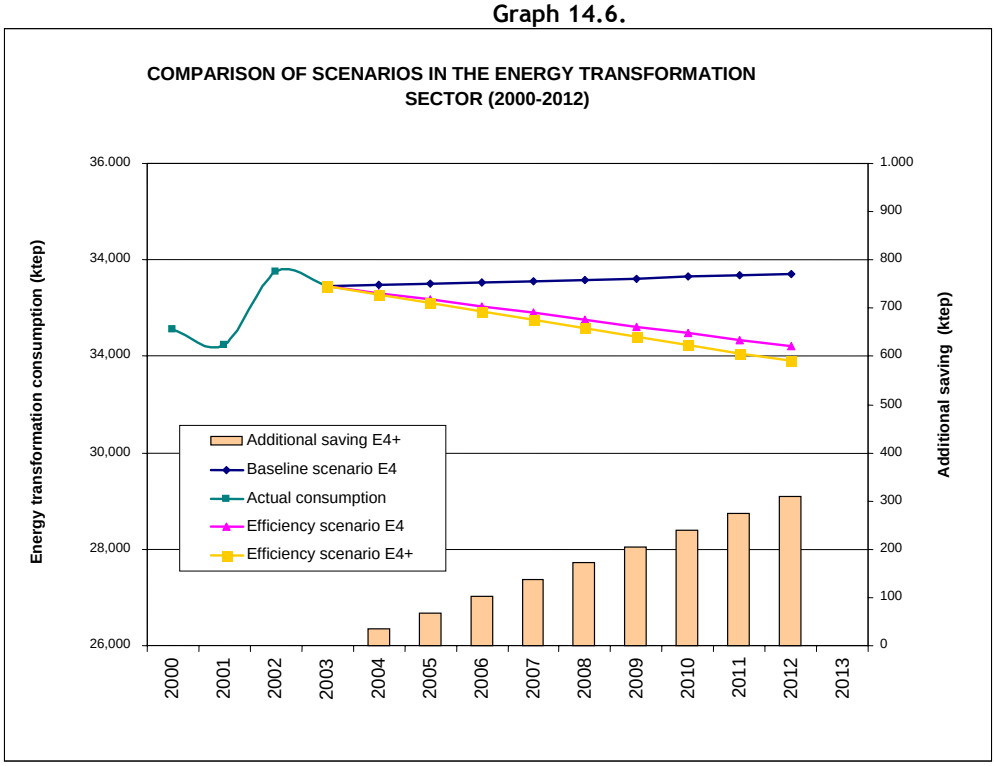
The objectives introduced by the present Plan mean an increase in the saving objective with respect to that identified by the E4. The table on the following page indicates the objectives in terms of primary energy saved and emissions of CO_2 avoided for 2012, on the one hand, as part of the E4 and, on the other hand, as per the objectives of this Plan associated with an additional effort for reduction of emissions (scenario E4+). These data are broken down according to the associated savings and emissions avoided directly through the public support indicated and that induced as a result of the implementation of the measures of the present Plan.

As can be seen, the planning of the present Plan brings an increase of 308 ktep as part of the additional effort associated with the PNA 2, originating entirely from the cogeneration sector.

It is notable that, with regard to development of cogeneration potential, the planning in force before the E4, that is, the Gas and Electricity Sectors Plan 2002 – 2011, already introduced a projection which assumes a considerable effort in growth of the installed capacity and electricity generated by cogeneration. In this way, the effort estimated by the present Plan that can be made additionally in cogeneration potential is limited and has been assessed as an increase of 315 MWe on top of the reference position in 2012.

The following graph reflects the baseline, E4 efficiency and E4+ efficiency scenarios from the actual consumption of 2003.

Graph 14.6.



Indicators

As indicators for the follow-up of energy efficiency in each of the Energy Transformation sectors, the following are proposed:

- *Oil Refining*: percentage variation of specific consumption per unit of product produced with respect to that taken as reference
- *Electricity Generation*: percentage variation of specific consumption per unit of electricity with respect to that taken as reference
- *Cogeneration*
    - *New potential*: installed electrical capacity in cogeneration systems from the reference position, the latter being understood as that given in the Electricity and Gas Sectors Plan 2002 – 2011
    - *Energy efficiency*: percentage variation of specific consumption per unit of energy produced with respect to that taken as reference

The following table shows the values of the indicators for each scenario in 2012.

Table 14.12.

SECTOR			Baseline scenario	Efficient scenario E4+ framework
Oil Refining			0%	10.1%
Electricity Generation			0%	3.01%
Cogeneration	New cogeneration potential	Increase with respect to 2003	0 MWe	315 MWe
		Total installed potential	8,085 MWe	8,400 MWe
	Energy efficiency		0%	14.5%

Table 14.13. Objectives of the efficiency scenario for 2012 proposed by the 2008 – 2012 Action Plan

