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# GLOBAL INDICATOR OF CLIMATE CHANGE ADAPTATION IN CATALONIA

## Documents from the Catalan Office for Climate Change

Generalitat de Catalunya
Departament de Territori i Sostenibilitat
**Secretaria de Medi Ambient
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# 1. Background

The Catalan Strategy for Adapting to Climate Change 2013-2020 (ESCACC), which was drafted by the Catalan Office for Climate Change (OCCC) and approved by the government under convention GOV 115/2012, of 13 November, published in DOGC (Official Journal of the Government of Catalonia) No. 6254, marks a significant step towards reducing Catalonia's vulnerability to the impacts of climate change.

The operational objectives of the ESCACC are firstly to generate and transfer knowledge of climate change adaptation and secondly to increase the adaptive capacity of the most vulnerable areas (the Pyrenees, the Ebro Delta and the coast), the socio-economic sectors and the natural systems in Catalonia: agriculture and livestock, biodiversity, water management, forest management, industry, services and trade, mobility and transport infrastructure, fisheries and marine ecosystems, health, energy, tourism, and urban planning and housing.

To achieve these objectives, the ESCACC proposes a total of 182 adaptation measures: 30 of these are generic and the remaining 152 are specific to sectors and systems. The generic measures include the drafting and approval of a Catalan climate change law (in progress), and the **establishment of a monitoring system and indicators for the adaptation measures** set out in the ESCACC, in order to evaluate how well climate change adaptation is progressing; in other words, a system to determine the effectiveness of the measures to adapt to the impacts of climate change.

Moreover, an initiative aimed at establishing indicators for the measures to adapt to climate change impacts is also envisaged within the framework of the project LIFE12 ENV/ES/000536: "Demonstration and validation of innovative methodology for regional climate change adaptation in the Mediterranean area", also known as LIFE MEDACC, for which the Ministry of Land and Sustainability, through the Catalan Office for Climate Change, is a coordinating beneficiary. Action B.1 of LIFE MEDACC proposes the definition of new adaptation measures based on the evaluation of climate change impacts and vulnerability and the evaluation of existing adaptation measures. For this purpose, sub-action B.1.2. states that it is necessary to compile and review methodologies by means of statistical analysis or an analysis of the existing literature in order to **develop a set of indicators of adaptation to the impacts of climate change**.

To summarize, there is a strategic framework for planning climate change policies (ESCACC) and a demonstration project at Mediterranean Europe level (LIFE MEDACC) that call for the establishment of a tool to assess the effectiveness of the measures to adapt to climate change impacts. The preliminary work carried out

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within the framework of both the ESCACC and MEDACC projects has made it possible to reach a sufficiently advanced stage such that the creation of a **global indicator of adaptation to climate change impacts in Catalonia** is now feasible.

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# 2

# 2. Preparatory work for the creation of the indicator

The adaptation evaluation, i.e. the analysis of whether or not Catalonia is making progress in its adaptation to climate change impacts, requires the creation of an indicator with three different levels of integration: (1) for the measure, whenever possible; (2) for each sector and system; (3) and lastly, for the whole of Catalonia.

Four basic criteria must be taken into account when the indicators are created: (1) they must be easy to achieve, i.e. the information should be easily available; (2) there must be historical data on what is measured; (3) the indicator must be easy to interpret; and (4) the information and data must be specific to the Catalan region.

The task of evaluating the effectiveness of adaptation measures is not straightforward. This was acknowledged in the communication from the European Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions concerning the EU Strategy on Adaptation to Climate Change, of 16 April 2013, COM (2013) 216 final. This communication stated: "Monitoring and evaluating climate change adaptation policies are crucial. The emphasis is still on monitoring impacts rather than adaptation action and its effectiveness. The Commission will develop indicators to help evaluate adaptation efforts and vulnerabilities across the EU, using LIFE funding and other sources." In March 2014, the Commission proposed an adaptation preparedness scoreboard based on the evaluation of five different areas as a tool for measuring the degree of progress in climate change adaptation policies in the member states of the European Union. One of these areas concerns the monitoring and evaluation of adaptation measures through indicators, but the calculation mechanisms were not specified.

## 2.1. Creation of Data

The unfamiliarity of the task at hand and the lack of references therefore meant that the search for indicators was neither simple nor easy. This partly explains why some

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of the initial indicators were more mature than others. Thus, a preliminary task to search and select data resulted in a proposal that grouped together a total of 83 potential indicators to evaluate the effectiveness of the adaptation measures. These indicators are listed in Appendix 1.

The information included in each indicator was organized in a data-sheet format[1] with the following sections:

1. **Sector indicator –** name of the indicator.
2. **Operational objective –** CONADAPT (to generate and transfer knowledge of climate change adaptation) or CAPADAPT (to increase the adaptive capacity of sectors and/or systems).
3. **Measure(s) to which it responds –** adaptation measure(s) to which the indicator corresponds.
4. **Source –** information source (direct and indirect sources are differentiated).
5. **Methodology –** explanation of the methodology used by the information source to obtain the numerical data.
6. **Data –** numerical values of the indicator by year (table).
7. **Graphic representation –** of the data.
8. **Desired trend of the adaptation –** description of the direction the indicator must take in order to achieve a more effective adaptation, i.e. whether it should increase or decrease. This is a way of explaining how to interpret the indicator and its evolution.
9. **Relevance of the indicator –** justification of why this indicator is useful for evaluating the specific measure. It also explains how the data should be interpreted.

The diversity of the indicators and, at the same time, the differences between qualitative and quantitative information for some of these indicators or the lack of time-based consistency of the data meant that it was impossible to respond to the key question: Is Catalonia adapting well to the impacts of climate change? Therefore, following a meeting with representatives from the Catalan Institute of Public Policy Evaluation (IVÀLUA), a preselection process was conducted. This second selection process was based primarily on the potential capacity of the indicator to quantify the outcome of adaptation actions implemented or in progress (and, therefore, on the effectiveness of the indicator to evaluate the measures). In other words, only indicators that directly measured the outcome of the application of the measure were included (e.g. the number of fatalities due to heat waves following implementation of the Action Plan to Prevent the Effects of Heat Waves on Health – POCS), while indicators that measured a sector or system's sensitivity or degree of exposure were rejected (e.g. the population ageing index). Indicators that were more qualitative in nature, such as planning tools that incorporate climate change impacts and adaptation (forestry plan, tourism plan, etc.), were also retained in the preselection process. During this process, the initial 83 indicators were reduced to a set of 50, which are listed in Appendix 2.

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[1] It is important to note that, at this stage, some of the data sheets on the indicators could summarize more than one indicator. For example, the indicator "Household consumption" (Water management) includes data broken down by the Metropolitan Area of Barcelona and by Catalonia as a whole.

# 3

# 3. Synthetic Adaptation Indicator

Following the work carried out with IVÀLUA, the services of Dr. Josep Maria Raya from Maresme College (Mataró-Maresme Tecnocampus, Universitat Pompeu Fabra) were contracted in order to obtain a synthetic indicator of climate change adaptation. The ultimate aim of the commissioned work was to make it possible to determine, in measurable terms, the extent to which Catalonia is adapting to the impacts of climate change.

This work entailed a third selection process: only those indicators with a series of historical data based on at least 10 consecutive years were chosen, as explained in Section 3.2. This process reduced the number of indicators to a total of 29.

## 3.1.    Methodology

In order to achieve the objective mentioned above, the most appropriate statistical technique was found to be principal component analysis (PCA), a procedure related to factor analysis. The purpose of factor analysis is to analyse the structure of interrelations between a number of variables (indicators, in our case) and define common dimensions, thus producing a lower dimensional space. Principal component analysis, in particular, aims to reduce the dimensionality of the data matrix in order to obtain a lower number of new variables (Zj) or principal components with the following characteristics:

- The principal components are linear combinations of the original variables.
- The principal components are not correlated with each other.
- The number of principal components must be simultaneously small (so that the analysis is effective) and sufficient (to absorb most of the information on the original variables). There are several criteria to determine the number of factors to incorporate. One of the most widely used criteria is to keep factors that have a characteristic value greater than one, or factors that explain more than 20% of the total variance.

Thus, the calculation of the first component (or factor) is performed as a linear combination of the original variables that retains the maximum amount of total variance. In the calculation of the second component (or factor), the same procedure

is performed (linear combination of the original variables to retain the maximum amount of total variance of the part not included in the first), and so on.

Interpreting the components (or factors) is easy in theory, but is usually quite difficult in practice. Each variable (indicator) has a relative contribution to each factor. This contribution expresses the correlation between this variable (indicator) and the factor. A high relative contribution of the variable tells us that there is a strong correlation between this variable and the factor. In other words, it means that this variable is important for the interpretation of the factor. This contribution can be positive or negative, depending on whether that variable increases or reduces the value of the factor.

## 3.2.    Results

This methodology was used to perform **the principal component analysis of the annual values of 29 indicators**[2] categorized into 10 groups (see Table 1 and Appendix 3). Of the 50 indicators originally provided, those that did not present sufficient variability were discarded in advance, either because the information was not annual, because the indicator was only qualitative, or because there were insufficient observations. With these special cases in mind, all biodiversity indicators and the majority of agriculture and livestock indicators had to be discarded for the analysis.

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[2] To carry out the principal component analysis, the presentation of the data for some indicators had to be adapted. For example, the data for the indicator "Total overnight stays in hotels in Catalonia" (Tourism) were broken down by the four quarters of the year. When entering the variables in the model, the data were entered as a percentage of overnight stays in the third quarter/year total, which was actually the most relevant information for the indicator. This is why the names of some indicators were adapted.

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Table 1: Name of the indicators included in the analysis

| Abbreviations[3] | Definition and units |
|---|---|
| pa1 | Total agricultural output of dryland crops with added value (t): olives+grapes |
| pe1 | % consumption of electricity from renewable sources |
| pe2 | Number of special regime facilities in Catalonia |
| pe6 | Primary energy intensity (energy content of GDP) (toe/€million in the year 2000) |
| pg1 | Household consumption (l/inhab./day): Catalonia |
| pg2 | Household consumption (l/inhab./day): Metropolitan Area of Barcelona |
| pgf2 | Timber harvesting for firewood and biomass in Catalonia (t) |
| pgf3 | Production of forest products (other than timber and firewood) (t): cork+truffles and other fungi+pine nuts |
| pgf5 | Hectares burned per fire (%) |
| pi1 | Water consumption: amount billed to industry and services ($m^3$) |
| pi2 | Final energy consumption of the industrial and service sectors (ktoe) |
| pi3 | GHG emissions from the industrial sector (thousands of t of $CO_2$-eq) |
| pi4 | Imports of oil extraction and refining, coal (millions of euros) |
| pm1 | Passengers on Renfe and FGC trains (thousands) |
| pm2 | Goods on Renfe and FGC trains (thousands of tonnes) |
| pm3 | Passengers on buses (thousands) |
| pm4 | Energy consumed by transport (ktoe) |
| pm5 | GHG emissions from transport (kt $CO_2$-eq) |
| prd1 | Domestic expenditure on R&D/GDP (%) |
| ps6 | At-risk-of-poverty rate: after social transfers in Catalonia |
| ps8 | Green area per inhabitant in the city of Barcelona ($m^2$/inhabitant) |
| ps9 | Catalan air quality index ICQA (% (satisfactory + excellent)) |
| ps10 | Maximum value of ozone immissions ($\mu g/m^3$) |
| pt2 | Total overnight stays in hotels in Catalonia (% 3rd quarter/year total) |
| pt5 | Foreign tourists' reasons for travelling to Catalonia (% professional tourism) |
| pt14 | Snow cannons on Catalan ski resort (km skislope/cannon) |
| pu2 | Volume of water billed in the household sector in Catalonia ($m^3$) |
| pu3 | Final energy consumption of the household sector in Catalonia (ktoe) |
| pu4 | GHG emissions from the residential sector (t $CO_2$-eq) |

In order to standardize the information, the values of all variables were converted to values of 0 to 1. Using the statistical program Stata, two factors that explained 100%

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[3] The letter that follows the "p" indicates the sector or system to which the indicator refers (a: agriculture and livestock; e: energy; g: water management; gf: forest management; i: industry, services and trade; m: mobility and transport infrastructure; rd: research, development and innovation; s: health; t: tourism; u: urban planning and housing). The number indicates the indicator's assigned position in the list of 50 indicators selected prior to the factor analysis.

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of the variability of the original information were obtained. **The first factor explained 61% of the variability and the second factor 39%**.

The significance of the two factors was interpreted as follows: the **first factor evaluates the use of resources (primarily water and energy)**, while the **second factor evaluates environmental quality (primarily atmospheric emissions)**. Tables 2 and 3 show the contribution of each variable to each of the factors.

Table 2: Relative contribution of each indicator to factor 1, which evaluates the use of resources (primarily water and energy)

| Code | Indicator | Factor 1 |
|------|-----------|----------|
| prd1 | Domestic expenditure on R&D/GDP (%) | -0.9973 |
| pe2 | Number of special regime facilities in Catalonia | -0.9900 |
| pa1 | Total agricultural output of dryland crops with added value (t): olives+grapes | -0.9596 |
| pm3 | Passengers on buses (thousands) | -0.9286 |
| ps6 | At-risk-of-poverty rate: after social transfers in Catalonia | -0.9039 |
| pe1 | % consumption of electricity from renewable sources | -0.8903 |
| ps8 | Green area per inhabitant in the city of Barcelona ($m^2$/inhabitant) | -0.7287 |
| pu3 | Final energy consumption of the household sector in Catalonia (ktoe) | -0.4418 |
| pi4 | Imports of oil extraction and refining, coal (millions of euros) | -0.2640 |
| pt2 | Total overnight stays in hotels in Catalonia (% 3rd quarter/year total) | -0.0745 |
| ps9 | Catalan air quality index ICQA (% (satisfactory + excellent)) | 0.0745 |
| pu4 | GHG emissions from the residential sector (t $CO_2$-eq) | 0.1877 |
| pgf5 | Hectares burned per fire (%) | 0.3279 |
| pm5 | GHG emissions from transport (kt $CO_2$-eq) | 0.3516 |
| ps10 | Maximum value of ozone immissions ($\mu g/m^3$) | 0.4148 |
| pm4 | Energy consumed by transport (ktoe) | 0.4518 |
| pt14 | Snow cannons on Catalan ski resort (km skislope/cannon) | 0.7051 |
| pgf3 | Production of forest products (other than timber and firewood) (t): cork+truffles and other fungi+pine nuts | 0.7516 |
| pi2 | Final energy consumption of the industrial and service sectors (ktoe) | 0.8110 |
| pgf2 | Timber harvesting for firewood and biomass in Catalonia (t) | 0.8613 |
| pi1 | Water consumption: amount billed to industry and services ($m^3$) | 0.8996 |
| pm1 | Passengers on Renfe and FGC trains (thousands) | 0.9399 |
| pu2 | Volume of water billed in the household sector in Catalonia ($m^3$) | 0.9568 |
| pi3 | GHG emissions from the industrial sector (thousands of t of $CO_2$-eq) | 0.9756 |
| pm2 | Goods on Renfe and FGC trains (thousands of tonnes) | 0.9765 |
| pt5 | Foreign tourists' reasons for travelling to Catalonia (% professional tourism) | 0.9858 |
| pg1 | Household consumption (l/inhab./day): Catalonia | 0.9919 |
| pe6 | Primary energy intensity (energy content of GDP) (toe/€million in the year 2000) | 0.9919 |
| pg2 | Household consumption (l/inhab./day): Metropolitan Area of Barcelona | 0.9929 |

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Table 3: Relative contribution of each indicator to factor 2, which evaluates environmental quality (primarily atmospheric emissions)

| Code | Indicator | Factor 1 |
|------|-----------|----------|
| **ps9** | Catalan air quality index ICQA (% (satisfactory + excellent)) | -0.9972 |
| **pi4** | Imports of oil extraction and refining, coal (millions of euros) | -0.9645 |
| **pm5** | GHG emissions from transport (kt $CO_2$-eq) | -0.9362 |
| **pm4** | Energy consumed by transport (ktoe) | -0.8921 |
| ps8 | Green area per inhabitant in the city of Barcelona ($m^2$/inhabitant) | -0.6848 |
| pi2 | Final energy consumption of the industrial and service sectors (ktoe) | -0.5850 |
| pi1 | Water consumption: amount billed to industry and services ($m^3$) | -0.4366 |
| ps6 | At-risk-of-poverty rate: after social transfers in Catalonia | -0.4277 |
| pm1 | Passengers on Renfe and FGC trains (thousands) | -0.3416 |
| pu2 | Volume of water billed in the household sector in Catalonia ($m^3$) | -0.2909 |
| pi3 | GHG emissions from the industrial sector (thousands of t of $CO_2$-eq) | -0.2194 |
| prd1 | Domestic expenditure on R&D/GDP (%) | 0.0728 |
| pg2 | Household consumption (l/inhab./day): Metropolitan Area of Barcelona | 0.1186 |
| pg1 | Household consumption (l/inhab./day): Catalonia | 0.1266 |
| pe6 | Primary energy intensity (energy content of GDP) (toe/€million in the year 2000) | 0.1266 |
| pe2 | Number of special regime facilities in Catalonia | 0.1413 |
| pt5 | Foreign tourists' reasons for travelling to Catalonia (% professional tourism) | 0.1676 |
| pm2 | Goods on Renfe and FGC trains (thousands of tonnes) | 0.2155 |
| pa1 | Total agricultural output of dryland crops with added value (t): olives+grapes | 0.2812 |
| pm3 | Passengers on buses (thousands) | 0.3711 |
| pe1 | % consumption of electricity from renewable sources | 0.4554 |
| pgf2 | Timber harvesting for firewood and biomass in Catalonia (t) | 0.5081 |
| pgf3 | Production of forest products (other than timber and firewood) (t): cork+truffles and other fungi+pine nuts | 0.6596 |
| pt14 | Snow cannons on Catalan ski resort (km skislope/cannon) | 0.7091 |
| **pu3** | Final energy consumption of the household sector in Catalonia (ktoe) | 0.8971 |
| **ps10** | Maximum value of ozone immissions (µg/$m^3$) | 0.9099 |
| **pgf5** | Hectares burned per fire (%) | 0.9447 |
| **pu4** | GHG emissions from the residential sector (t $CO_2$-eq) | 0.9822 |
| **pt2** | Total overnight stays in hotels in Catalonia (% 3rd quarter/year total) | 0.9972 |

Indicators with a strong contribution to each factor are marked in colour. Values below -0.8 or above 0.8 were considered to be strong contributions. Thus, examples of indicators that strongly affect factor 1 (the use of resources) are "Number of special regime facilities in Catalonia" (-0.9900) and "Household consumption (l/inhab./day): Metropolitan Area of Barcelona" (0.9929). In the case of factor 2 (environmental quality), those with most influence are "Catalan air quality index ICQA (% (satisfactory + excellent))" (-0.9972) and "GHG emissions from the residential sector (t $CO_2$-eq)" (0.9822).

Finally, to avoid overweighting groups with a greater number of indicators, the influence of each of the 10 groups (systems and sectors) was evaluated. Thus, the

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weighting of natural systems and socio-economic sectors **based on their vulnerability to the impacts of climate change** (and in accordance with the ESCACC diagnosis) resulted in the indicators being divided into the following five groups, from most to least importance (see Figure 1):

1. Water management (35%)
2. Agriculture and livestock; Forest management; Health (30%, i.e. 10% each)
3. Energy (8%)
4. Industry, services and trade; Tourism; Urban planning and housing; Mobility and transport infrastructure (24%, i.e. 6% each)
5. Research, development and innovation (3%)

Figure 1: Weight percentages of the indicators by sector

Figura 1: Percentatges de ponderació dels indicadors per cada sector
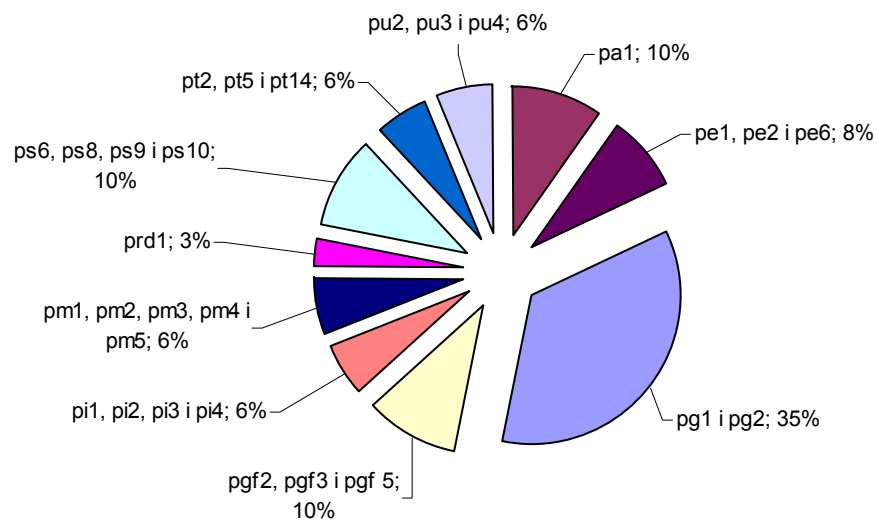


Lastly, within each factor, the weighted value of the indicator is multiplied by the indicator's contribution to the factor and by the value (between 0 and 1) of the indicator during the selected time period (years). By performing this calculation for both factors and for 2005 and 2011, the results indicated in Table 4 are obtained. As can be seen, both factors have a medium value (around 5) (see Figures 2 and 3). In both cases, there was a slight decrease in the year 2011 compared with 2005.

Table 4: Calculation of the final indicators based on the information for 2005 and 2011

|  | Use of resources 2005 | Use of resources 2011 | Environmental quality 2005 | Environmental quality 2011 |
|---|---|---|---|---|
| Value between -1 and 1 | 0.01178539 | -0.00651876 | 0.025385413 | 0.011514624 |
| Value between 0 and 10 | 5.05892695 | 4.967406201 | 5.126927065 | 5.057573122 |

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Figure 2: Year-on-year comparison of the final factors based on the information for 2005 and 2011
Use of resources (primarily water and energy)
Environmental quality (primarily atmospheric emissions)



Figura 2: Comparativa interanual dels factors finals d'acord amb la informació al 2005 i 2011
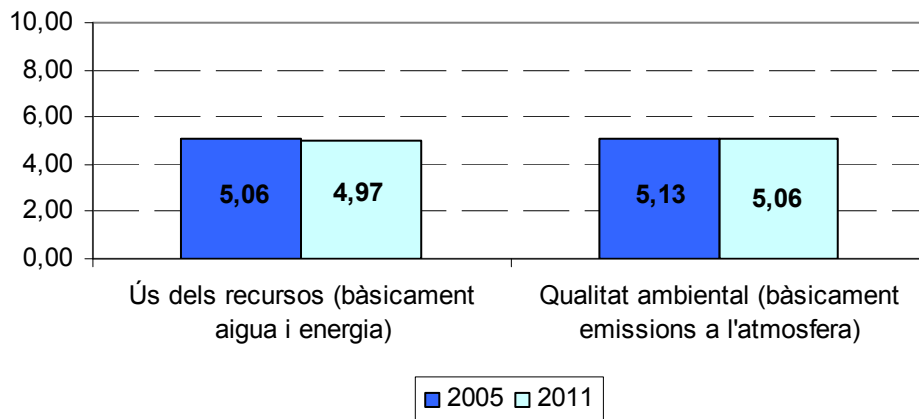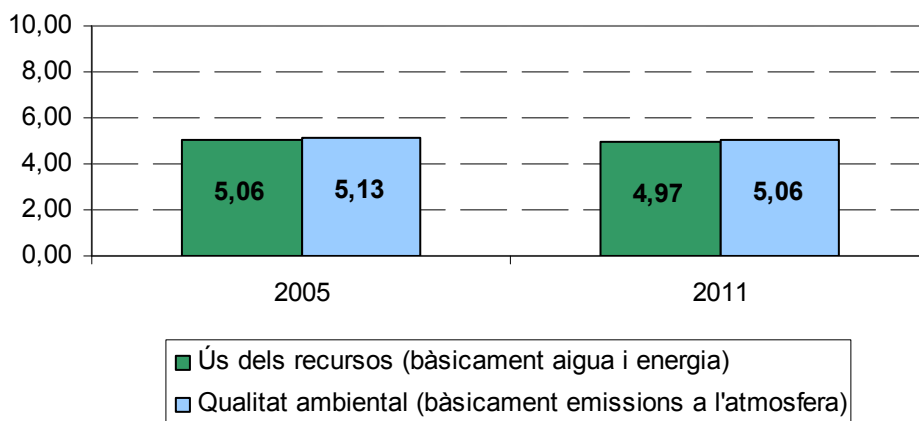
Figure 3: Intra-annual comparison of the final factors based on the information for 2005 and 2011
Use of resources (primarily water and energy)
Environmental quality (primarily atmospheric emissions)



Figura 3: Comparativa intranual dels factos finals d'acord amb la informació al 2005 i 2011

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# 4

## 4. Conclusions

- As a result of applying the principal component analysis, **a synthetic adaptation indicator** was obtained. This will enable us to monitor the development of Catalonia's capacity to adapt to the impacts of climate change. This synthetic adaptation indicator is determined by two factors that explain 100% of the variability of the original information contained in 29 indicators. Each of these factors corresponds to a different aspect: **(1) use of resources and (2) environmental quality**. Since having data with annual variability is essential, indicators for which there was no variability (qualitative indicators) or for which the information was not annual, based on a minimum of 10 consecutive years, were discarded.

  The synthetic adaptation indicator, expressed as the result of both factors, shows a medium level in terms of the capacity to adapt to climate change impacts; just a pass. The evolution of this capacity has been decreasing slightly in recent years (2011 versus 2005). It is important to bear in mind that in order to monitor the synthetic indicators properly, rapid access to the information relating to the original indicators is required. These indicators should be reviewed every five or ten years based on new information available (in order to include more aspects in the synthetic indicator).

- It should be noted that biodiversity is the primary source of environmental services, so its effective or poor adaptation to climate change impacts will directly affect the other natural systems and many, if not all, economic systems. Biodiversity has thus far not been included in this quantitative analysis of the adaptation, but its key importance means that a more qualitative evaluation is also needed.

  The fishing industry was also omitted from the analysis, but for a different reason. In this case, there were initially three indicators, but they were rejected during the first selection process because they were largely indirect, since the adaptation measures were highly general. It is necessary to wait until more basic knowledge of the impacts and the most effective measures for combating climate change in this sector is available.

# 5

# 5. APPENDICES

## 5.1. Appendix 1: List of the 83 Indicators

Agriculture and livestock

- Livestock units (UR) with sheep, goats and horses in Catalonia
- Livestock units (UR) and pig farms in Catalonia
- Land for permanent pastures in Catalonia
- Agricultural output of dryland crops with added value
- Water demand for agricultural use

Biodiversity

- Ecosystem productivity
- Ecological connectivity
- Invasive non-native species

Water management

- Household consumption
- Degree of achievement of planning objectives

Forest management

- General Forestry Policy Plan of Catalonia 2014-2024
- Relationship between timber harvesting and growth in Catalonia
- Timber harvesting for firewood and biomass in Catalonia
- Production of forest products (other than timber and firewood) in Catalonia
- Percentage of forest affected by decline
- Hectares burned per fire
- Evolution of the percentage of managed forest area in Catalonia
- Percentage of forest coverage and surface area covered by trees
- Evolution of the number of subsidized biomass facilities (thermal sector)
- Consumption of primary energy from forest and agriculture biomass

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- Riparian forest quality (QBR) index
- Total number of Land Stewardship Agreements and the area affected by the agreements

## Industry, services and trade

- Water consumption: amount billed to industry and services
- Industrial waste by sector of activity
- Final energy consumption of the industrial and service sectors 2005-2009
- Industrial investment by type of goods
- GHG emissions from the industrial sector in Catalonia
- Foreign trade (imports of oil extraction and refining, coal)

## Mobility and transport infrastructure

- Rail in Catalonia (Renfe and FGC)
- Number of passengers transported by city and intercity buses
- Energy consumed by transport in Catalonia
- GHG emissions from transport in Catalonia

## Fisheries and marine ecosystems

- Fish caught (tonnes) / vessel
- Fish caught (tonnes) / Horsepower (HP)
- % non-industrial fishing vessels (small scale)

## Health

- Interdepartmental Plan for Public Health (PINSAP)
- Action Plan to Prevent the Effects of Heat Waves on Health (POCS)
- Ageing index
- Over-ageing index
- Care at home in people >74 years
- Household type (single person)
- Population insured by the public health system (CATSALUT)
- Causes amenable to intervention by intersectoral health policies and avoidable mortality
- At-risk-of-poverty rate
- Green area per inhabitant in the city of Barcelona
- Catalan air quality index (ICQA)
- Maximum value of ozone immissions
- Evolution of VOPS (target value for the protection of human health) at measuring stations with maximum exceedance values of VOPS

## Energy

- % consumption of electricity from renewable sources
- Evolution of final energy consumption by energy sources (ktoe)

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- Evolution of the gross electricity production in Catalonia 2005-2009
- Evolution of electricity demand GWh 2007-2013
- Evolution of demand for natural gas GWh PCS 2007-2013
- Evolution of motor fuel consumption (ktoe) 2007-2013
- Evolution of the amount invoiced for accumulated electricity by sector (GWh) 2007-2013
- Number of special regime facilities in Catalonia
- Degree of self-consumption with respect to the gross energy production of special regime facilities in Catalonia
- Final energy intensity

Tourism

- Strategic Tourism Plan for Catalonia 2013-2016 and the National Tourism Guidelines 2020
- Total overnight stays in hotels in Catalonia
- Occupancy in tourism establishment (not including apartments)
- Foreign tourists' reasons for travelling to Catalonia
- Number of cruise passengers in Catalonia (Barcelona and Tarragona)
- Biological quality of coastal water bodies in Catalonia
- Density of *Posidonia oceanica* meadows
- Quality of bathing water (beaches and inland bathing areas) in Catalonia
- Evolution (dynamic behaviour) of the Catalan coast (beaches) 1995-2004
- Classification of Catalan beaches according to their physical stability 1995-2004
- Classification of Catalan coastal beaches according to their suitability for recreational/tourist activities
- Plan for Spaces of Natural Interest (PEIN)
- Snow cannons on Catalan ski resort

Urban planning and housing

- Aid scheme for energy efficiency improvement of homes
- Degree of conservation of buildings used as family dwellings in Catalonia
- Volume of water billed in the household sector in Catalonia
- Total annual expenditure of households in Catalonia on housing, water, electricity, gas and other fuels (including rental costs, mortgage, etc.)
- Degree of conservation of buildings in Catalonia
- Final energy consumption of the household sector in Catalonia
- Distribution of the area for different land use types in Catalonia
- Employed population working outside the municipality of residence
- GHG emissions from the residential sector

Research, development and innovation

- Domestic expenditure on R&D/GDP by sector in Catalonia
- Domestic expenditure on R&D/GDP in Catalonia

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- Domestic expenditure on R&D/GDP in Catalonia, Spain and the EU

## 5.2. Appendix 2: List of the 50 Indicators

Agriculture and livestock

- Livestock units (UR) with sheep, goats and horses in Catalonia
- Livestock units (UR) and pig farms in Catalonia
- Land for permanent pastures in Catalonia
- Agricultural output of dryland crops with added value
- Water demand for agricultural use

Biodiversity

- Ecosystem productivity
- Ecological connectivity

Water management

- Household consumption
- Degree of achievement of planning objectives

Forest management

- General Forestry Policy Plan of Catalonia 2014-2024
- Relationship between timber harvesting and growth in Catalonia
- Timber harvesting for firewood and biomass in Catalonia
- Production of forest products (other than timber and firewood) in Catalonia
- Percentage of forest affected by decline
- Hectares burned per fire
- Evolution of the number of subsidized biomass facilities (thermal sector)
- Consumption of primary energy from forest and agriculture biomass

Industry, services and trade

- Water consumption: amount billed to industry and services
- Final energy consumption of the industrial and service sectors 2005-2009
- GHG emissions from the industrial sector in Catalonia
- Foreign trade (imports of oil extraction and refining, coal)

Mobility and transport infrastructure

- Rail in Catalonia (Renfe and FGC)
- Number of passengers transported by city and intercity buses
- Energy consumed by transport in Catalonia
- GHG emissions from transport in Catalonia

Health

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- Interdepartmental Plan for Public Health (PINSAP)
- Action Plan to Prevent the Effects of Heat Waves on Health (POCS)
- Care at home in people >74 years
- Population insured by the public health system CATSALUT
- At-risk-of-poverty rate
- Green area per inhabitant in the city of Barcelona
- Catalan air quality index (ICQA)
- Maximum value of ozone immissions

## Energy

- % consumption of electricity from renewable sources
- Number of special regime facilities in Catalonia
- Degree of self-consumption with respect to the gross energy production of special regime facilities in Catalonia
- Final energy intensity

## Tourism

- Strategic Tourism Plan for Catalonia 2013-2016 and the National Tourism Guidelines 2020
- Total overnight stays in hotels in Catalonia
- Foreign tourists' reasons for travelling to Catalonia
- Quality of bathing water (beaches and inland bathing areas) in Catalonia
- Classification of Catalan coastal beaches according to their suitability for recreational/tourist activities
- Snow cannons on Catalan ski resort

## Urban planning and housing

- Aid scheme for energy efficiency improvement of homes
- Volume of water billed in the household sector in Catalonia
- Degree of conservation of buildings used as family dwellings in Catalonia
- Final energy consumption of the household sector in Catalonia
- Employed population working outside the municipality of residence
- GHG emissions from the residential sector

## Research, development and innovation

- Domestic expenditure on R&D/GDP in Catalonia, Spain and the EU

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## 5.3. Appendix 3: Indicators Included in the Principal Component Analysis

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## AGRICULTURE AND LIVESTOCK

**1. Sector indicator:**

**pa1 – Total agricultural output of dryland crops with added value (t): olives + grapes**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

**3. Measure(s) to which it corresponds:**

− The implementation of management measures to prevent the salinization, erosion and loss of organic matter of soil in Catalonia. Specifically, the implementation of measures to reduce abandonment of drylands to prevent reforestation, an increased risk of fire and alterations in the hydrologic cycle, etc.
− Abandonment of drylands causes recolonization and thus leads to changes in the water balance. Water-use efficiency should also be promoted in drylands; the water saved in large-scale irrigations should be used for this and other purposes.

**4. Source:** Idescat (Agricultural production. Main products).

**5. Methodology:** The production data are obtained by applying the estimated unitary yields of each crop to the surface area in production.