	Baseline Scenario 2012		Efficiency Scenario E4		Scenario E4+		Scenario difference	
	2012	2008-2012	2012	2008-2012	2012	2008-2012	2012	2008-2012
Consumption								
Primary energy consumption (ktep)	33,700	168,223	32,206	162,527	31,898	161,516	-308	-1,011
Average consumption growth	-	-	-	-0.4%	-	-0.5%	-	-0.1%
Savings								
Direct savings (ktep)	-	-	34	108	131	434	97	326
Induced savings (ktep)	-	-	1,460	5,588	1,671	6,274	212	686
Total saving								
On top of baseline scenario E4 (ktep)	-	-	1,494	5,696	1,802	6,707	308	1,011
On top of baseline scenario E4 (%)	-	-	4.4%	3.4%	5.3%	4.0%	0.9%	0.6%
Contribution of sectoral measures								
Oil Refining Measures	-	-	38.6%		32.0%		-	
Electricity Generation Measures	-	-	51.4%		42.6%		-	
Cogeneration Measures	-	-	10.0%		25.4%		-	
Emissions avoided ($ktCO_2$)								
Through direct saving	-	-	101	316	356	1,169	255	852
Through induced savings	-	-	3,861	14,756	4,453	16,664	592	1,908
Total	-	-	3,962	15,072	4,809	17,832	847	2,760
Associated investments (k€)	-	-	-	585,264	-	1,085,330	-	500,066
Public support (k€)	-	-	-	7,631	-	29,284	-	21,652

14.2. Measures

MEASURE 1: Oil Refining. Joint Committee

Objective

Follow-up of development of energy consumption and measures proposed in the Saving and Energy Efficiency Strategy in the Oil Refining sector, during the period 2008-2012.

Description

Continuation of the follow-up activity of the Joint Committees in the Oil Refining sector with the following composition:

- Representation from the Spanish Association of Oil Product Operators (AOP)
- Representation from the Ministry of Industry, Trade and Tourism/IDAE

The basic tasks of these Committees are in essence the same as those indicated in the previous Action Plan:

- Follow-up of the technical measures proposed in the E4 during the period 2008 - 2012
- Incorporation of new measures for improvement of energy efficiency
- Development and introduction of a system for measuring energy saving from an indirect calculation based on data in a first phase, as well as later development of a system based on representative measurements
- Preparation of half-yearly reports on the follow-up of investment and energy savings achieved
- Implementation of possible technical studies and/or publications on saving and energy-efficiency actions in Oil Refining

Responsibility and Collaborators

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Associations and companies of the Oil Refining sector

Actions

Continuation of the follow-up Joint Committees for the Oil Refining sector.

Public support

The public support necessary for development of this measure during the period 2008-2012 rises to 90 thousand euro, with the following annual breakdown:

Table 14.14.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	18.0	18.0	18.0	18.0	18.0	**90.0**

The total for this public support relates to the budget of the Ministry of Industry, Trade and Tourism by way of the IDAE for carrying out the actions described above.

Planning

The criterion of the previous Action Plan is maintained with respect to the frequency of meetings. Accordingly, the Joint Committee will meet every six months during the five effective years of the present Plan.

Energy savings and emissions of CO_2 avoided

The energy savings and emissions avoided associated with this measure are of an induced nature and are broken down in the following table.

Table 14.15.

Year	2008	2009	2010	2011	2012	Total
Primary energy saving (ktep)	320.3	384.3	448.4	512.5	576.5	**2,242.0**
Emissions of CO_2 avoided ($ktCO_2$)	960.9	1,153.0	1,345.2	1,537.4	1,729.5	**6,726.0**

MEASURE 2: Electricity Generation. Joint Committee

Objective

Follow-up of the development of energy consumption and measures proposed in the Saving and Energy Efficiency Strategy in the Electricity Generation sector during the period 2008-2012.

Description

Continuation of the activity of the Joint Committee in the Electricity Generation sector with the following composition:

- Representation from the Spanish Association of the Electrical Industry (UNESA)
- Representation from the Ministry of Industry, Trade and Tourism/IDAE
- Representation from IDAE

The basic tasks of these Committees are in essence the same as those indicated in the previous Action Plan:

- Follow-up of technical measures proposed in the E4 during the period 2008 -2012
- Incorporation of new measures for improvement of energy efficiency
- Development and introduction of a system for measuring energy saving from an indirect calculation based on data in a first phase, as well as later development of a system based on representative measurements
- Preparation of half-yearly reports on the follow-up of investments and energy savings achieved
- Implementation of possible technical studies and/or publications on saving and energy-efficiency actions in Electricity Generation

Responsibility and collaborators

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Associations and companies of the Electricity Generation sector

Actions

Continuation of the follow-up Joint Committee for the Electricity Generation sector.

Public support

The public support necessary for the development of this measure during the period 2008-2012 rises to 90 thousand euro, with the following annual breakdown:

Table 14.16.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	18.0	18.0	18.0	18.0	18.0	**90.0**

The total for this public support relates to the budget of the Ministry of Industry, Trade and Tourism by way of the IDAE for carrying out the actions described above.

Planning:

The criterion of the previous Action Plan is maintained with respect to the frequency of meetings. Accordingly, the Joint Commitee will meet every six months during the five effective years of the present Plan.

Energy savings (ktep) and emissions of CO_2 avoided

Energy savings and emissions avoided associated with this measure are of an induced nature, and are broken down in the following table.

Table 14.17.

Year	2008	2009	2010	2011	2012	Total
Primary energy saving (ktep)	426.4	511.7	597.0	682.2	767.5	**2,984.8**
Emissions of CO_2 avoided ($ktCO_2$)	995.8	1,195.0	1,394.2	1,593.3	1,792.5	**6,970.9**

MEASURE 3: Development of cogeneration potential. Feasibility Studies

Objective

To analyze the economic viability of high-efficiency cogeneration installations according to the criteria of Directive 2004/8/EC.

Description

Implementation of studies which determine the technical, economic and administrative feasibility of the applicability of a cogeneration system. They will be carried out by engineering companies specializing in cogeneration technologies and familiar with the regulations relating thereto.