**6. Data:**

| Year | Olives | Grapes | TOTAL |
|------|--------|--------|-------|
| 1997 | 214,750 | 469,419 | **684,169** |
| 1998 | 111,190 | 420,663 | **531,853** |
| 1999 | 195,869 | 459,857 | **655,726** |
| 2000 | 88,385 | 454,169 | **542,554** |
| 2001 | 69,669 | 408,997 | **478,666** |
| 2002 | 77,824 | 439,794 | **517,618** |
| 2003 | 142,098 | 487,564 | **629,662** |
| 2004 | 117,862 | 557,521 | **675,383** |
| 2005 | 121,024 | 384,413 | **505,437** |
| 2006 | 103,880 | 452,675 | **556,555** |
| 2007 | 102,412 | 417,937 | **520,349** |
| 2008 | 174,164 | 411,447 | **585,611** |
| 2009 | 151,110 | 439,828 | **590,938** |
| 2010 | 172,742 | 437,331 | **610,073** |
| 2011 | 107,133 | 451,203 | **558,336** |
| 2012 | 114,478 | 372,257 | **486,735** |

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## 7. Graphic representation:

**Total agricultural output of dryland crops with added value**
Tonnes
Year
Olives
Grapes
TOTAL



**Producció agrícola de secà amb valor afegit**
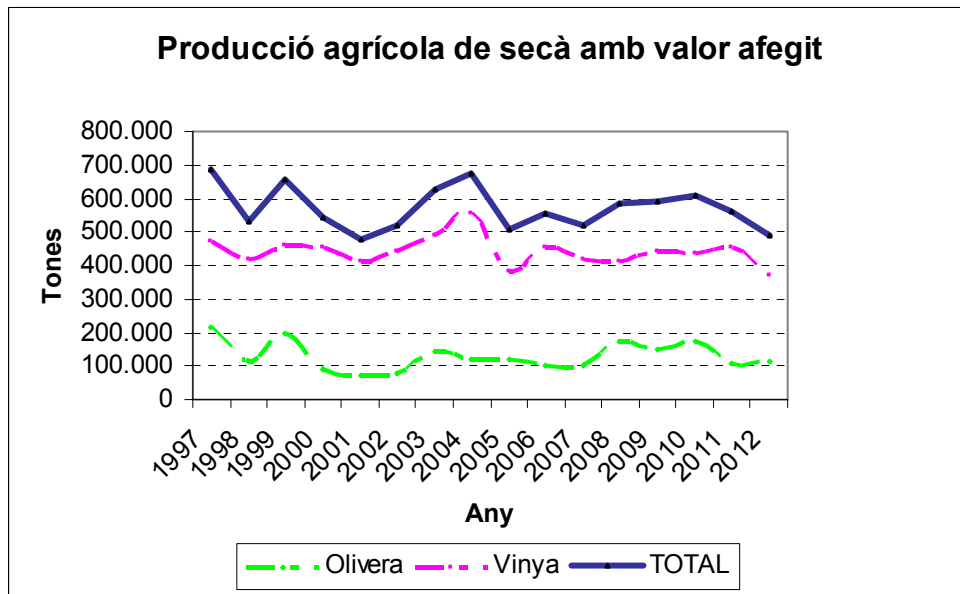
## 8. Desired trend of the adaptation: A sustainable increase.

## 9. Relevance of the indicator: The data on grape and olive production have the same relevance as the indicator of the area of these crops.

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## ENERGY

### 1. Sector indicator:

**pe1 - % consumption of electricity obtained from renewable sources**

### 2. Operational objective of the ESCACC: To increase the adaptive capacity.

### 3. Measure:

- To establish the transition to a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

### 4. Source: Catalan Energy Institute and Eurostat.

### 5. Methodology: This indicator is the ratio between the electricity produced from renewable energy sources and the total national electricity consumption for a given year.

The electricity produced from renewable energy sources comprises that generated from hydroelectric plants (excluding pumping), wind, solar, geothermal and biomass power, and waste plants. Electricity from biomass power and waste plants includes that generated from burning wood and wood waste and other renewable solid waste (e.g. straw and black liquor), from the incineration of municipal solid waste, biogas (from landfill, wastewater treatment plants and farms, etc.) and liquid biofuels.

The total national electricity consumption comprises the total gross national electricity generation from all forms of energy (including self-produced), plus electricity imports and minus electricity exports.

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## 6. Data:

| Year | % renewable with respect to total energy consumption in Catalonia | % renewable with respect to total energy consumption in Spain |
|------|------|------|
| 2000 | 12 | 15.6 |
| 2001 | 12.8 | 20.6 |
| 2002 | 10.4 | 13.93 |
| 2003 | 14 | 21.51 |
| 2004 | 12.6 | 19 |
| 2005 | 8.9 | 19.1 |
| 2006 | 8.4 | 20 |
| 2007 | 8.8 | 21.7 |
| 2008 | 10.7 | 23.7 |
| 2009 | 12.5 | 27.8 |
| 2010 | 16.4 | 29.7 |
| 2011 | 14.8 | 31.6 |

## 7. Graphic representation:

**% consumption of electricity obtained from renewable sources**
Year
Spain
Catalonia

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## % Consum energia elèctrica obtinguda per renovables



**Anys**

Espanya
Catalunya
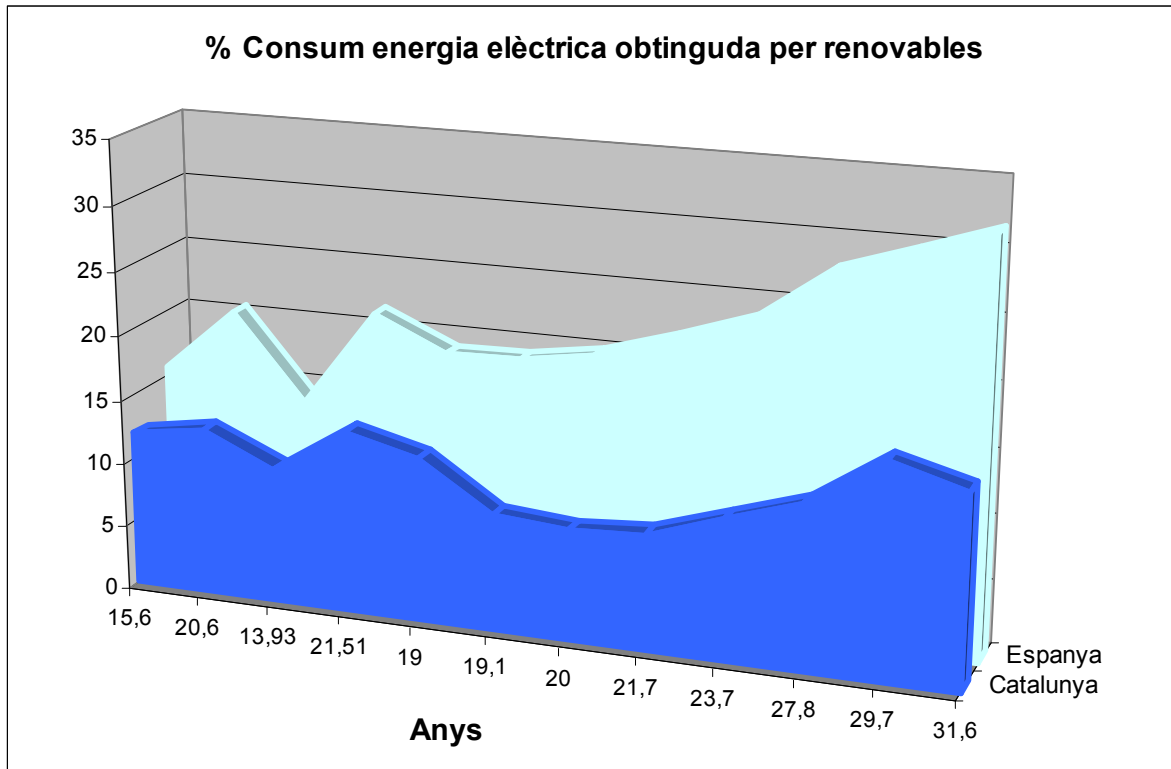
**8. Desired trend:** An increase in the percentage of renewable electrical energy consumption.

**9. Relevance of the indicator:** This indicator is crucial if a diversified, low-carbon energy model, consistent with the strategic objectives of the European Union in terms of energy and climate, is to be achieved.

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## 1. Sector indicator:

**pe2 - Number of special regime facilities in Catalonia**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

- To establish the transition to a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

## 4. Source: Catalan Energy Institute.

## 5. Methodology: According to ICAEN data (energy statistics for Catalonia).

## 6. Data:

| Year | No. special regime facilities in Catalonia |
|------|----------------------------------|
| 1992 | 308 |
| 1993 | 328 |
| 1994 | 368 |
| 1995 | 388 |
| 1996 | 422 |
| 1997 | 439 |
| 1998 | 458 |
| 1999 | 465 |
| 2000 | 473 |
| 2001 | 486 |
| 2002 | 545 |
| 2003 | 596 |
| 2004 | 698 |
| 2005 | 785 |
| 2006 | 1,008 |
| 2007 | 1,510 |
| 2008 | 3,036 |
| 2009 | 3,126 |

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## 7. Graphic representation:

**No. special regime facilities in Catalonia**
No. special regime facilities in Catalonia



Nº d'instal·lacions de règim especial a Catalunya
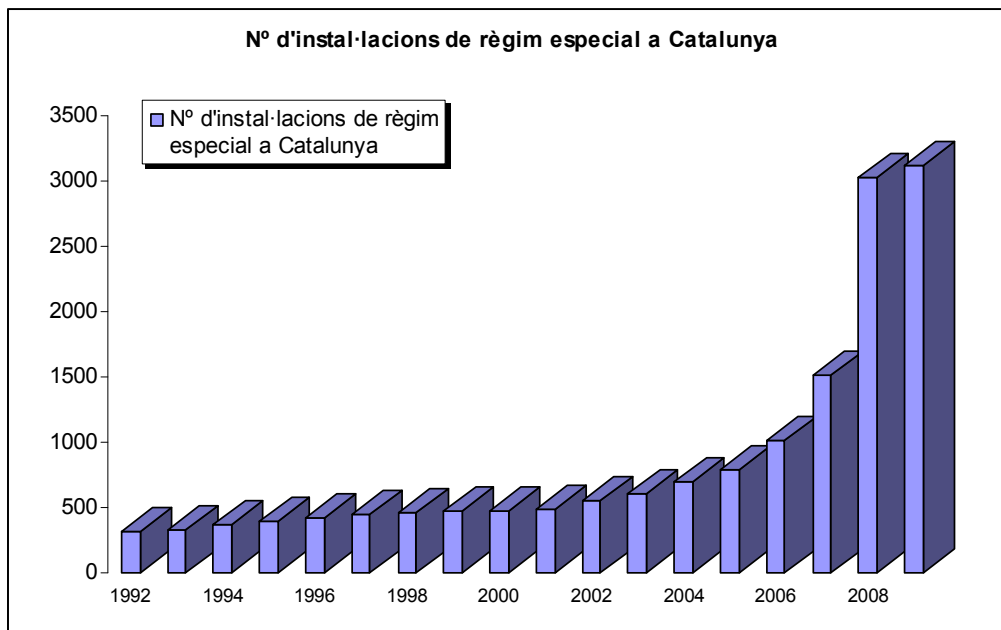
**No. special regime facilities in Catalonia 1992**
Cogeneration and generator units: 76
Hydraulic: 226
Wind: 2
MSW: 4



Nº d'instal·lacions de règim especial a Catalunya 1992
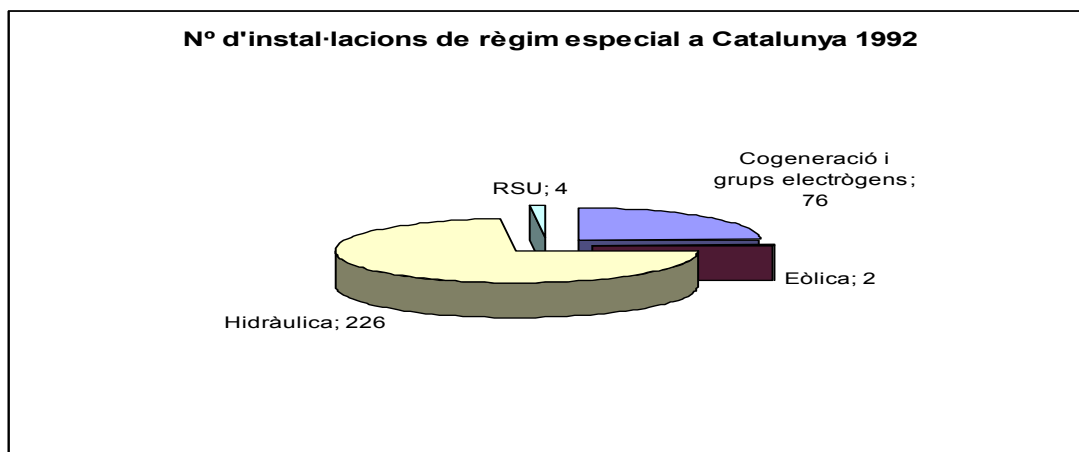
**No. special regime facilities in Catalonia 2002**
Agricultural biomass: 1
Combined-cycle plants using natural gas (public service): 1
Non-renewable industrial waste: 2
Landfills: 3
MSW: 5
Pig slurry: 3
Cogeneration and generator units: 153
Hydraulic: 279
Ecoparks: 1
WWTPs: 9
Wind: 7
Photovoltaic: 81



Nº d'instal·lacions de règim especial a Catalunya 2002

Biomassa agrícola; 1
Cicles combinats de gas natural servei públic; 1
Residus industrials no renovables; 2
Abocadors; 3
RSU; 5
Cogeneració i grups electrògens; 153
Purins de porc; 3
Ecoparcs; 1
EDAR; 9
Hidràulica; 279
Eòlica; 7
Fotovoltaica; 81

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**No. special regime facilities in Catalonia 2009**
Renewable industrial waste: 2
Waste treatment on farms: 5
Cogeneration and generator units: 106
Non-renewable industrial waste: 2
MSW: 4
Hydraulic: 280
Landfills: 5
Ecoparks: 3
Wind: 24
Pig slurry: 6
WWTPs: 11
Agricultural biomass: 1
Photovoltaic: 2677



**Nº d'instal·lacions de règim especial a Catalunya 2009**
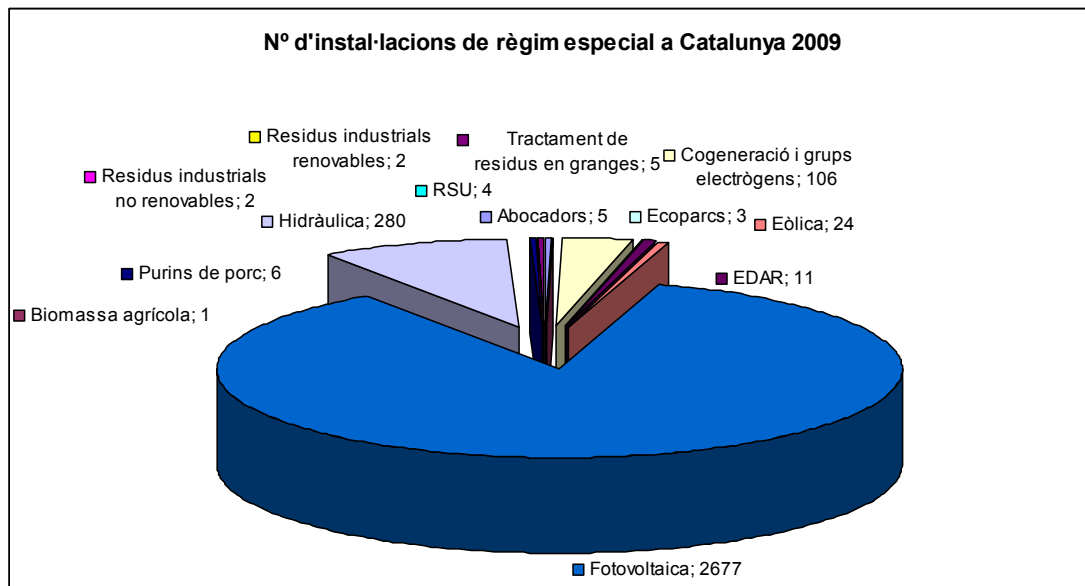
**8. Desired trend:** An increase in the number of facilities for renewable energy sources.

**9. Relevance of the indicator:** This indicator is also critical if a diversified, low-carbon energy model, consistent with the strategic objectives of the European Union in terms of energy and climate, is to be achieved.

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## 1. Sector indicator:

**pe6 - Primary energy intensity (energy content of GDP) (toe/€million in the year 2000)**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

## 3. Measure:

- To establish the transition to a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

**4. Source:** Catalan Energy Institute.

**5. Methodology:** According to ICAEN data

## 6. Data:

| Year | Primary energy intensity (toe/€million in the year 2000) |
|------|----------------------------------------------------------|
| 1990 | 188 |
| 1991 | 191 |
| 1992 | 188 |
| 1993 | 193 |
| 1994 | 194 |
| 1995 | 192 |
| 1996 | 198 |
| 1997 | 196 |
| 1998 | 200 |
| 1999 | 198 |
| 2000 | 194 |
| 2001 | 194 |
| 2002 | 197 |
| 2003 | 200 |
| 2004 | 198 |
| 2005 | 192 |
| 2006 | 184 |
| 2007 | 180 |
| 2008 | 171 |
| 2009 | 170 |

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## 7. Graphic representation:

**Primary energy intensity (toe/€million in the year 2000)**
Year
Primary energy intensity (toe/€million in the year 2000)

**Intensitat energètica primària (tep/milió € any 2000)**



**Anys**

Intensitat energètica primària (tep/milió €
any 2000)
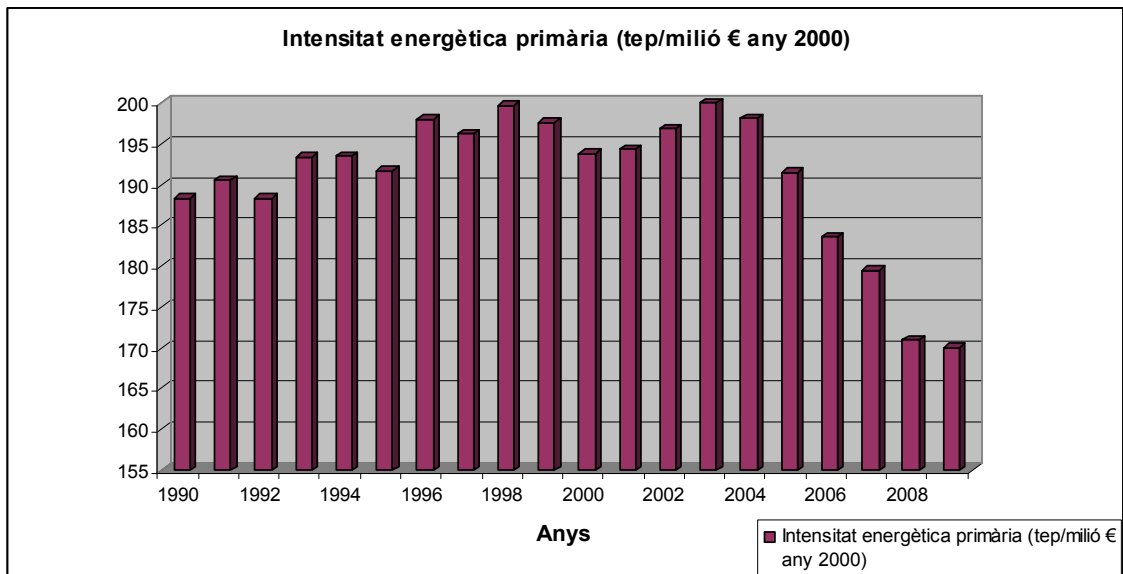
**8. Desired trend:** The downward trend of the energy intensity of GDP must be maintained.