The studies will take account of criteria laid down in Directive 2004/8/EC concerning high-efficiency cogeneration, with the aim of selecting an alternative which might mean greater primary-energy saving, and prioritizing actions in sectors and sizes of plant which favour achievement of the PNA. In the same way, they will be carried out according to a minimum content specified by the responsible and collaborating bodies for this measure.

This measure is directed at all activities likely to use a cogeneration system. Nevertheless, the new cogeneration potential is distributed between the primary, industrial and services sectors, approximately 80% of the total being represented by the Industrial Sector.

Below is an explanatory and non-exhaustive list of the activities in which cogeneration has been introduced in a more significant manner:

A. **Industry**, with special emphasis on the following branches in which technically there are the best conditions for the siting of cogenerations:
   - Food, Drink and Tobacco
   - Chemicals
   - Paper and Cardboard
   - Non-metallic Minerals
   - Oil Refining
   - Textiles, Leather and Footwear

B. **Tertiary Sector**: residential and commercial activities, in which the following stand out:
   - Hospitals

- Hotels
- Commercial superstores
- Prisons
- Institutional buildings

The instruments under consideration to implement this measure are the following:

A. **Voluntary Agreements** between the Ministry of Industry, Trade and Tourism and the sectoral associations or representatives of collectives at whom the measure is directed. It is proposed to continue with the Agreements arrived at in the period relating the 2005 – 2007 Action Plan, as well as the formalization of new agreements. This instrument involves the analysis and proposal of actions for better implementation of feasibility studies, as well as a preference in the award of possible public support associated with the measure to the collective which signs it.

B. **Public Support**. This assumes allocation of an amount of public finance without recovery to defray a part of the total cost of the study.

Responsibility and collaboration

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Autonomous Communities, associations and companies of the sector

Actions

Implementation of 200 feasibility studies during the period 2008 - 2012.

Public support

For the estimate of the public support for this measure, the criterion indicated in the E4 has been used on the average unit cost per feasibility study (15,000 €), with public support of 75%. The remainder of the budget will be borne by the company owning the possible future cogeneration plant.

The necessary public support for the development of this measure during the period of the 2008-2012 Action Plan rises to 2,250 thousand euro, with the following chronological breakdown:

Table 14.18.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	450.0	450.0	450.0	450.0	450.0	**2,250.0**

These estimates of public support relate to the budget of the Ministry of Industry, Trade and Tourism for carrying out the actions described above, as well as funds originating from the Autonomous Communities.

Planning

The new Voluntary Agreements with associations and representatives of collectives have to be formalized in 2008. The feasibility studies will be implemented as from the same year, being intended as continuity of those carried out in the 2005 – 2007 Action Plan. The following table represents the number of studies expected to be made each year during the period.

Table 14.19.

Year	2008	2009	2010	2011	2012	Total
Number of studies to be made	40	40	40	40	40	**200**

Energy savings (ktep) and emissions of CO_2 avoided

This measure has the effect of an inducement to achieve the objective of new installed capacity, reaching 8,400 MWe installed in 2012, not being associated in itself with energy saving nor, therefore, reduction of emissions of CO_2.

MEASURE 4: Development of cogeneration potential. Promotion of new installations in non-industrial activities

Objective

To contribute to developing high-efficiency cogeneration potential in non-industrial activities. This measure is based on the fact that cogeneration systems in this type of activity have a marginal presence.

Description

Promotion of introduction of new cogeneration systems by way of various institutional actions that allow for a significant increase in the participation of these plants in non-industrial sectors.

This measure is aimed at high-efficiency cogeneration plants with a capacity over 150 Kwe that use natural gas or diesel as fuel, including refrigeration systems in the case of trigeneration plants.

This measure is to be applied to all non-industrial activities likely to use cogeneration systems.

The most typical receiving sectors are the tertiary, residential and commercial in which the degree of penetration is practically nil in residential activities and 14% in commercial activities. Also the primary sector is only included with regard to waste assessment activities. The technological potential assessed in typical receiving sectors is the following:

- Domestic activities: 5,220 MWe, with an estimated growth for 2012 that would contribute a total potential of 6,690 MWe in this year
- Commercial activities: 1,194 MWe, with a potential also estimated for 2012 of 1,600 MWe
- Cogeneration from biogas: there is a potential of some 320 MWe in treatment of sludge from waste water purification stations, and some 960 MWe in treatment of cow dung

The instruments under consideration to implement this measure are the following:

A. **Voluntary Agreements** between the Ministry of Industry, Trade and Tourism and the sectoral associations or representatives of collectives at whom the measure is directed. It is proposed to continue with the Agreements arrived at in the period relating to the 2005 – 2007 Action Plan, as well as the formalization of new agreements. As in the previous measure, this instrument involves the analysis and proposal of promotional actions, as well as a preference in the award of possible public support.

B. **Public support**. This assumes the allocation of an amount of public finance without recovery to carry out the cogeneration project. In this case, all non-industrial activities will be included except waste treatment.

C. **Dissemination**. Given the existence in receiving sectors of market niches not familiar with cogeneration plants, there is provision for the production of publications and dissemination workshops which provide technical, economic, environmental and administrative knowledge of cogeneration systems.

Responsibility and collaboration

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Autonomous Communities, associations and companies of the sector

Actions

This takes into consideration the implementation of commercial and pilot projects by the IDAE in offices, business centres and in district heating and cooling systems. It is estimated that this will have an inducement effect which might achieve the installation of 277 MWe in some 350 installations, increasing sectoral penetration to 12% in commerical activities and 30% in biogas.

Public support

The public support for the projects affected by this measure will be 10% of the total cost eligible, which means a total public contribution of 11.4 million euro with the following annual contribution:

Table 14.20.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	2,281.2	2,287.5	2,287.5	2,287.5	2,287.5	**11,431.1**

These estimates of public support relate to the budget of the Ministry of Industry, Trade and Tourism/IDAE for carrying out the actions described above, as well as funds originating from the Autonomous Communities.

Planning

The forecast quantity of new electrical installed capacity associated with this measure throughout the effective period of the plan is the following:

Table 14.21.

Year	2008	2009	2010	2011	2012	Total
New installed capacity (MWe)	55.3	55.5	55.5	55.5	55.5	**277.1**

Energy savings (ktep) and emissions of CO_2 avoided

The total saving associated with the measure will be a cumulative annual 94.4 ktep at the end of the Plan period, avoiding the emission of 220,000 tonnes of CO_2 per annum. This saving has been assessed in comparison with the separate generation of electricity and thermal energy from natural gas. Of this total saving, 47.2 ktep relates to a direct saving arising from public support. The annual breakdown of cumulative annual impact in the period 2008 – 2012 is given in the following table:

Table 14.22.

Year	2008	2009	2010	2011	2012	Total
Primary energy saving (ktep)	42.9	55.8	68.7	81.5	94.4	**343.3**
Direct	21.5	27.9	34.3	40.8	47.2	**171.6**
Induced	21.5	27.9	34.3	40.8	47.2	**171.6**
Emissions avoided ($ktCO_2$)	100.2	130.3	160.3	190.4	220.5	**801.7**
Through direct savings	50.1	65.1	80.2	95.2	0.2	**400.8**
Through induced savings	50.1	65.1	80.2	95.2	110.2	**400.8**

MEASURE 5: Development of cogeneration potential. Promotion of small capacity cogeneration plants

Objective

Promotion of the installation of cogeneration systems with electrical capacity equal to or less than 150 kWe and installation of a strategically significant quantity of this type of plant. This measure is part of the additional effort associated with the reduction of emissions.

Description

The technical characteristics and size of the equipment for very low capacity cogeneration allow for its introduction in activities with limited energy demands, typical of non-industrial sectors. This measure assumes institutional support to build up a significant presence of these systems by way of various instruments.

The measure assumes the implementation of demonstration projects by the IDAE and commissioning of cogeneration installations of smaller size, these being understood as cogeneration systems with electrical capacity no greater than 150 kWe.

This measure is aimed at all industrial and non-industrial activities likely to use cogeneration systems. Nevertheless, those receiving sectors understood to be more closely related, on the one hand, are those which have buildings likely to supply

energy, and on the other hand, activities likely to take advantage of small quantities of fuel generated as a byproduct or waste, as is the case with biogas. These sectors are the following:

- Tertiary, residential, commercial and institutional sector
- SMEs of the Industrial Sector
- Exploiting biogas originating from waste

On the other hand, the potential assessed for micro-cogeneration is the following:

- Buildings: 8,100 kWe for 2012
- Exploitation of biogas: 6,050 kWe for 2012

Again the instruments considered in this measure are the following:

A. **Voluntary Agreements** between the Ministry of Industry, Trade and Tourism and the sectoral associations or representatives of collectives at whom the measure is directed. Also in this case, this instrument involves the analysis and proposal of promotional actions, as well as a preference in the award of possible public support.

B. **Support for technological demonstration projects**. The technology employed in cogeneration systems has been properly investigated. Nevertheless, its commercial applicability using actual operational data has not been adequately documented. To ease this problem, the Plan provided for the implementation of technological demonstration projects applied using a percentage of the investment originating from public support.

C. **Public support**. This assumes the allocation of an amount of public finance without recovery to carry out part of the micro-cogeneration project.

D. **Dissemination**. In micro-cogenerations, dissemination activities are deemed to be of special importance given the sparse knowledge in the residential area of this type of system. There is provision for publications and dissemination workshops which provide technical, economic, environmental and administrative knowledge of same.

E. **Legislative development**. Development and introduction in Spanish legislation of a regulation concerning the connection to the low-voltage electricity grid of small-capacity cogeneration. This regulation aims to specify the following aspects in relation to connection to the electricity grid for low-capacity cogenerations:

   - Administrative procedures. Simplification and improvement of existing procedure
   - Technical aspects. Minimum technical conditions that could be required

   The drafting of this legislation will be carried out by the Ministry of Industry, Trade and Tourism.

Responsibility and collaboration

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Autonomous, associations and businesses of the sector

Actions

In the period 2008 – 2012, the following actions are provided for:

- Six technological demonstration projects in three different activities with various energy requirements. These projects will analyze the technical and economic feasibility of application of the technology currently developed and will be carried out by the IDAE
- Programme of public aid for the promotion of low-capacity cogeneration plants. It is hoped to mobilize a total capacity with public aid of 1,981 kWe of the total of 2,830 kWe for which there is provision in the period

Public support

The investments associated with the actions described above are the following:

- Demonstration projects. The estimated total investment is 315,000 €
- Cogeneration projects, with a total investment of 7,924,000 € over the entire period of the Plan

With respect to public support, it is considered that 100% of the investment associated with demonstration projects will come from IDAE funds and that the public aid for the low-capacity cogeneration projects will range from 10% to 30% depending on the capacity of each project. Estimated total public support rises to 1,979,000 € with the following plan:

Table 14.23.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	63.0	63.0	395.8	562.8	894.4	**1,979.0**

These estimates of public support relate to the budget of the Ministry of Industry, Trade and Tourism for carrying out the actions described above, as well as funds originating from the Autonomous Communities.