**9. Relevance of the indicator:** Achieving a significant improvement in the area of energy efficiency and energy saving will make the sector more resilient and less vulnerable to the impacts of climate change.

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## WATER MANAGEMENT

### 1. Sector indicator:

**pg1 - Household consumption (l/inhab./day): Catalonia**

**pg2 - Household consumption (l/inhab./day): Metropolitan Area of Barcelona**

### 2. Operational objective of the ESCACC: To increase the adaptive capacity.

### 3. Measure(s) to which it corresponds:

− To improve the efficient use of water.

### 4. Source consulted: The Provisional Outline of the Most Important Issues (EPTI) established in the Catalan River Basin District for the review of the Programme of Measures and the Demarcation Management Plan. Catalan Water Agency, March 2014.

### 5. Methodology: This information is collected by the Catalan Water Agency from annual data on the water surcharge and from concessionary companies that supply drinking water.

### 6. Data: The consumption is expressed in litres per inhabitant per day (l/inhab./day)

| Year | Catalonia (pg1) | Metropolitan Area of Barcelona (pg2) |
|------|-----------------|--------------------------------------|
| 1993 | 126 | 116 |
| 1994 | 134 | 122 |
| 1995 | 129 | 121 |
| 1996 | 129 | 123 |
| 1997 | 131 | 120 |
| 1998 | 136 | 125 |
| 1999 | 136 | 123 |
| 2000 | 132 | 121 |
| 2001 | 142 | 128 |
| 2002 | 142 | 127 |
| 2003 | 140 | 128 |
| 2004 | 139 | 126 |
| 2005 | 134 | 121 |
| 2006 | 129 | 117 |
| 2007 | 128 | 114 |
| 2008 | 124 | 110 |
| 2009 | 123 | 108 |
| 2010 | 122 | 107 |

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| Year | Catalonia (pg1) | Metropolitan Area of Barcelona (pg2) |
|------|-----------------|--------------------------------------|
| 2011 | 121 | 107 |
| 2012 | 119 | 106 |

## 7. Graphic representation:

l/inhab./day
Catalonia
Metropolitan Area of Barcelona
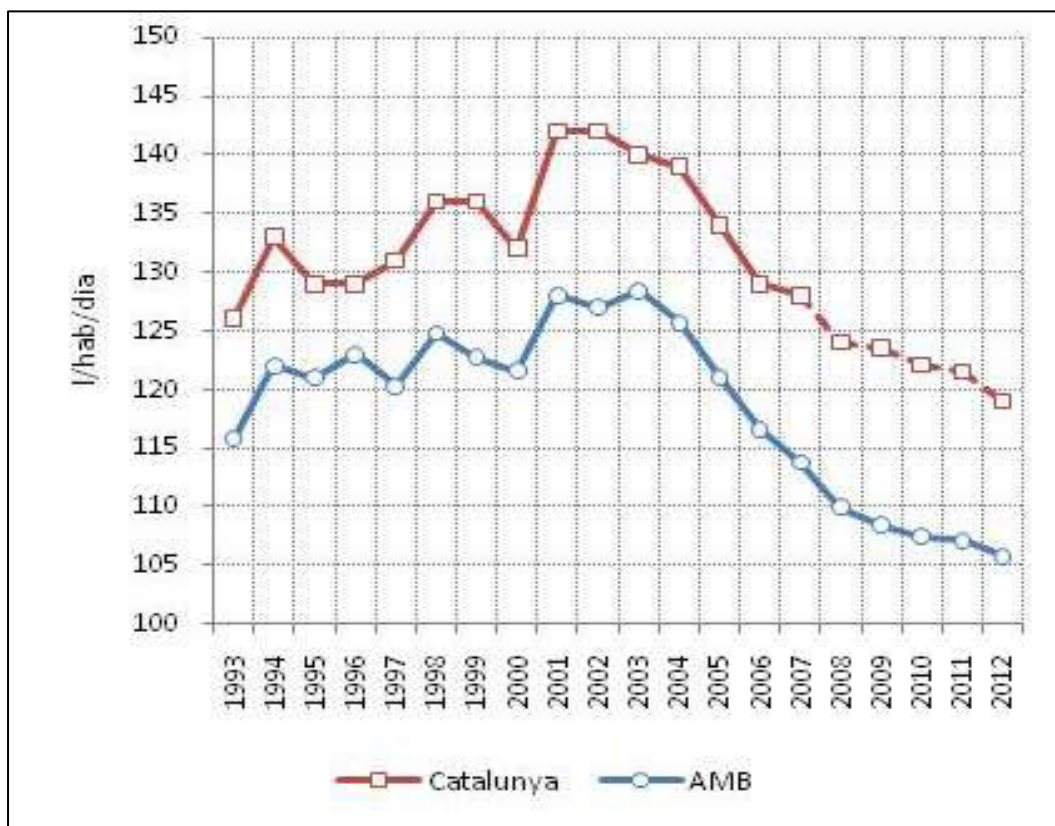


## 8. Desired trend of the adaptation: To decrease and remain stable.

## 9. Relevance of the indicator: This is a direct indicator of both the efficient use of water in our homes (less consumption for the same or greater comfort) and actual savings. Thus, the evolution of household consumption indicates an accumulated reduction of 15% in the maximum historical levels, which, expressed in terms of volume, is equivalent to about 120 $hm^3$, or in other words, twice the volume of water the Boadella reservoir can hold (60 $hm^3$).

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## FOREST MANAGEMENT

### 1. Sector indicator:

**pgf2 - Timber harvesting for firewood and biomass in Catalonia (t)**

### 2. Operational objective of the ESCACC: To increase the adaptive capacity.

### 3. Measure(s) to which it corresponds:

− To strengthen support for innovation, knowledge transfer and markets for local, sustainable forest products.
− To create synergies between forest management (withdrawal of fuel) and renewable energy (biomass).

### 4. Source: Ministry of Agriculture, Livestock, Fisheries, Food and Natural Environment (PGPF).

### 5. Methodology: The data refer to authorized harvesting. Timber for firewood and biomass is considered as round wood used for fuel and charcoal production (forestry production statistics, Ministry of Agriculture, Livestock, Fisheries, Food and Natural Environment).

### 6. Data:

**Timber harvesting for firewood and biomass in Catalonia (1999-2011)**

|      | Conifers | | Holm oaks and common oaks | | Other hardwood | | Other shrubs and bushes | | TOTAL |
|------|---------|-------|---------|-------|---------|-------|---------|-------|---------|
|      | tonnes | % | tonnes | % | tonnes | % | tonnes | % | tonnes |
| 1999 | 37,102 | 31.28 | 58,630 | 49.43 | 22,662 | 19.10 | 226 | 0.19 | **118,620** |
| 2000 | 51,203 | 38.31 | 61,008 | 45.65 | 21,359 | 15.98 | 78 | 0.06 | **133,648** |
| 2001 | 38,507 | 28.92 | 64,654 | 48.57 | 29,950 | 22.50 | 17 | 0.01 | **133,128** |
| 2002 | 23,351 | 21.22 | 66,909 | 60.79 | 19,563 | 17.77 | 245 | 0.22 | **110,068** |
| 2003 | 30,646 | 20.23 | 85,589 | 56.49 | 35,103 | 23.17 | 164 | 0.11 | **151,502** |
| 2004 | 19,524 | 18.50 | 61,832 | 58.59 | 23,847 | 22.60 | 330 | 0.31 | **105,533** |
| 2005 | 22,974 | 12.88 | 116,029 | 65.05 | 38,840 | 21.78 | 514 | 0.29 | **178,357** |
| 2006 | 31,707 | 20.15 | 100,418 | 63.83 | 25,004 | 15.89 | 196 | 0.12 | **157,325** |
| 2007 | 30,953 | 19.20 | 90,585 | 56.19 | 39,071 | 24.24 | 605 | 0.38 | **161,215** |
| 2008 | 20,633 | 14.21 | 80,509 | 55.45 | 43,168 | 29.73 | 875 | 0.60 | **145,184** |
| 2009 | 24,836 | 15.54 | 105,658 | 66.09 | 29,326 | 18.34 | 53 | 0.03 | **159,873** |
| 2010 | 22,281 | 12.53 | 101,829 | 57.26 | 53,740 | 30.22 | 0 | 0.00 | **177,850** |
| 2011 | 31,842 | 18.64 | 89,921 | 52.65 | 48,945 | 28.66 | 83 | 0.05 | **170,790** |

Source: Ministry of Agriculture, Livestock, Fisheries, Food and Natural Environment (draft PGPF)

Global Indicator of Climate Change Adaptation in Catalonia

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## 7. Graphic representation:

**Timber harvesting for firewood and biomass in Catalonia (1999-2011)**
**tonnes**
Conifers
Holm oaks and common oaks
Other hardwood
Other shrubs and bushes



Aprofitament de fusta per llenya i biomassa a Catalunya (1999-2011)

tones

Coníferes   Alzines i roures   Altres planifolis   Arbustos i matollars
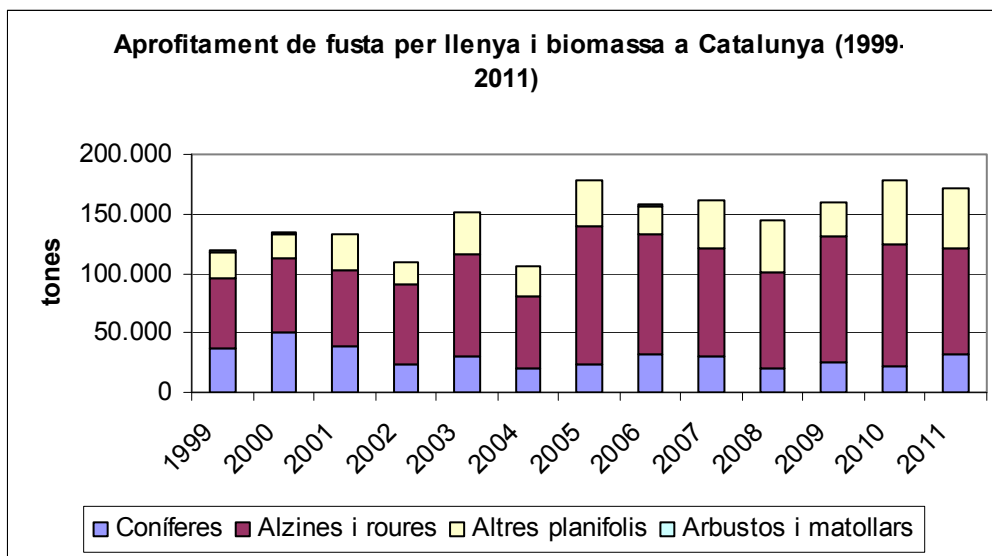
**8. Desired trend of the adaptation:** To increase to sustainable values. The target value of the General Forestry Policy Plan of Catalonia 2014-2024 (PGPF) is a 50% increase throughout its term.

**9. Relevance of the indicator:** High values indicate a good level of exploitation of the forest's productive function. Low values indicate neglect of this function.

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## 1. Sector indicator:

**pgf3 - Production of forest products (other than timber and firewood) (t): cork+truffles and other fungi+pine nuts**

**2. Operational objective of the ESCACC:** To generate and transfer knowledge about adaptation.

## 3. Measure(s) to which it corresponds:

- To strengthen support for innovation, knowledge transfer and markets for local, sustainable forest products.

**4. Source:** Ministry of Agriculture, Livestock, Fisheries, Food and Natural Environment.

**5. Methodology:** Cork production: the expanse of forests with non-timber market production, including the cork oak (*Quercus suber*), regardless of whether or not they are exploited.

## 6. Data:

|  | Cork | Truffles and other edible fungi | Pine nuts | TOTAL |
|---|---|---|---|---|
| 1999 | 3,522 | 4,364 | 0.29 | **7,885.90** |
| 2000 | 8,489 | 3,007 | 0.25 | **11,495.99** |
| 2001 | 7,759 | 1,411 | 0.23 | **9,170.11** |
| 2002 | 7,432 | 346 | 0.35 | **7,778.71** |
| 2003 | 3,955 | 6,647 | 0.21 | **10,602.44** |
| 2004 | 4,331 | 228 | 0.26 | **4,559.65** |
| 2005 | 3,917 | 2,579 | 0.17 | **6,496.20** |
| 2006 | 3,235 | 4,584 | 0.14 | **7,818.94** |
| 2007 | 3,556 | 1,048 | 0.22 | **4,603.84** |
| 2008 | 5,461 | 5,523 | 0.62 | **10,984.15** |
| 2009 | 3,432 | 5,033 | 0.78 | **8,465.33** |
| 2010 | 1,919 | 4,968 | 0.42 | **6,887.89** |
| 2011 | 5,258 | 3,668 |  | **8,925.88** |
| 2012 | 5,337 | 6,087 |  | **11,423.37** |

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## 7. Graphic representation:

**Production of forest products (other than timber and firewood)**
**tonnes**
Cork
Truffles and other edible fungi
Pine nuts



**Producció forestal (sense fusta i llenya)**

Legend: Suro | Tòfones i altres bolets comestibles | Pinyó
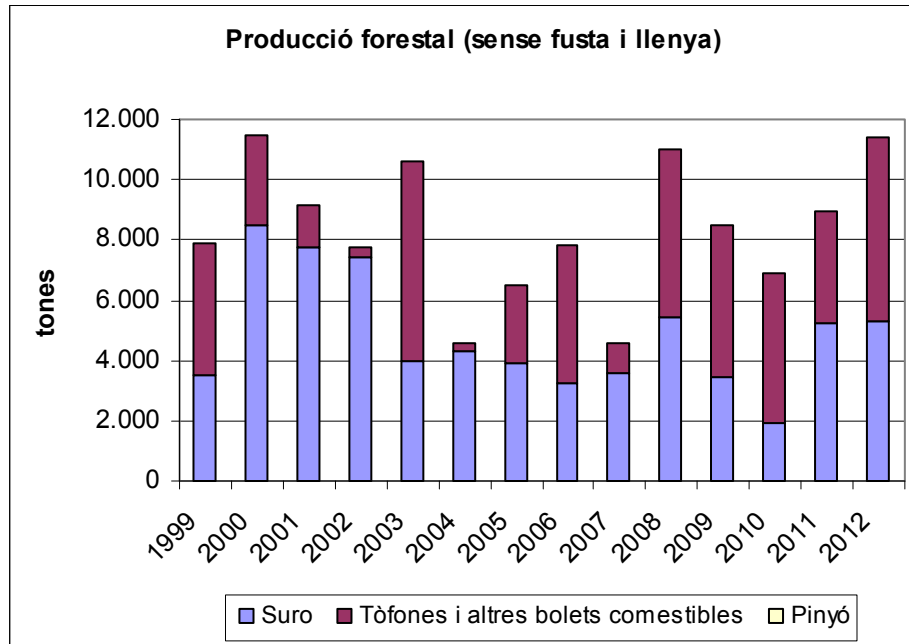
## 8. Desired trend of the adaptation: An increase. The target value of the General Forestry Policy Plan of Catalonia 2014-2024 (PGPF) during its term is as follows:

- A 40% increase in cork production
- A 5% increase in the production of truffles and other fungi
- A 25% increase in pine nut production

## 9. Relevance of the indicator: High values indicate a good level of exploitation of the forest's productive function. Low values indicate neglect of this function.

Cork production experienced a sharp increase during the years 2000-2003. Other than this period, the annual production of cork in Catalonia in recent years has remained around 3000-4000 t, although production increased considerably in 2008. Compared to last year, this year's cork season in Catalonia was affected by the consequences of snow-related damage in March. The adverse weather conditions and weak demand for Catalan cork resulted in a 40% reduction in the peeled volume of cork, to 1919 t.

A total of 42.5% of the overall forest area used to produce the main products is subject to a forest management tool (IOF). Twenty-seven percent has a technical plan for forest improvement and management (PTGMF), less than 1% has a simple forest management plan (PSGF) and the remaining 15% has an IOF for public forests. Cork and wood in forests are the two products subject to the highest levels of planning, 48% and 46%, respectively.

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The production of edible fungi fluctuates annually depending on weather conditions each year, since fungi are particularly sensitive to changes in temperature and rainfall. In general, an upward trend in the collection of mushrooms is observed.

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## 1. Sector indicator:

**pgf5 - Hectares burned per fire (%)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure(s) to which it corresponds:

– To promote risk assessment skills in forestry agencies.
– To define and promote forest management to increase the resistance and resilience of wooded regions to the effects of climate change (e.g. by regulating competition) and reduce the water footprint.
– To promote actions designed to protect soil and wooded areas against extreme events (especially fires and droughts).
– To promote the use of livestock for cleaning the undergrowth.
– To encourage forest owner associations to improve joint management.

## 4. Source: Ministry of Agriculture, Livestock, Fisheries, Food and Natural Environment, own data.

## 5. Methodology: The information on forest fires corresponds firstly to the annual number of fires registered, and secondly to the total area affected (and whether or not this area was wooded).

As for the causes leading to the fires, these can be summarized in five general categories:

- Accidental: railways, power lines, military manoeuvres, cars
- Intentional
- Natural
- Negligence: landfill, burning of agriculture / pasture, campfires, smokers, forestry work
- Not known

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## 6. Data:

|  | **Number of fires** | **Total area affected (ha)** | **ha burned/no. fires** |
|---|---|---|---|
| 1986 | 563 | 65,812 | **116.9** |
| 1987 | 352 | 1,945 | **5.5** |
| 1988 | 646 | 3,084 | **4.8** |
| 1989 | 669 | 5,996 | **9.0** |
| 1990 | 590 | 1,092 | **1.9** |
| 1991 | 782 | 5,332 | **6.8** |
| 1992 | 368 | 1,554 | **4.2** |
| 1993 | 791 | 7,343 | **9.3** |
| 1994 | 1,217 | 76,625 | **63.0** |
| 1995 | 753 | 7,128 | **9.5** |
| 1996 | 463 | 814 | **1.8** |
| 1997 | 672 | 906 | **1.3** |
| 1998 | 961 | 18,349 | **19.1** |
| 1999 | 841 | 1,298 | **1.5** |
| 2000 | 790 | 8,058 | **10.2** |
| 2001 | 723 | 3,010 | **4.2** |
| 2002 | 544 | 2,009 | **3.7** |
| 2003 | 701 | 9,442 | **13.5** |
| 2004 | 565 | 1,048 | **1.9** |
| 2005 | 893 | 5,180 | **5.8** |
| 2006 | 629 | 3,288 | **5.2** |
| 2007 | 578 | 1,591 | **2.8** |
| 2008 | 421 | 555 | **1.3** |
| 2009 | 746 | 3,462 | **4.6** |
| 2010 | 475 | 618 | **1.3** |
| 2011 | 586 | 1,097 | **1.9** |
| 2012 | 747 | 15,026 | **20.1** |

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## 7. Graphic representation:

**Hectares burned per fire**
Ha/no. fires



**Hectàrees cremades per incendi**
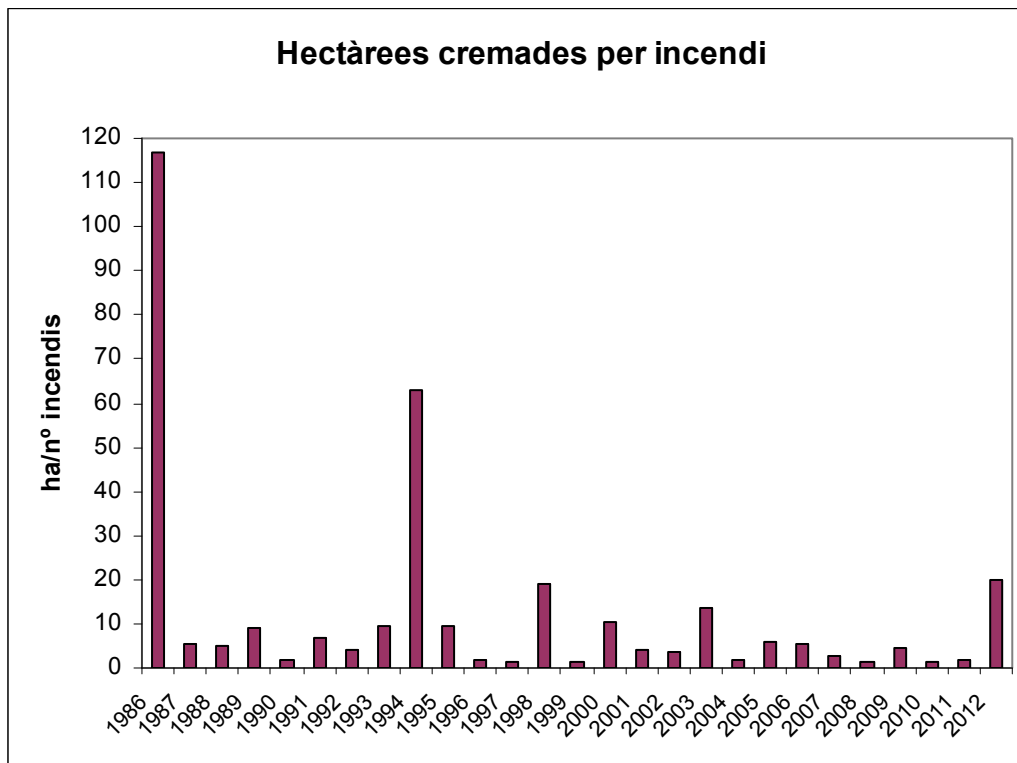
## 8. Desired trend of the adaptation: A decrease.

## 9. Relevance of the indicator: The best-prepared forests are those capable of preventing a fire from becoming a major fire.

**INDUSTRY, SERVICES AND TRADE**

## 1. Sector indicator:

**pi1 - Water consumption: amount billed to industry and services (m$^3$)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

− To improve the efficient use of water and energy in the management of all industrial companies.

**4. Source:** Catalan Water Agency (official economic and socio-economic data, environmental control data, data from supramunicipal bodies on supply and tax data on the water surcharge).

**5. Methodology:** The methodology is established in the Catalan River Basin District Management Plan.

## 6. Data:

| Year | Consumption industry and services (m$^3$) |
|------|-------------------------------------------|
| 1993 | 268,970,680 |
| 1994 | 286,333,913 |
| 1995 | 283593.685 |
| 1996 | 279,417,917 |
| 1997 | 295,447,642 |
| 1998 | 296182.057 |
| 1999 | 289,455,548 |
| 2000 | 307,947,839 |
| 2001 | 322,230,511 |
| 2002 | 320,917,493 |
| 2003 | 325,675,090 |
| 2004 | 324,900,303 |
| 2005 | 315,143,721 |
| 2006 | 312,315,960 |
| 2007 | 315,273,448 |
| 2008 | 290,619,076 |
| 2009 | 274,771,220 |
| 2010 | 273,570,835 |
| 2011 | 270,439,046 |

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## 7. Graphic representation:

**Water consumption industry and services**
Year



Consum d'aigua sectors indústria i serveis
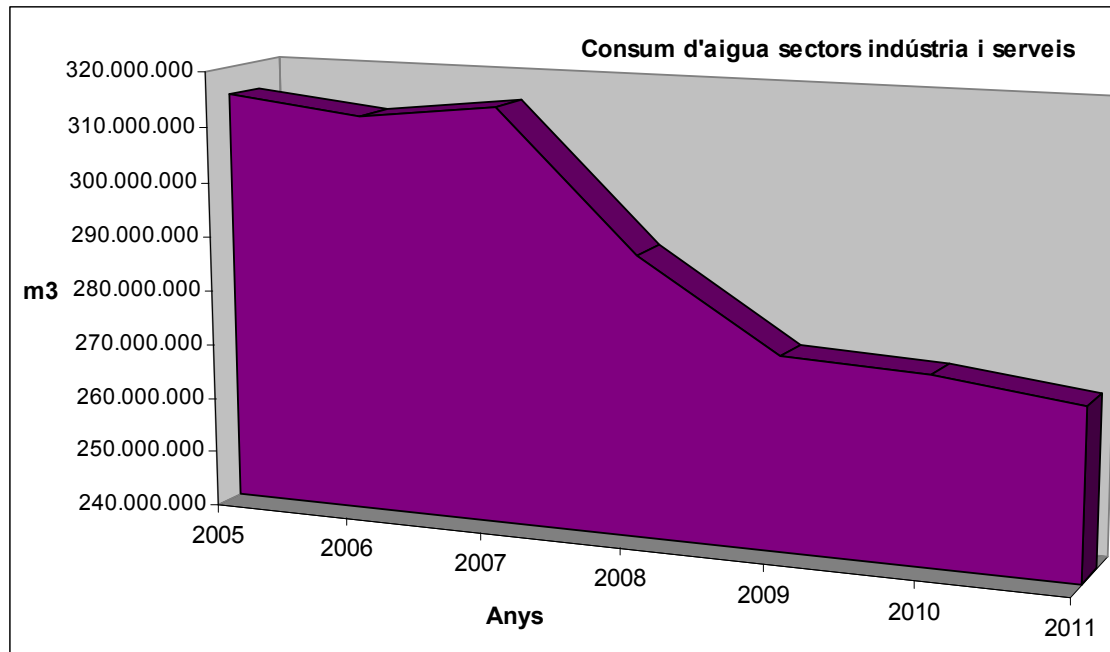
**8. Desired trend:** A reduction in the water consumed in industry and services.

**9. Relevance of the indicator:** An efficient use of resources will enable the industrial and service sectors to become more resilient to the expected impacts of reduced water availability and to increase their adaptive capacity.

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## 1. Sector indicator:

**pi2 - Final energy consumption of the industrial and service sectors (ktoe)**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

## 3. Measure:

- To improve the efficient use of water and energy in the management of all industrial companies.

**4. Source:** Catalan Energy Institute.

**5. Methodology:** Defined in the Catalan Energy and Climate Change Plan 2012-2020.

## 6. Data:

| Year | Final energy consumption of the industrial and service sectors (ktoe) |
|------|-----------------------------------------------------------------------|
| 1990 | 4,467 |
| 1991 | 4,503 |
| 1992 | 4,466 |
| 1993 | 4,286 |
| 1994 | 4,543 |
| 1995 | 4,790 |
| 1996 | 5,009 |
| 1997 | 5,182 |
| 1998 | 5,459 |
| 1999 | 5,661 |
| 2000 | 5,756 |
| 2001 | 6,093 |
| 2002 | 6,210 |
| 2003 | 6,576 |
| 2004 | 6,606 |
| 2005 | 6,716 |
| 2006 | 6,673 |
| 2007 | 6,691 |
| 2008 | 6,313 |
| 2009 | 5,708 |

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## 7. Graphic representation:

Final energy consumption of the industrial and service sectors (ktoe)
Year
Final energy consumption of the industrial and service sectors (ktoe)

**Consum final d'energia del sector industrial i de serveis (ktep)**
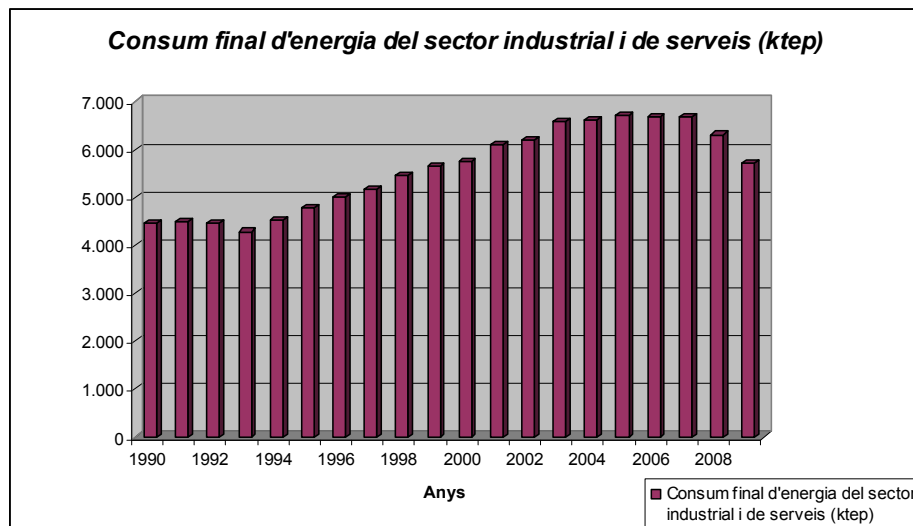


**8. Desired trend:** A reduction in final energy consumption.

**9. Relevance of the indicator:** An efficient use of resources will enable the industrial and service sectors to increase their adaptive capacity and thus become more resilient to the expected impacts of the increased energy demand and the economic difficulties owing to the rising prices of energy.

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## 1. Sector indicator:

**pi3 - GHG emissions from the industrial sector (thousands of t of $CO_2$-eq)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

   – To establish the transition to a more diversified, decentralized, low-carbon,
   economically dynamic, socially inclusive and environmentally consistent energy
   model, as provided for in the PECAC.

## 4. Source: Catalan Office for Climate Change.

## 5. Methodology: The analysis presented in this report is based on information from the
National Greenhouse Gas Inventory for the period 1990-2011 (2013 version) from the
Ministry of Agriculture, Food and Environment (MAGRAMA), broken down by autonomous
communities, as well as data from the Catalan Ministry of Land and Sustainability (DTES) on
the emissions trading scheme and forecasts made by the Catalan Office for Climate
Change.

## 6. Data: Emissions from cogeneration are included.

| Sector | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|
| Industrial processes (thousands of tonnes of $CO_2$) | 13,102 | 12,979 | 13,081 | 12,847 | 15,548 | 17,985 | 17,112 | 18,388 | 18,240 | 19,916 |

| 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20,961 | 18,959 | 17,072 | 19,211 | 19,365 | 19,606 | 19,011 | 18,352 | 16,735 | 14,296 | 14,909 | 14,177 |

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## 7. Graphic representation:

**Emissions trend in the industrial sector in Catalonia**
Thousands of tonnes of $CO_2$-eq



Tendència d'emissions en el sector industrial a Catalunya
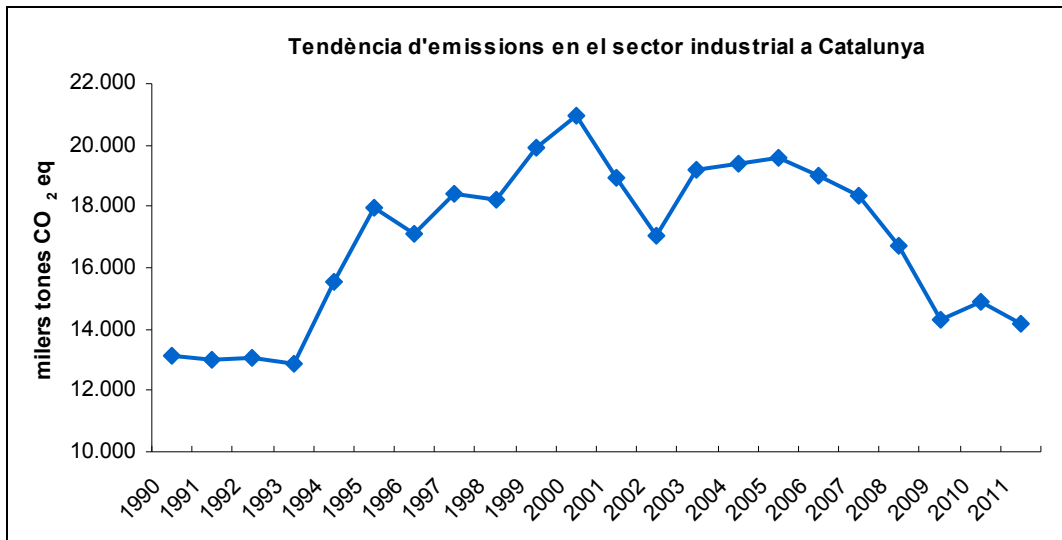
**8. Desired trend:** A reduction in GHG emissions from the industrial sector.

**9. Relevance of the indicator:** Achieving the transition to a more diversified, decentralized, low-carbon energy model will be a key factor for the successful adaptation of the sector.

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## 1. Sector indicator:

**pi4 - Imports of oil extraction and refining, coal (millions of euros)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

– To move towards a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

## 4. Source: Idescat, from data provided by the State Tax Administration Agency (AEAT).

## 5. Methodology: Idescat generates these statistics from the most relevant aspects of data on exports to third countries based on the Single Administrative Document (SAD), and intra-Community dispatches based on Intrastat reporting.

Intrastat is a system for gathering information directly and continuously from companies (consignors and consignees) in order to produce statistics on the trade in goods between member states by means of a statistical declaration. Intrastat replaces the Single Administrative Document (SAD) for this trade.

The branches of activity are obtained from the following divisions of the NACE Rev 2:

- 05+06+09+19 Mining, extraction and refined petroleum products.

## 6. Data:

| Year | Imports of oil extraction and refining, coal |
|------|------|
| 1999 | 1,742.2 |
| 2000 | 3,954.5 |
| 2001 | 3,994.5 |
| 2002 | 3,407.80 |
| 2003 | 3,717.50 |
| 2004 | 4,470.00 |
| 2005 | 6,090.70 |
| 2006 | 7,333.00 |
| 2007 | 8,289.20 |
| 2008 | 9,948.70 |
| 2009 | 6,840.00 |
| 2010 | 9,391.30 |
| 2011 | 10,030.40 |
| 2012 | 10,518.2 |
| 2013 | 8,523.2 |

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## 6.  Graphic representation:

Imports of oil extraction and refining, coal to Catalonia
Millions of euros
Year

Importacions d'extracció i refinament de petroli, carbons a  Catalunya
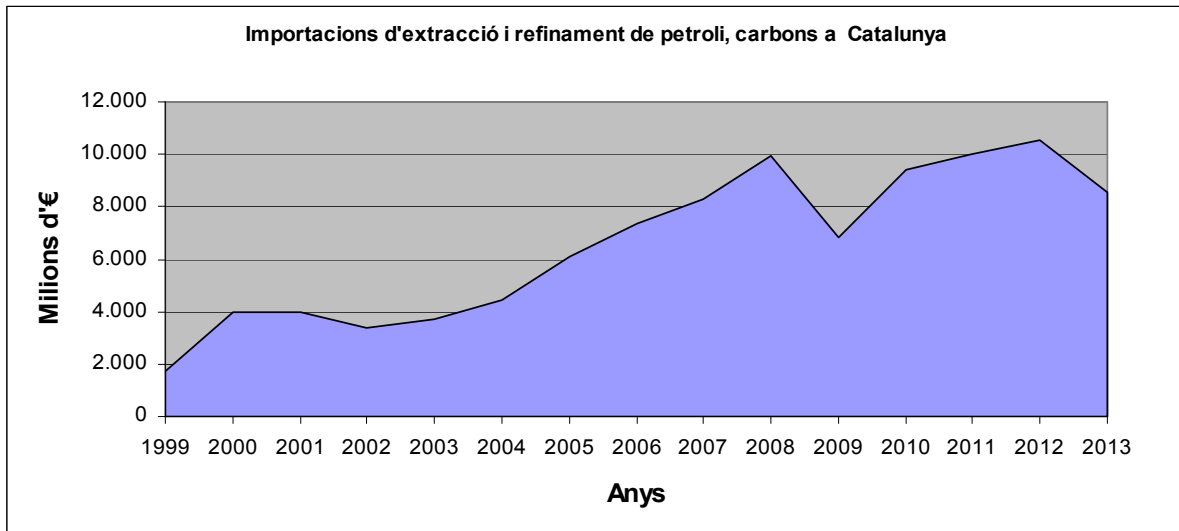


**8. Desired trend:** A reduction in fossil fuel imports.

**9. Relevance of the indicator:** In order to make the transition to a more diversified, decentralized, low-carbon energy model, it is necessary to reduce fossil fuel imports.