Planning

The forecast of the quantity of newly installed electrical capacity associated with this measure throughout the effective period of the Plan is the following:

Table 14.24.

Year	2008	2009	2010	2011	2012	Total
New installed capacity (kWe)	0.0	0.0	566.0	850.0	1,414.0	**2,830.0**

Energy savings (ktep) and emissions of CO_2 avoided

The saving assumed with the introduction of the 2,830 Kwe induced by this measure brings with it the cumulative annual saving of 537 tep in 2012, avoiding the annual emission for that year of 1,255 tonnes of CO_2. Of this total saving, 376 tep relates to direct saving arising from public support. This saving has been evaluated in comparison with the separate generation of electricity and thermal energy from natural gas. The annual breakdown concentrates on the last three years of the effective period of the Plan, this being the time at which the results of the demonstration projects are obtained.

Table 14.25.

Year	2008	2009	2010	2011	2012	Total
Primary energy saving (tep)	0.0	0.0	107.5	268.9	537.4	**913.8**
Direct	0.0	0.0	75.2	188.3	376.2	**639.7**
Induced	0.0	0.0	32.2	80.7	161.2	**274.1**
Emissions avoided (tCO_2)	0.0	0.0	251.0	628.1	1,255.1	**2,134.2**
Through direct saving	0.0	0.0	175.7	439.7	878.5	**1,493.9**
Through induced saving	0.0	0.0	75.3	188.4	376.5	**640.2**

In spite of the limited saving of primary energy and CO_2 emissions avoided, the implementaton of this measure has a strategic interest since it means the introduction of a new applied form of cogeneration in our country, which in future will increase the installed quantity of this type of plant.

MEASURE 6: Improved energy efficiency in cogeneration. Energy audits

Objective

To analyze and assess the potential for improvement of energy efficiency in operating cogeneration power stations, taking into consideration both technological design aspects of the cogeneration plants themselves (age) and improvements applicable to their operation and adaptation to the new legal framework.

Description

Individualized audit-type studies to obtain information relating to the potential for improvement from both the energy-efficiency point of view and the operation viewpoint in the face of the electrical system in operating cogeneration systems. In the same way, they will assess the technical, economic and administrative feasibility of modernization of cogeneration. The audits will be carried out by engineering companies specializing in cogeneration technologies and familiar with the regulations relating thereto.

The audits will be carried out taking account of the criteria laid down in Directive 8/2004/EC concerning high-efficiency cogeneration, with the aim of selecting an alternative which might mean greater saving of primary energy, and prioritizing actions in sectors and sizes of plants which favour achievement of the PNA. In the same way, they will be carried out using a minimum content specified by the responsible and collaborating bodies for this measure.

This measure is directed at all the sectors that have installed cogenerations. Nevertheless, it will be more applicable in those in which the existing cogenerations are of a certain age, as is the case for the Industry Sector.

The instruments under consideration for implementing this measure are the following:

A. **Voluntary Agreements** between the Ministry of Industry, Trade and Tourism and the sectoral associations or representatives of collectives at whom the measure is directed. It is proposed to continue with the Agreements arrived at in the period relating to the 2005 – 2007 Action Plan, as well as the formalization of new agreements. This instrument involves the analysis and proposal of actions for better implementation of energy audits, as well as a preference in the award of possible public support associated with the measure to the collective which signs it.

B. **Public support**. This assumes the allocation of an amount of public finance without recovery to defray a part of the total cost of the energy audit

Responsibility and collaboration

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Autonomous Communities, associations and companies of the sector

Actions

Implementation of 360 energy audits during the period 2008 - 2012.

Public support

For the estimate of the public support of this measure, the criterion indicated in the E4 has been used on the average unit cost per audit (12,000 €), with public support of 75%. The remainder of the budget will be borne by the audited company.

The public support necessary for the development of this measure during the period of the 2008-2012 Action Plan rises to 3,240 thousand euro, with the following chronological breakdown.

Table 14.26.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	648.0	648.0	648.0	648.0	648.0	**3,240.0**

These estimates of public support relate to the budget of the Ministry of Industry, Trade and Tourism for carrying out the actions described above, as well as funds originating from the Autonomous Communities.

Planning

The new Voluntary Agreements with associations and representatives of collectives have to be formalized in 2008. The audits will be carried out as from that year, these being understood as continuity of those carried out in the 2005 – 2007 Action Plan. The following table represents the number of audits to be carried out each year during the period.

Table 14.27.

Year	2008	2009	2010	2011	2012	Total
Number of audits to be carried out	72	72	72	72	72	**360**

Energy savings (ktep) and emissions of CO_2 avoided

This measure does not have an energy saving nor, therefore, emissions of CO_2 avoided since its effect is to induce actions which do, in fact, involve this type of benefit.

MEASURE 7: Improved energy efficiency in cogeneration. Renovation Plan for existing plants

Objective

Improvement of energy efficiency by way of renovation of equipment by achieving improved output and consuming less primary energy while the same final energy is supplied.

Description

Replacement of equipment in installed cogeneration systems with the objective of adapting it to the needs of the production process, better available techniques and even the current regulatory position. This measure considers those actions which involve a substantial modification of existing cogeneration plants, meaning by substantial modification those investments of at least 50% of the cost of a new cogeneration installation.

This measure is applicable to all activities likely to use cogeneration systems, despite the fact that almost all the renovation potential is concentrated in the secondary sector. In this way, activity sectors with greater probability of introducing this measure are the following:

- Food, Drink and Tobacco
- Chemicals
- Paper and Cardboard
- Non-metallic Minerals
- Oil Refining
- Textiles, Leather and Footwear

The renovation potential has been assessed taking account of the number of plants with sixteen or more years of operation, which means 2,350 MWe in 2012.

The instruments considered for implementing this measure are the following:

A. **Voluntary Agreements** between the Ministry of Industry, Trade and Tourism and the sectoral associations or representatives of collectives at whom the measure is directed. This instrument entails a preference in the award of the economic aid associated with the measure to the collective which signs it.

B. **Public support**. This assumes the allocation of an amount of public finance without recovery to carry out part of the cogeneration modernization project.

Responsibility and collaboration

- Responsible: Ministry of Industry, Trade and Tourism/IDAE
- Collaborators: Autonomous Communities, associations and companies of the sector

Actions

There is provision for modernization of 940 MWe existing with sixteen years or more, which means modernizing 40% of the capacity of this age.

Public support

The total investment associated with the measure is around 443 million euro. This figure will be contributed, for the most part, by owners of installations on the basis of criteria of greater efficiency and energy and economic saving.

This measure takes into consideration public support, which could be implemented on around 23% of modernized installations in order to activate the inducement effect expected for the total. Public support of 10% of the cost of the renovation project has been taken into consideration, by which, should the modernizations indicated above take place, the public budget necessary for development of this measure during the period of the 2008-2012 Action Plan rises to the following figures:

Table 14.28.

Year	2008	2009	2010	2011	2012	Total
Public support (k€)	2,813.7	2,181.0	1,260.1	1,383.8	2,564.9	**10,203.4**

These estimates of public support relate to the budget of the Ministry of Industry, Trade and Tourism for carrying out the actions described above, as well as funds originating from the Autonomous Communities.

Planning

The annual modernized electrical capacity, without accumulation throughout the effective period of the Plan, was expected to be put in place according to the following plan:

Table 14.29.

Year	2008	2009	2010	2011	2012	Total
Modernized capacity (MWe)	259.2	200.9	116.1	127.5	236.3	**940.0**

Energy savings (ktep) and emissions of CO_2 avoided

The full development of this measure as has been described means a cumulative annual saving of 363 ktep in 2012, avoiding the emission in that year of 1,065 thousand tonnes of CO_2. Of this total, 83.6 ktep relates to direct saving arising from public support. This saving is achieved by the replacement of existing cogeneration equipment, increasing the electrical output. The annual breakdown of impact in the period 2008 – 2012 in cumulative annual figures is given in the following table:

Table 14.30.

Year	2008	2009	2010	2011	2012	Total
Primary energy saving (ktep)	100.2	177.9	222.7	272.0	363.4	**1,136.2**
Direct	23.0	40.9	51.2	62.6	83.6	**261.3**
Induced	77.2	137.0	171.5	209.5	279.8	**874.9**
Emissions avoided (ktCO_2)	293.8	521.5	653.1	797.6	1,065.4	**3,331.6**
Through direct saving	67.6	120.0	150.2	183.5	245.1	**766.3**
Through induced saving	226.2	401.6	502.9	614.2	820.4	**2,565.3**

14.3. Summary of costs and benefits by measure

Table 14.31.

	Measure	Energy savings (ktep)						Emissions avoided (ktCO2)						Public support (k€)						Investment (k€)					
		2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total	2008	2009	2010	2011	2012	Total
1	Oil Refining Joint Committees	320.3	384.3	448.4	512.5	576.5	2,242.0	960.9	1,153.0	1,345.2	1,537.4	1,729.5	6,726.0	18.0	18.0	18.0	18.0	18.0	90.0	16,517	16,517	16,517	16,517	16,517	82,585
2	Electricity Generation Joint Committees	426.4	511.7	597.0	682.2	767.5	2,984.8	995.8	1,195.0	1,394.2	1,593.3	1,792.5	6,970.9	18.0	18.0	18.0	18.0	18.0	90.0	63,050	63,050	63,050	63,050	63,050	315,251
3	Development of cogeneration potential. Feasibility studies	-	-	-	-	-	-	-	-	-	-	-	-	450.0	450.0	450.0	450.0	450.0	2,250.0	600	600	600	600	600	3,000
4	Development of cogeneration potential. New installations in non-industrial activities	42.9	55.8	68.7	81.5	94.4	343.3	100.2	130.3	160.3	190.4	220.5	801.7	2,281.2	2,287.5	2,287.5	2,287.5	2,287.5	11,431.1	45,623	45,750	45,750	45,750	45,750	228,621
5	Development of cogeneration potential. Promotion of small capacity cogeneration plants	0.0	0.0	0.1	0.3	0.5	0.9	0.0	0.0	0.3	0.6	1.3	2.1	63.0	63.0	395.8	562.8	894.4	1,979.0	0	0	1,585	2,380	3,959	7,924
6	Improved energy efficiency in cogeneration. Energy audits	-	-	-	-	-	-	-	-	-	-	-	-	648.0	648.0	648.0	648.0	648.0	3,240.0	864	864	864	864	864	4,320
7	Improved energy efficiency in cogeneration. Renovation Plan for existing installations	100.2	177.9	222.7	272.0	363.4	1,136.2	293.8	521.5	653.1	797.6	1,065.4	3,331.6	2,813.7	2,181.0	1,260.1	1,383.8	2,564.9	10,203.4	122,333	94,827	54,786	60,166	111,516	443,628
	TOTAL	889.8	1,129.7	1,336.9	1,548.5	1,802.3	6,707.1	2,350.7	2,999.8	3,553.1	4,119.4	4,809.2	17,832.2	6,291.8	5,665.5	5,077.4	5,368.1	6,880.8	29,283.6	248,988	221,608	183,151	189,327	242,256	1,085,330