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## MOBILITY AND TRANSPORT INFRASTRUCTURE

### 1. Sector indicator:

**pm1 - Passengers on Renfe and FGC trains (thousands)**

**pm2 - Goods on Renfe and FGC trains (thousands of tonnes)**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

### 3. Measure:

− To encourage and support all measures that promote actions aimed at sustainable mobility and the use of local public transport.

**4. Source:** Idescat. Renfe Operadora and Ferrocarrils de la Generalitat de Catalunya (FGC).

**5. Methodology:** The section on rail contains data from Renfe and Ferrocarrils de la Generalitat de Catalunya. The number of long-distance railway tickets issued does not correspond to the number of passengers who have used this mode of transport, because the figures do not only reflect tickets between Catalan stations, but also take into account those sold in Catalonia for non-Catalan stations.

### 6. Data:

| Year | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| **Passengers (thousands)** | 169,613 | 173,116 | 177,576 | 184,358 | 188,375 | 184,019 |
| **Goods (thousands of tonnes)** | 5,349 | 11,692 | 13,723 | 13,444 | 8,958 | 8,947 |

| Year | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| **Passengers (thousands)** | 185,418 | 181,276 | 204,259 | 208,331 | 198,704 |
| **Goods (thousands of tonnes)** | | 6,242 | 8,482 | 9,851 | 7,579 |

## 7. Graphic representation:

**Transportation of passengers and goods in Catalonia**
Year
Passengers (thousands)



Transport de viatgers i mercaderies a Catalunya
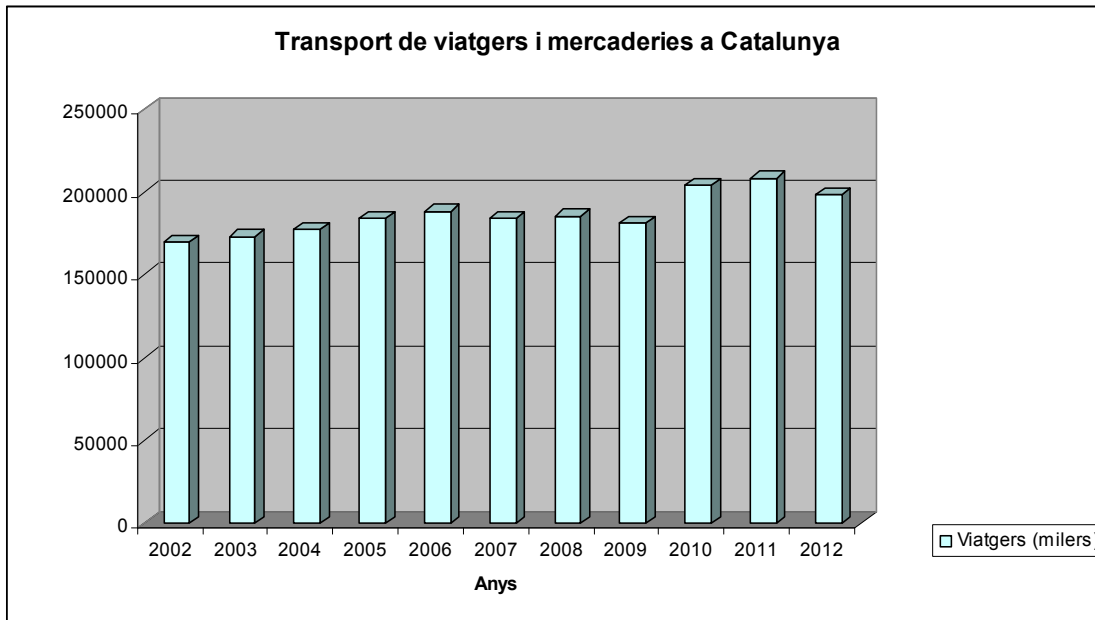
**Transportation of passengers and goods in Catalonia**
Year
Goods (thousands of
tonnes)



Transport de viatgers i mercaderies a Catalunya
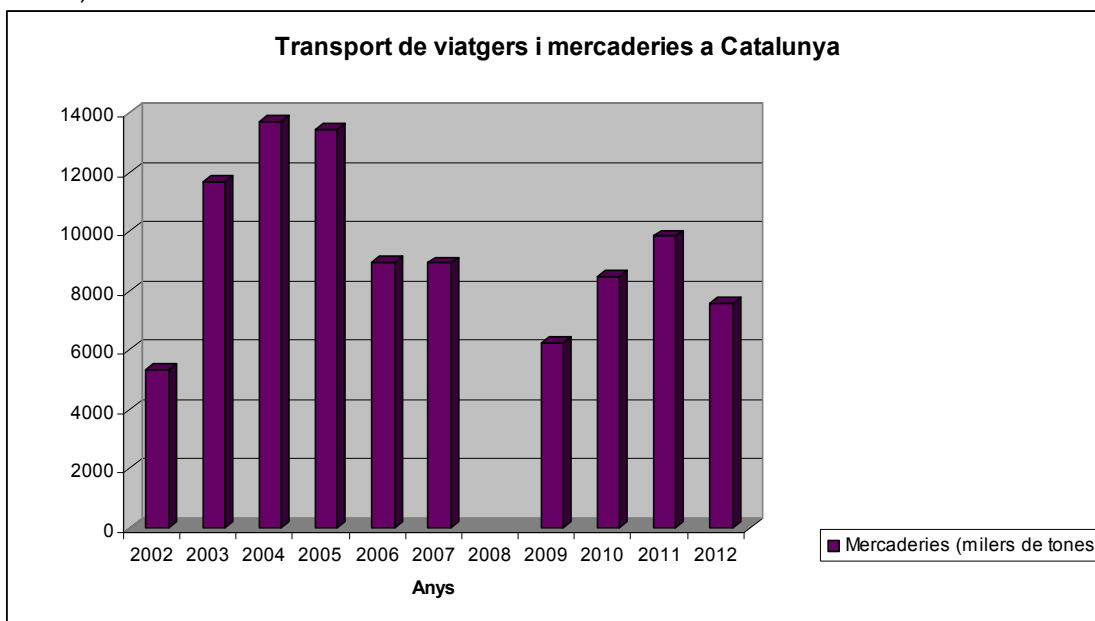
**8. Desired trend:** An increase in rail's share of passenger and goods transport.

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**9. Relevance of the indicator:** In order to move towards a low-carbon model that is resilient to the impacts of climate change, it is necessary to steadily increase the share of rail transport as a more sustainable mode than fossil-fuel intensive road transport.

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## 1. Sector indicator:

**pm3 - Passengers on buses (thousands)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

− To encourage and support all measures that promote actions aimed at sustainable mobility and the use of local public transport.

## 4. Source: Idescat. Ministry of Land and Sustainability

## 5. Methodology: Data on regular passenger transport by road in Catalonia are given. The Ministry of Land and Sustainability obtains these figures directly from the companies authorized to provide these services.

In terms of urban public transport it includes data on surface transport in the biggest cities in Catalonia, provided by the Ministry of Land and Sustainability, and also on metropolitan underground railways and urban railway lines.

## 6. Data:

|  | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|
| **Urban lines** | 265,423 | 267,342 | 248,234 | 259,502 | 277,610 | 282,043 | 270,694 | |

|  | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| **Urban lines** | 276,089 | 284,591 | 341,135 | 334,661 | 335,820 | 321,425 | 323,774 |

## 7. Graphic representation:

**Buses. Passengers transported in Catalonia.**
Year
Buses. Passengers transported.

**Autobusos. Viatgers transportats a Catalunya.**



Legend: Autobusos. Viatgers transportats.
Y-axis: Milers — 0, 50.000, 100.000, 150.000, 200.000, 250.000, 300.000, 350.000
X-axis: Anys — 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013
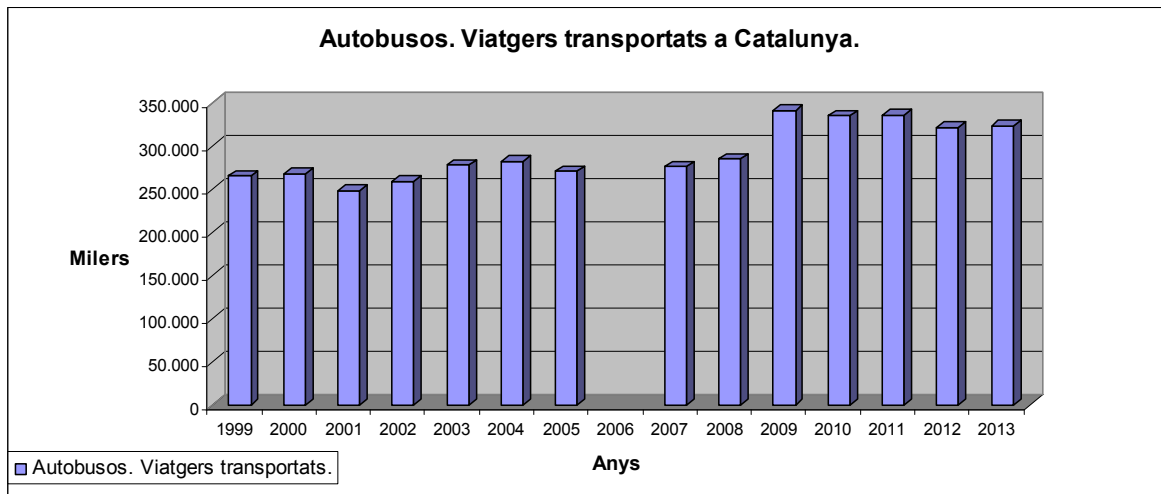
**8. Desired trend:** An increase in the number of passengers travelling on public transport in Catalonia (buses).

**9. Relevance of the indicator:** In order to move towards a low-carbon model that is resilient to the impacts of climate change, it is necessary to steadily increase the share of bus transport as a more sustainable mode than fossil-fuel intensive road transport.

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## 1. Sector indicator:

**pm4 - Energy consumed by transport (ktoe)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

- To move towards a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

## 4. Source: ICAEN

## 5. Methodology: Set out in the Catalan Energy and Climate Change Plan 2012-2020.

## 6. Data:

| Year | Energy consumed by transport (ktoe) |
|------|-------------------------------------|
| 1990 | 3,436 |
| 1991 | 3,547 |
| 1992 | 3,630 |
| 1993 | 3,690 |
| 1994 | 3,920 |
| 1995 | 4,223 |
| 1996 | 4,494 |
| 1997 | 4,690 |
| 1998 | 4,979 |
| 1999 | 5,219 |
| 2000 | 5,405 |
| 2001 | 5,596 |
| 2002 | 5,655 |
| 2003 | 5,861 |
| 2004 | 6,121 |
| 2005 | 6,148 |
| 2006 | 6,263 |
| 2007 | 6,447 |
| 2008 | 6,136 |
| 2009 | 5,959 |

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## 7. Graphic representation:

**Energy consumed by transport (ktoe)**
Year
Energy consumed by transport (ktoe)

**Energia consumida pel transport (ktep)**
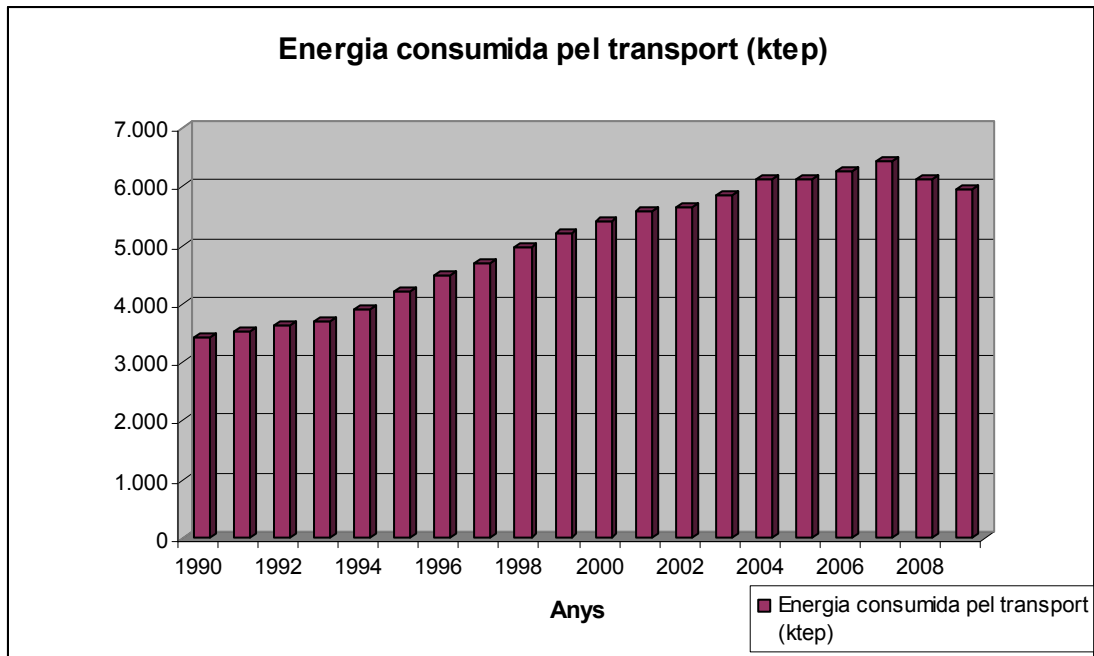


**8. Desired trend:** The transition towards a more efficient energy model in the transport sector.

**9. Relevance of the indicator:** In order to move towards a more diversified, decentralized, low-carbon, economically dynamic and environmentally friendly energy model, a reduction in the transport sector's dependence on fossil fuels is essential.

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## 1. Sector indicator:

**pm5 - GHG emissions from transport (kt $CO_2$-eq)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure:

- To move towards a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

## 4. Source: Fourth progress report on the Kyoto objectives.

## 5. Methodology: The analysis presented in this report is based on information from the National Greenhouse Gas Inventory for the period 1990-2011 (2013 version) from the Ministry of Agriculture, Food and Environment (MAGRAMA), broken down by autonomous communities, as well as data from the Catalan Ministry of Land and Sustainability (DTES) on the emissions trading scheme and forecasts made by the Catalan Office for Climate Change.

## 6. Data:

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Emissions from transport (kt $CO_2$-eq) | 10,292 | 10,690 | 11,453 | 10,858 | 11,805 | 11,880 | 12,107 |

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|
| Emissions from transport (kt $CO_2$-eq) | 11,682 | 12,591 | 12,998 | 13,319 | 13,619 | 13,485 | 14,216 |

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|
| Emissions from transport (kt $CO_2$-eq) | 14,535 | 14,813 | 15,542 | 16,099 | 15,010 | 14,290 | 13,524 | 12,941 |

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## 7. Graphic representation:

**Emissions trend in the transport sector in Catalonia**
Thousands of tonnes of $CO_2$-eq

**Tendència d'emissions en el transport a Catalunya**

milers tones $CO_2$ eq
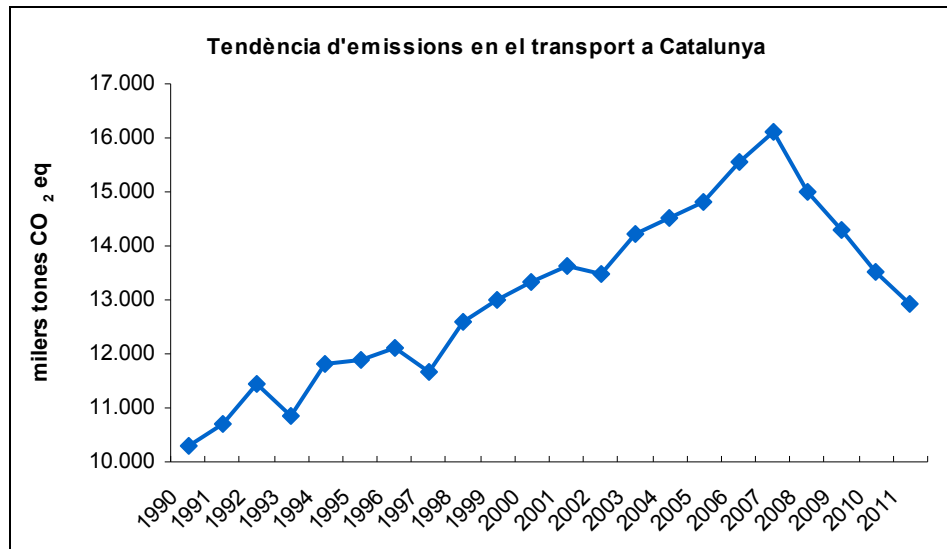


**8. Desired trend:** A reduction in GHG emissions from the transport sector.

**9. Relevance of the indicator:** Achieving the transition towards a more energy-diverse and low-carbon transport model is essential for an effective adaptation to climate change. Emissions from the sector must continue to decrease.

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## RESEARCH, DEVELOPMENT AND INNOVATION

**1. Indicator:**

**prd1 - Domestic expenditure on R&D/GDP (%)**

**2. Operational objective of the ESCACC:** To generate and transfer knowledge about adaptation.

**3. Measure:** R&D&I cross-cutting objective.

**4. Source:** Idescat, INE and Eurostat.

**5. Methodology:** Data on Catalonia's work in the area of research and development (R&D) come from the statistics produced by the Spanish Statistical Office (INE) every year. To facilitate comparability with other countries in the European Union, the methodology used in these statistics follows that proposed by the Organization for Economic Cooperation and Development (OECD), described in the Frascati Manual.

Scientific research and technological development (R&D) comprises all creative work undertaken on a systematic and/or sporadic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

R&D statistics are census-based in public administrations, higher education and private non-profit institutions, and sample-based in the business sector.

**6. Data:**

| % EXPENDITURE R&D/GDP | | | | |
|---|---|---|---|---|
| Year | EUROPE 2020 | EU (27 countries) | CATALONIA | SPAIN |
| 2002 | 3 | 1.87 | 1.28 | 1.03 |
| 2003 | 3 | 1.86 | 1.38 | 1.10 |
| 2004 | 3 | 1.83 | 1.33 | 1.06 |
| 2005 | 3 | 1.82 | 1.35 | 1.12 |
| 2006 | 3 | 1.84 | 1.42 | 1.20 |
| 2007 | 3 | 1.84 | 1.48 | 1.27 |
| 2008 | 3 | 1.91 | 1.61 | 1.35 |
| 2009 | 3 | 2.01 | 1.70 | 1.39 |
| 2010 | 3 | 2.01 | 1.65 | 1.39 |
| 2011 | 3 | 2.05 | 1.55 | 1.33 |

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## 8. Graphic representation:

EUROPE 2020
EU (27 countries)
CATALONIA
SPAIN
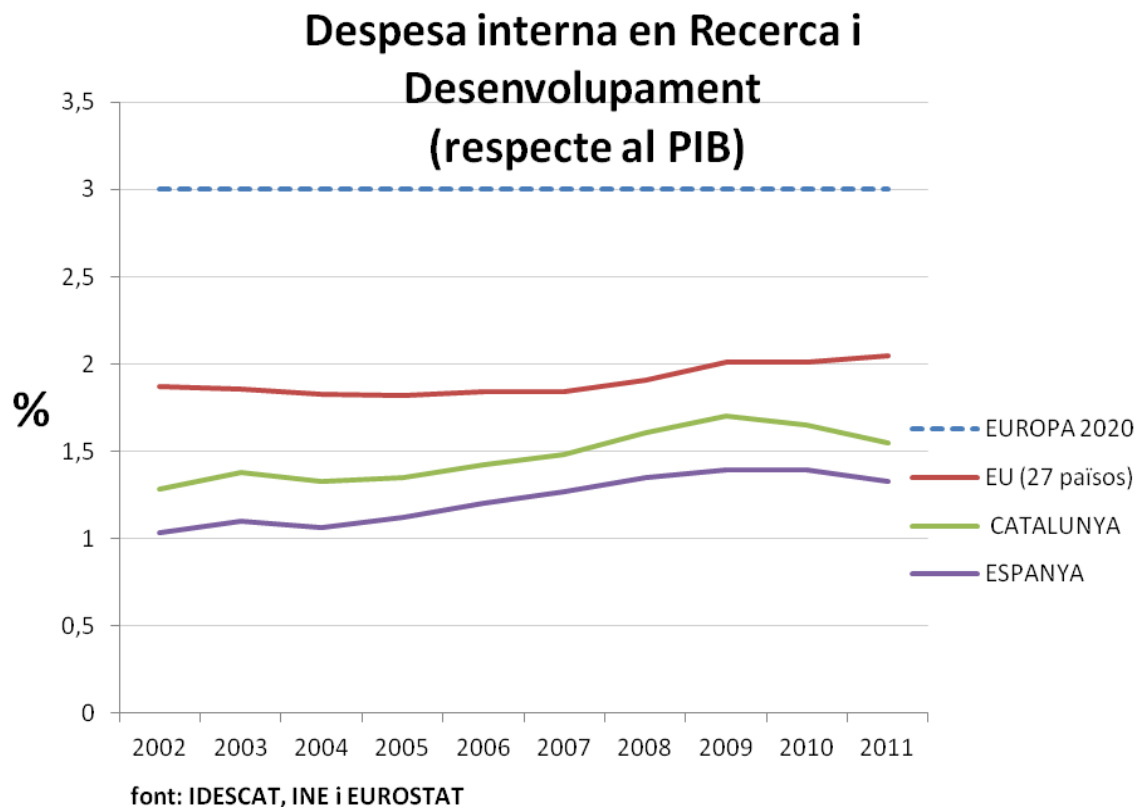


**8. Desired trend:** An increase in domestic expenditure on R&D / GDP in Catalonia with the aim of achieving the target of 3% set out in the Europe 2020 strategy.

**9. Relevance of the indicator:** R&D is the ultimate indicator of intelligent, inclusive and sustainable development, as stated in the objectives of the Catalonia 2020 Strategy.

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## HEALTH

### 1. Sector indicator:

**ps6 - At-risk-of-poverty rate: after social transfers in Catalonia**

### 2. Operational objective of the ESCACC: To increase the adaptive capacity.

### 3. Measure to which it corresponds:

- To develop preventive tools and protocols of action for responding to the impacts among the most vulnerable groups (elderly people, children, the chronically ill, the mentally ill, people at risk of social exclusion, etc.).

### 4. Source: Idescat and Eurostat.

### 5. Methodology: The concept of poverty here is that of relative poverty or risk of poverty. People described as poor or at risk of poverty are those whose income falls below the average standard of living in the society where they live. Setting an at-risk-of-poverty threshold is a fundamental step in defining the median standard of living. The population living above and below this threshold can then be identified, calculated and analysed. The use of a middle value was considered as an indicator for the average standard of living, for example the median. The **threshold** was set at **60%** of the value of the median equivalized **annual disposable income** of people. The **at-risk-of-poverty rate is the percentage of people living below this threshold**.

Considering the at-risk-of-poverty rate before and after social transfers aims to quantify the efforts undertaken by the social protection system to reduce the risk of poverty. In order to analyse the extent to which social benefits can reduce situations of poverty risk, three values were analysed, according to the different incomes recorded: income before all social transfers, income after old-age or survivors' pensions, and income after all social transfers (pensions, unemployment benefits, social assistance and family protection).

### 6. Data:

| At-risk-of-poverty rate after social transfers | |
|---|---|
| 2004 | 17.7 |
| 2005 | 17.2 |
| 2006 | 19.0 |
| 2007 | 18.2 |
| 2008 | 16.6 |
| 2009 | 18.4 |
| 2010 | 19.9 |
| 2011 | 19.1 |

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| At-risk-of-poverty rate after social transfers | |
|---|---|
| 2012 | 20.1 |

## 7. Graphic representation:

**At-risk-of-poverty rate (after social transfers in Catalonia)**
Catalonia



**Taxa risc a la pobresa
(després transferències socials)**
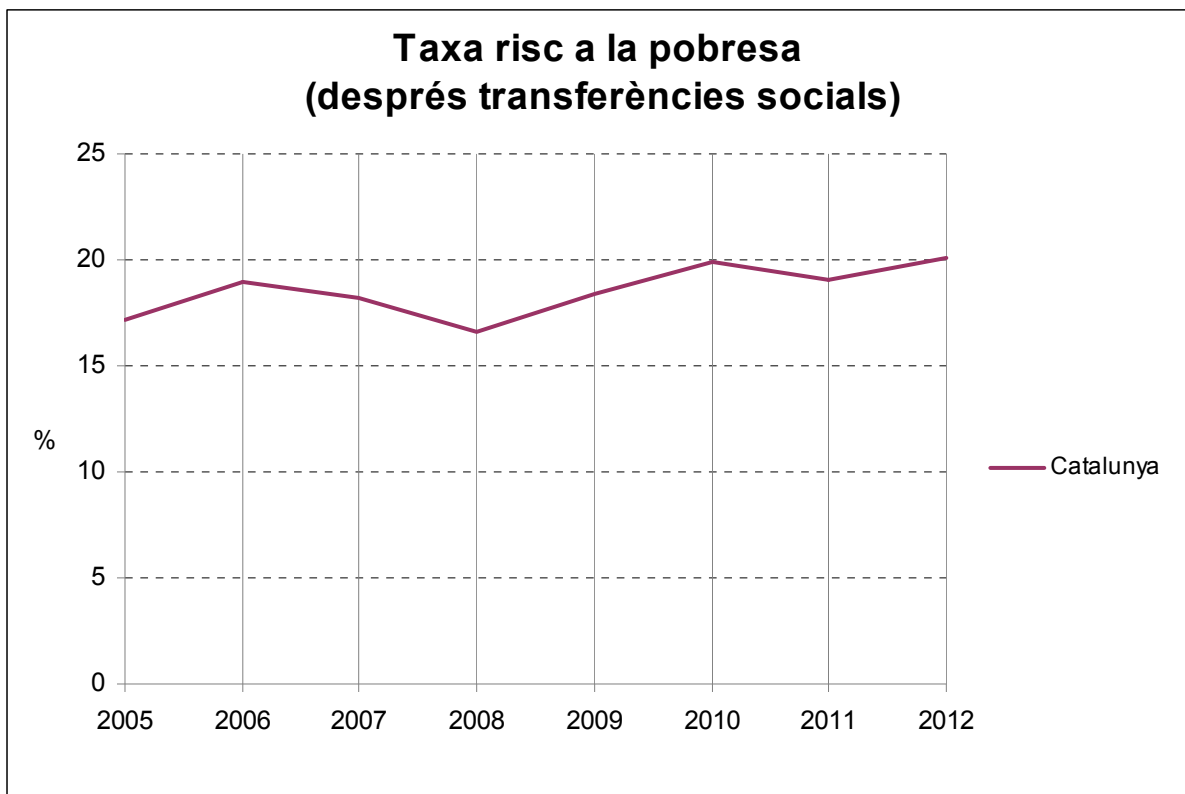
**8. Desired trend of the adaptation:** A reduction.

**9. Relevance of the indicator:** Considering the at-risk-of-poverty rate before and after social transfers aims to quantify the efforts undertaken by the social protection system to reduce the risk of poverty.

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## 1. Sector indicator:

**ps8 - Green area per inhabitant in the city of Barcelona (m$^2$/inhabitant)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure to which it corresponds:

   – In urban planning, particularly in cities, to incorporate all preventive measures (green zones, blue zones, trees, canopied areas, etc.) aimed at reducing the "urban heat island" effect.

## 4. Source: Authors' own figures based on Barcelona City Council's GREEN PLAN.

## 5. Methodology: The area of the Collserola Park (included in the Barcelona City Council's Green Plan) has been deducted.

## 6. Data:

| BARCELONA city | | |
|---|---|---|
| Year | Green area in the city (km$^2$) | Green area in the city per inhabitant (m$^2$/inhab.) |
| 1998 | 9.39 | 6.24 |
| 1999 | 9.68 | 6.44 |
| 2000 | 9.84 | 6.58 |
| 2001 | 9.89 | 6.58 |
| 2002 | 10.07 | 6.59 |
| 2003 | 10.36 | 6.55 |
| 2004 | 10.40 | 6.59 |
| 2005 | 10.42 | 6.54 |
| 2006 | 10.52 | 6.55 |
| 2007 | 10.62 | 6.66 |
| 2008 | 10.80 | 6.68 |
| 2009 | 10.77 | 6.64 |
| 2010 | 10.82 | 6.68 |
| 2011 | 10.98 | 6.80 |
| 2012 | 11.02 | 6.80 |

Note:   Collserola Park not included

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## 7. Graphic representation:

**Green area per inhabitant in the city of Barcelona (not including Collserola Park)**
**Green area in the city - km$^2$**
Green area in the city per inhabitant - m$^2$/inhab.
Green area in the city
Green area in the city per inhabitant



Superfície verda Barcelona ciutat per habitant
(no inclou Collserola)
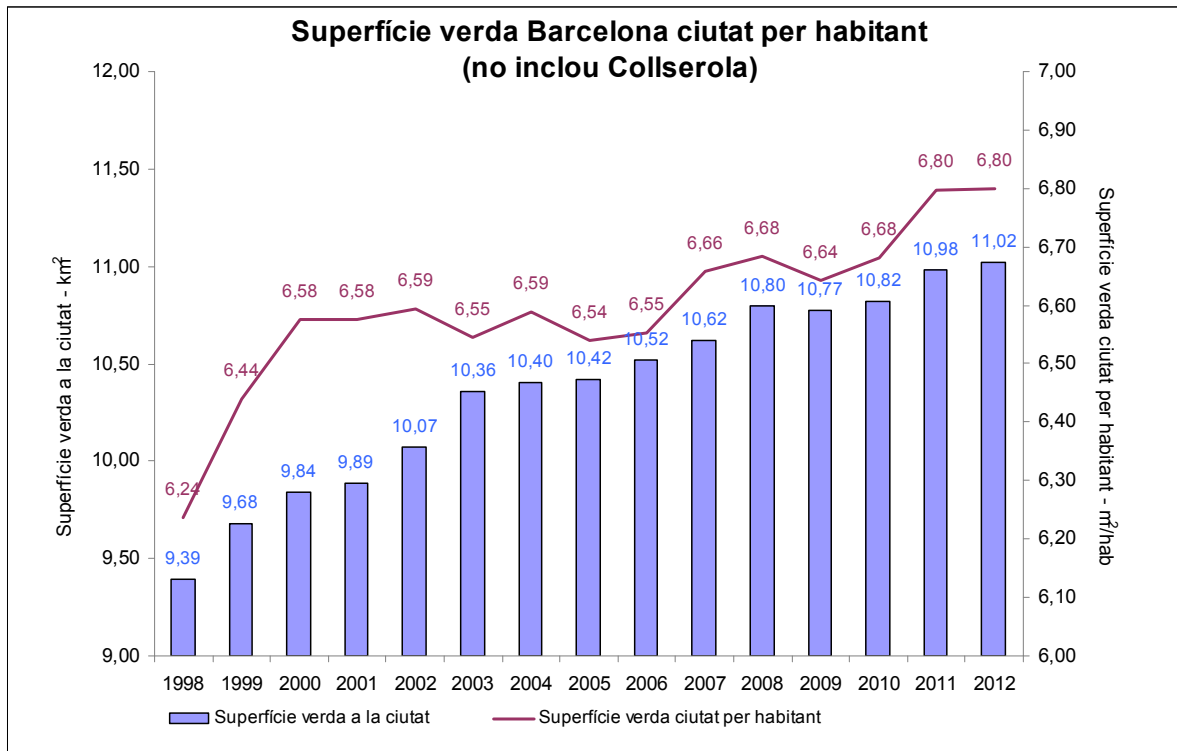
**8. Desired trend of the adaptation:** An increase towards the 15 m$^2$ per inhabitant recommended by the World Health Organization.

**9. Relevance of the indicator:** Green areas play a vital role in reducing the "urban heat island" effect.

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## 1. Sector indicator:

**ps9 - Catalan air quality index ICQA (% satisfactory + excellent)**

**2. Operational objective of the ESCACC:**. To generate and transfer knowledge about adaptation.

**3. Measure to which it corresponds:**

− To implement and strengthen networks for monitoring and preventing pollution.

**4. Source:** Network for Monitoring and Forecasting of Air Pollution (XVPCA). Air quality. Directorate General for Environmental Quality. Secretariat for Environment and Sustainability. Ministry of Land and Sustainability.

http://www20.gencat.cat/portal/site/mediambient/menuitem.8f64ca3109a92b904e9cac3bb0c0e1a0/?vgnextoid=eef59524bd927210VgnVCM1000008d0c1e0aRCRD&vgnextchannel=eef59524bd927210VgnVCM1000008d0c1e0aRCRD

ICQA

http://www20.gencat.cat/portal/site/mediambient/menuitem.8f64ca3109a92b904e9cac3bb0c0e1a0/?vgnextoid=2a2cd5029e927210VgnVCM1000008d0c1e0aRCRD&vgnextchannel=2a2cd5029e927210VgnVCM1000008d0c1e0aRCRD&vgnextfmt=default

Basic Environmental Indicators in Catalonia, Ministry of Land and Sustainability.

http://www20.gencat.cat/portal/site/territori/menuitem.2a0ef7c1d39370645f13ae92b0c0e1a0/?vgnextoid=96a9988b39775310VgnVCM1000008d0c1e0aRCRD&vgnextchannel=96a9988b39775310VgnVCM1000008d0c1e0aRCRD&vgnextfmt=default

Environmental Data 2013, Ministry of Land and Sustainability.

http://www20.gencat.cat/portal/site/territori/menuitem.c6e8d3be598ec9745f13ae92b0c0e1a0/?vgnextoid=cccec45609775310VgnVCM1000008d0c1e0aRCRD&vgnextchannel=cccec45609775310VgnVCM1000008d0c1e0aRCRD&vgnextfmt=default

**5. Methodology:** In Catalonia, air quality monitoring is carried out by the stations in the **Air Pollution Monitoring and Forecast Network (XVPCA)**. These stations measure the concentration of key pollutants in the air, i.e. the emission levels. The network's role is not to control the pollutant emission sources, but to monitor the quality of the air we breathe.

The Catalan air quality index (ICQA) is calculated based on data from automated stations in the Air Pollution Monitoring and Forecast Network (XVPCA). The emission levels of carbon monoxide (CO), nitrogen dioxide ($NO_2$), sulphur dioxide ($SO_2$), ozone ($O_3$) and particulate matter (PM10) are used to calculate the ICQA.

The Catalan air quality index is a single figure without units that weights the contribution of the different pollutants measured (CO, $NO_2$, $SO_2$, $O_3$ and PM10) to the overall air quality. It is an indicator that is specially designed to inform the public.

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The ICQA is calculated based on the concentration of each pollutant. The lowest ICQA is chosen, and this becomes the ICQA for that day.

The ICQA is therefore not an average: the daily ICQA is the ICQA caused by the pollutant that has had the greatest impact on air quality that day. The ICQA is calculated by all automated stations, although some of them do not measure the five pollutants that determine the index.

How to interpret the ICQA:

- A negative ICQA means that at least one of the pollutants has exceeded the emission limit values set by the latest regulations in force.
- A positive ICQA means that the five pollutants that determine the ICQA are present in the air in concentrations below the limit values.

Air quality is defined based on the numerical value of the ICQA. The higher the ICQA, the higher the air quality.

Classification of air quality based on the ICQA value:

**Good**
**Normal**
**Poor**
**Excellent** air quality
**Satisfactory** air quality
**Acceptable** air quality
**Low** air quality
**Poor** air quality
**Very poor** air quality

| | | | | |
|---|---|---|---|---|
| **Bona**<br>50 ≤ ICQA ≤ 100 | ★ ★ ★ ★ ★ | Qualitat de l'aire **excel·lent** | 75 ≤ ICQA ≤ 100 | |
| | ★ ★ ★ ★ | Qualitat de l'aire **satisfactòria** | 50 ≤ ICQA < 75 | |
| **Regular**<br>0 ≤ ICQA < 50 | ★ ★ ★ | Qualitat de l'aire **acceptable** | 25 ≤ ICQA < 50 | |
| | ★ ★ | Qualitat de l'aire **baixa** | 0 ≤ ICQA < 25 | |
| **Pobra**<br>ICQA < 0 | ★ | Qualitat de l'aire **deficient** | -50 ≤ ICQA < 0 | |
| | ● | Qualitat de l'aire **molt deficient** | ICQA < -50 | |

The ICQA should be considered as an indicator primarily aimed at informing the general public about air quality. Experts obviously have to take account of other factors such as synergies between pollutants, the effect of unmeasured substances, the presence of non-harmful but irritating compounds, etc. Reports on the ICQA.