14.4. Economic benefits

The full implementation of the measures laid down in the present Plan for Energy Transformation means a cumulative annual economic saving for 2012 of 951 million euro with a total for the period 2008 – 2012 of 3,540 million euro. For the economic assessment, account has been taken of the benefits through energy saving and those derived from emissions of CO_2 avoided using the following criteria:

- Economic benefit through energy saving: 480 €/tep
- Economic benefit through emissions of CO_2 avoided: 18 €/tCO_2

The following table gives the data for each effective year of the present Plan:

Table 14.32.

Economic benefits	2008	2009	2010	2011	2012	Total
Energy origin (M€)	427.1	542.2	641.7	743.3	865.1	3,219.4
Origin CO_2 avoided (M€)	42.3	54.0	64.0	74.1	86.6	321.0
Total	469.4	596.2	705.6	817.4	951.7	3,540.4

ANNEX: TABLES AND INDICATORS

TRANSFER AND EMISSION FACTORS, BY SECTOR

The factors of transfer between final and primary energy have been analyzed using the 2005 sectoral consumption structure and applying to the saving structure in terms of type of energy affected; from this same saving structure, the emissions avoided are calculated. It is pointed out that the consumption structure is different from that of saving which impacts on one or other energy sources affected by the final result. The combination of the thermal/electrical system means that the result differs from one case to another and from year to year.

a) Factors for energy *savings* according to sectoral measures and objectives

SECTORAL ANALYSIS		FACTORS FOR THE STRUCTURE OF PAE4+ SAVINGS		
		FACTOR FROM FE TO PE	FACTOR OF AVGE WEIGHTED EMISSION tco2/tep FINAL ENERGY	FACTOR OF AVGE WEIGHTED EMISSION tCO2/tep PRIMARY ENERGY
END- USE SECTORS	INDUSTRY	1.4253	3.4073	2.3905
	TRANSPORT	1.1035	3.5434	3.2111
	BUILDINGS	1.9258	4.4784	2.3255
	DOM. & OFFICE EQUIPMENT	2.5160	5.3717	2.1351
	AGRICULTURE	1.1656	3.6464	3.1284
	PUBLIC SERVICES	2.5160	5.3717	2.1351
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION			2.6590
TOTALS		1.3662	3.7053	2.7121

CALCULATIONS ON ENERGY SCHEME 2005 (IDAE)

b) Factors for energy *consumption* according to the primary supply mix of 2005 and sectoral consumption

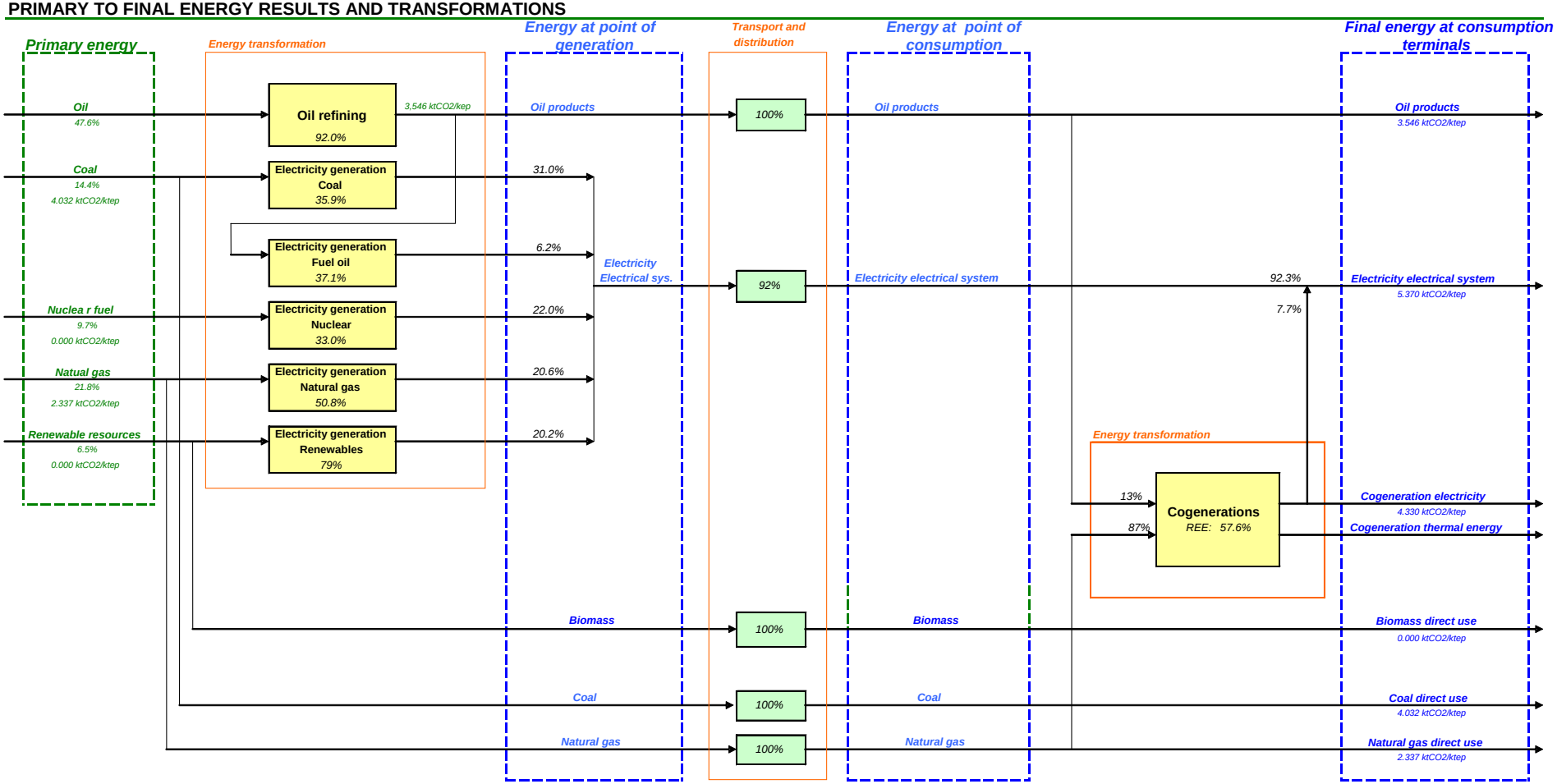
SECTORAL ANALYSIS		FACTORS FOR THE STRUCTURE OF 2005 CONSUMPTION		
		FACTOR FROM FE TO PE	FACTOR OF AVGE WEIGHTED EMISSION tco2/tep FINAL ENERGY	FACTOR OF AVGE WEIGHTED EMISSION tCO2/tep PRIMARY ENERGY
END- USE SECTORS	INDUSTRY	1.4253	3.4073	2.3905
	TRANSPORT	1.1035	3.5434	3.2111
	BUILDINGS	1.5004	3.4760	2.3168
	DOM. & OFFICE EQUIPMENT	2.2590	4.8574	2.1502
	AGRICULTURE	1.1239	3.5932	3.1970
	PUBLIC SERVICES	2.5160	5.3717	2.1351
TRANSFORMATION SECTOR	ENERGY TRANSFORMATION			2.6590
TOTALS		1.3558	3.5789	2.6397

RESULTS OF THE ENERGY SYSTEM WITH ENERGY TRANSFORMATION FACTORS, OUTPUTS AND EMISSION FACTORS BY ENERGY SOURCE

The attached graph outlines the basic lines of transformation of some primary energy sources into others that are secondary or end-use, giving the conversion factors, transformation outputs, and emission factors by energy source. These results have been arrived at using the results and consumptions issued by the Ministry of Industry, Trade and Tourism of 2005, the latest year for which this segregation by source and sector is available. Using these factors, primary energy savings were obtained and quantified from sectoral assessments in terms of final energy, except in the case of energy transformation which operates on the first rung of the ladder; whereas emissions avoided were determined for the corresponding generation mix of the electrical system, also taking into consideration the effect of cogenerations by taking account of thermal and electricity generation. Accordingly, the energy flows appear in the following stages:

- Primary or crude energy to the system
- Energy transformation for its delivery to the market
- Energy at generation points for supply to the system
- Electricity transport and distribution
- Energy available at points of consumption
- Cogeneration
- Final energy at consumption terminals

PRIMARY TO FINAL ENERGY RESULTS AND TRANSFORMATIONS



CONVERSION OR TRANSFORMATION FACTORS

Energy ratio factors (ktep/ ktep)	Primary/c.t.	Primary/point of consumption	Primary/final
Oil products	**1.087**	**1.087**	**1.087**
Electricity electrical system	**2.373**	**2.579**	**2.516**
Coal	0.863		0.865
Oil	0.182		0.183
Nuclear	0.667		0.669
Natural gas	0.406		0.407
Renewables	0.255		0.256
Oil - cogenerations	-		0.019
Natural gas - cogenerations	-		0.117
Electricity cogeneration	**-**	**-**	**1.756**
Oil - cogenerations	-		0.245
Natural gas - cogenerations	-		1.510
Thermal energy cogeneration	**-**	**-**	**1.000**
It was considered that the fuel for thermal energy in cogeneration is directly final energy since these fuels are considered as final energy if they are supplied directly for processing. In this way, the RTE is 100%			
Biomass direct use	**1.000**	**1.000**	**1.000**
Coal direct use	**1.000**	**1.000**	**1.000**
Natural gas direct use	**1.000**	**1.000**	**1.000**

CO2 emissions/final energy consumed ratio factors (ktCO2/ktep)	At consumption terminals
Oil products	**3.546**
Electricity electrical system	**5.370**
Coal	3.488
Fuel oil, diesel	0.597
Nuclear	0.000
Natural gas	0.951
Renewables	0.000
Cogenerations	0.335
Electricity cogeneration	**4.330**
Biomass direct use	**0.000**
Coal direct use	**4.032**
Natural gas direct use	**2.337**

Table of Energy Results, Emissions, Investments and Support