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## 6. Data:

| Catalan air quality index ICQA (% (satisfactory + excellent)) | |
|---|---|
| 2004 | 76 |
| 2005 | 62 |
| 2006 | 62 |
| 2007 | 65 |
| 2008 | 67 |
| 2009 | 62 |
| 2010 | 60 |
| 2011 | 80 |
| 2012 | 81 |
| 2013 | 78 |

## 7. Graphic representation:

**ICQA (% (satisfactory + excellent))**
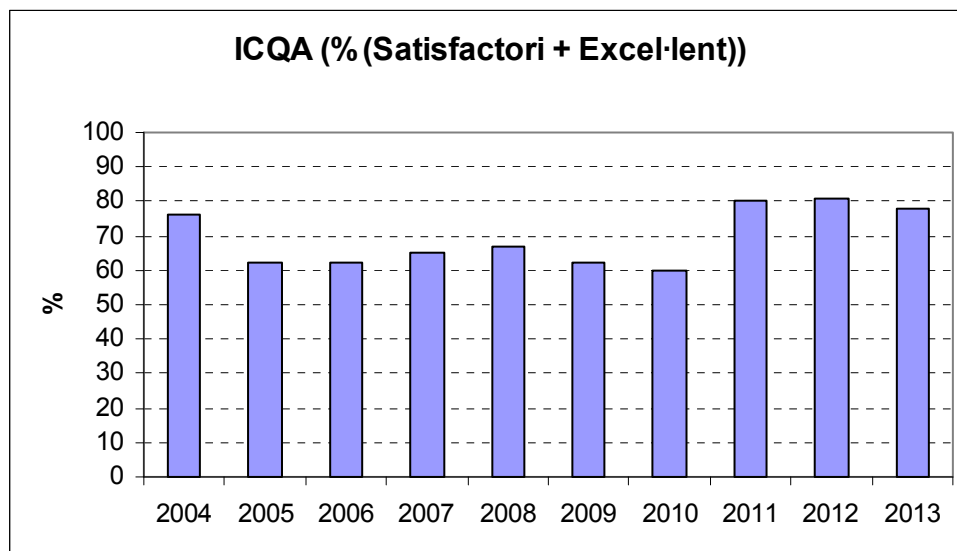


**8. Desired trend of the adaptation:** An increase in the ICQA values that indicate better air quality.

**9. Relevance of the indicator:** Air pollution and climate change are different problems, but they are inextricably linked. Some air pollutants (certain components of PM and $O_3$) also affect the climate and are therefore known as climate pollutants (short-lived). For example, in addition to the serious impact it has on public health and ecosystems, ozone also

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contributes to global warming, since it absorbs part of the infrared energy emitted by the earth and creates heating effects in the immediate environment. Ozone also reduces the photosynthesis of plants and consequently reduces plants' absorption of $CO_2$.

At higher temperatures, the harmful effects of pollution increase because certain toxic elements are more volatile and because the heat increases their oxidative capacity. The health risks of air pollution primarily stem from particulate matter and ground-level ozone. Rising temperatures could increase the formation and combination of atmospheric pollutants (CO, NOx, $O_3$).

Areas with worse air quality, subject to the same rises in average temperature or in the frequency or intensity of heat waves, are more harmful to human health than areas with better quality air. Therefore, actions designed to reduce local pollution sources are excellent measures for adapting to climate change.

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## 1. Sector indicator:

**ps10 - Maximum value of ozone immissions (μg/m$^3$)**

**2. Operational objective of the ESCACC:**. To generate and transfer knowledge about adaptation.

**3. Measure to which it corresponds:**

− The campaign for monitoring tropospheric ozone levels in Catalonia.

**4. Source:** Idescat. Air pollution

http://www.idescat.cat/pub/?id=aec&n=237&t=2012&x=9&y=6

**5. Methodology:** The emission levels (presence) of ozone in the troposphere are analysed. The maximum hourly values are calculated.

**6. Data:**

| Hourly average ozone concentrations (immissions) | |
|---|---|
| Year | Maximum ozone value (μg/m$^3$)* |
| 2000 | 227 |
| 2001 | 272 |
| 2002 | 384 |
| 2003 | 288 |
| 2004 | 180 |
| 2005 | 246 |
| 2006 | 250 |
| 2007 | 219 |
| 2008 | 219 |
| 2009 | 233 |
| 2010 | 232 |
| 2011 | 218 |
| 2012 | 229 |

| Maximum hourly averages: | |
|---|---|
| Public information threshold | 180 μg/m$^3$ |
| Alert threshold | 240 μg/m$^3$ |

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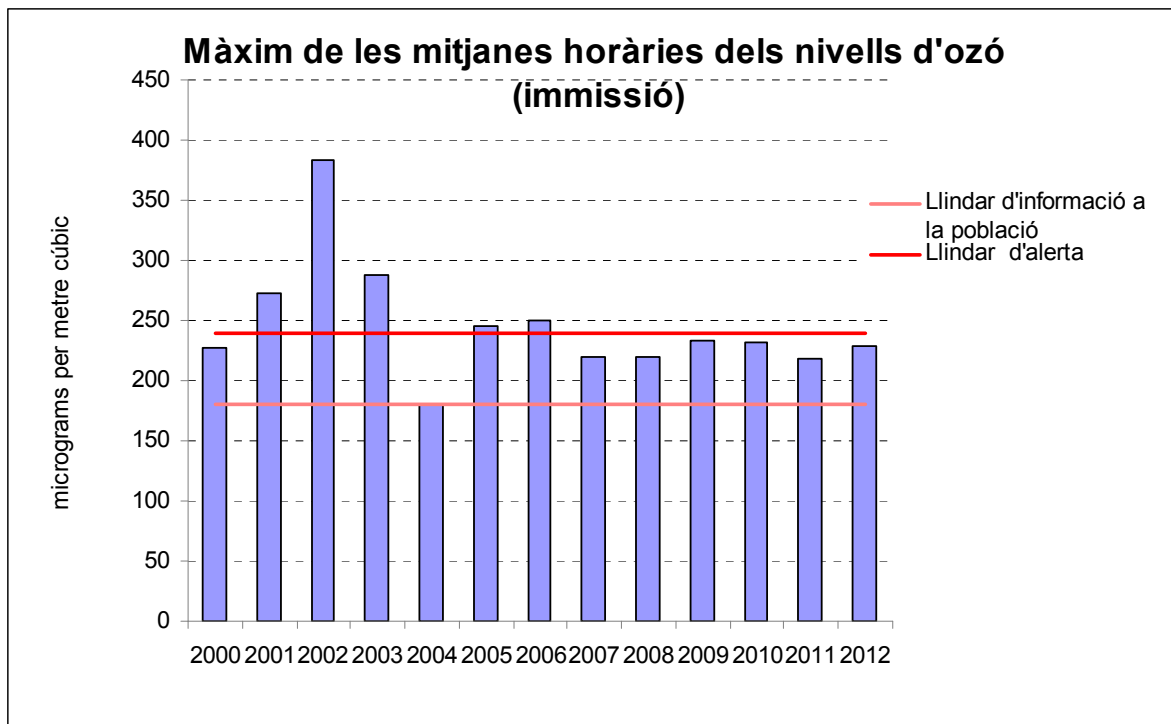
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## 7. Graphic representation:

**Maximum hourly average ozone concentrations (immissions)**
Public information threshold
Alert threshold
Micrograms per cubic metre

### Màxim de les mitjanes horàries dels nivells d'ozó (immissió)



**8. Desired trend of the adaptation:** A reduction to levels below the public information threshold.

**9. Relevance of the indicator:** The ozone concentration in a particular location is dependent on temperature, but also on solar radiation and, in particular, levels of certain precursors such as nitrogen oxide, a gas generated by human activity (e.g. transport) in significant amounts. Our capacity to limit the concentration of these precursors, and therefore the anthropogenic sources that emit them, will be a determining factor in further reducing the vulnerability of the population.

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## TOURISM

### 1. Sector indicator:

**pt2 - Total overnight stays in hotels in Catalonia (% 3rd quarter/year total)**

### 2. Operational objective of the ESCACC: To increase the adaptive capacity.

### 3. Measure to which it corresponds:

- To encourage the deseasonalization of tourism (to promote the bimodal season: spring and autumn) and of demand (changes in the school calendar).

### 4. Source: Idescat www.idescat.cat

### 5. Methodology: The data on overnight stay in hotels in Catalonia are broken down by quarter and their evolution analysed.

### 6. Data:

| | Overnight stays in hotels in Catalonia (thousands) | | | | |
|---|---|---|---|---|---|
| | 1st QUARTER | 2nd QUARTER | 3rd QUARTER | 4th QUARTER | TOTAL |
| **2007** | 5,209.20 | 12,254.00 | 18,110.30 | 6,907.40 | 42,480.90 |
| **2008** | 5,657.60 | 11,716.00 | 18,188.60 | 6,419.50 | 41,981.70 |
| **2009** | 4,640.70 | 11,716.60 | 17,862.20 | 6,599.90 | 40,819.40 |
| **2010** | 5,524.80 | 12,022.00 | 19,647.20 | 7,509.10 | 44,703.10 |
| **2011** | 5,715.60 | 12,803.20 | 21,081.80 | 7,460.00 | 47,060.60 |
| **2012** | 5,824.00 | 13,772.10 | 21,369.80 | 7,331.30 | 48,297.20 |
| **2013** | 5,969.50 | 13,703.30 | 21,686.50 | 7,917.20 | 49,276.50 |

| | % overnight stays 3rd quarter |
|---|---|
| **2004** | 44% |
| **2005** | 44% |
| **2006** | 43% |
| **2007** | 43% |
| **2008** | 43% |
| **2009** | 44% |
| **2010** | 44% |
| **2011** | 45% |

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|  | % overnight stays 3rd quarter |
|---|---|
| **2012** | 44% |
| **2013** | 44% |

## 7. Graphic representation:

% overnight stays in hotels 3rd quarter
% quarter/year total

**% Pernoctacions hotels III trimestre**
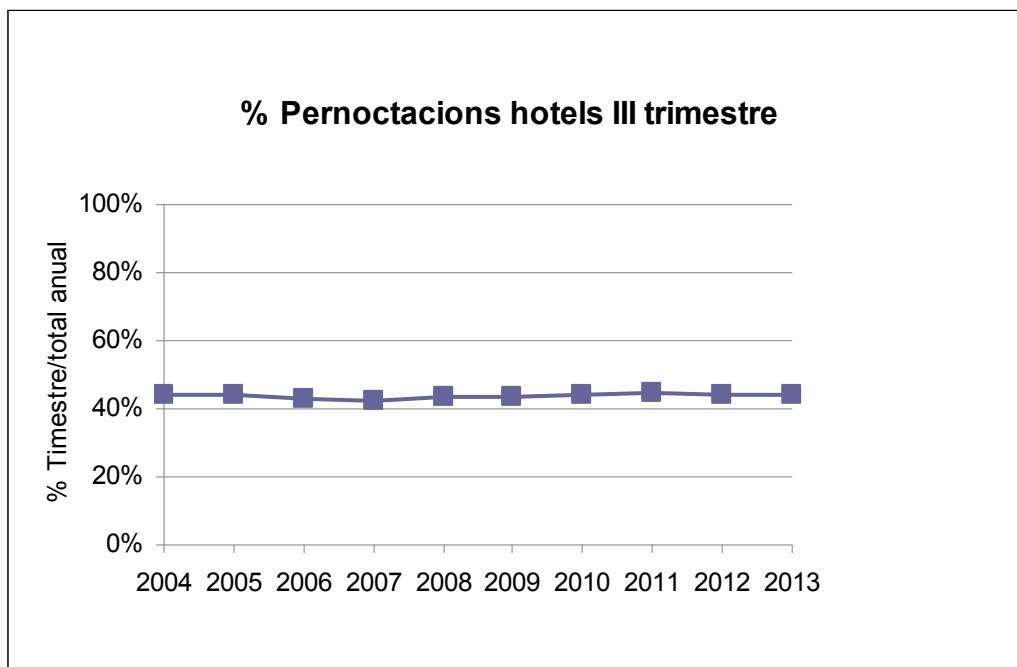


**8. Desired trend of the adaptation:** Deseasonalization: a reduction in the percentage of overnight stays in the third quarter (July/August/September).

**9. Relevance of the indicator:** Deseasonalization would help reduce the demand for resources during the warmer months. Water resources are most compromised in the third quarter due to competition with other sectors such as agriculture, whose water demand is also highest during this quarter.

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## 1. Sector indicator:

**pt5 - Foreign tourists' reasons for travelling to Catalonia (% professional tourism)**

## 2. Operational objective of the ESCACC: To increase the adaptive capacity.

## 3. Measure(s) to which it corresponds:

– To promote the diversification of tourism in order to increase the number of less climate-dependent options (e.g. cultural, family, business, sports, mountain, spa, gastronomy using locally sourced ingredients, wine, etc.).

## 4. Source: Idescat http://www.idescat.cat/economia/inec?tc=3&id=5430

## 5. Methodology: The objective of the statistics on trips by foreign tourists is to quantify and describe the flow of visitors to Catalonia, as well as determine the declared tourism expenditure.

The data are obtained from the Survey of Tourism Movements at Borders (Frontur) produced by Institute of Tourism Studies (IET). Based on the restricted-access databases supplied by the IET, Idescat expands on the results with a higher degree of disaggregation of the variables for Catalonia. These provide annual information on tourists by country of origin, based on trips to the primary destination and secondary destination in Catalonia. The primary destination is understood as the main place visited on the trip, based on the highest number of overnight stays. Moreover, the information relating to tourists is classified by different variables: accommodation, reason for the trip, country of residence and type of transport.

Frontur is an ongoing monthly survey that uses a mixed data-collection system. It uses administrative records for all types of transport used, takes a manual count at border points and carries out sample-based surveys at entry and exit points in Spain. This statistical operation generates information on the number of travellers.

A tourist is a traveller who stays overnight, while a tripper is a traveller who does not stay overnight. The sum of tourists and trippers (including travellers passing through) is the total number of visitors.

An overnight stay is understood as a night spent outside the usual residence. Tourist arrivals is the number of people who stay one or more nights in a row in the same accommodation.

In March 2009, Idescat started to use a new methodology for estimates. Data for 2006, 2007 and 2008 have been revised, since the Frontur data have incorporated methodological changes. These changes improve the estimates of data on travellers who come to Spain through ports and by road (coaches). Other access routes (airport, train and light road vehicles) remain unaffected by the changes.

As of March 2011, the table of reasons for trips, according to IET, can be broken down into: leisure/holidays, professional reasons, personal (family, health, purchases) and other.

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## 6. Data:

| % professional tourism/total (foreign tourists) | | | |
| --- | --- | --- | --- |
| Foreign tourists (thousands) | | | |
| Year | TOTAL | Professional motives | % professional/total (foreign tourists) |
| 2004 | 13,170.40 | 1,813.20 | **13.77** |
| 2005 | 14,662.00 | 1,909.40 | **13.02** |
| 2006 | 15,809.50 | 1,790.50 | **11.33** |
| 2007 | 15,892.40 | 1,677.50 | **10.56** |
| 2008 | 15,026.90 | 1,493.40 | **9.94** |
| 2009 | 13,597.00 | 1,194.70 | **8.79** |
| 2010 | 14,206.60 | 1,448.30 | **10.19** |
| 2011 | 14,969.40 | 1,397.90 | **9.34** |
| 2012 | 15,553.60 | 1,440.70 | **9.26** |
| 2013 | 16,638.40 | 1,670.40 | **10.04** |

## 7. Graphic representation:

**% business travel/total (foreign tourists)**



**% Turisme de negocis/total (turistes estrangers)**
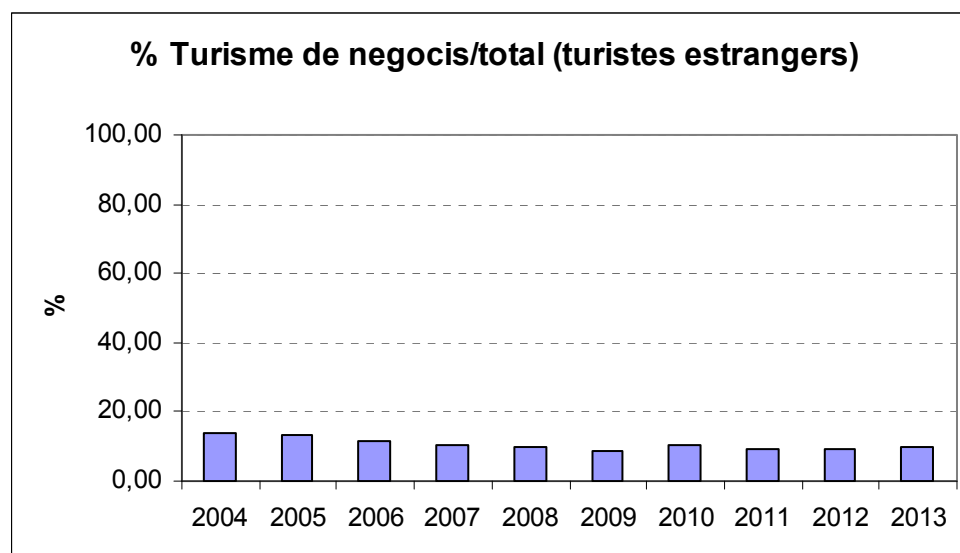
**8. Desired trend of the adaptation:** To increase the type of tourism that is non-climate dependent, such as business travel.

**9. Relevance of the indicator:** The indicator shows the evolution of the diversification beyond sun-and-beach tourism, which is highly dependent on the weather conditions. The evolution of non-climate dependent tourism, such as business travel, shows a very positive development.

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## 1. Sector indicator:

**pt14 - Snow cannons on Catalan ski resort (km ski slope/cannon)**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

**3. Measure to which it corresponds:**

− To promote the diversification of tourism in order to increase the number of less climate-dependent options (e.g. cultural, family, professional, sports, mountain, spa, gastronomy using locally sourced ingredients, wine, etc.).

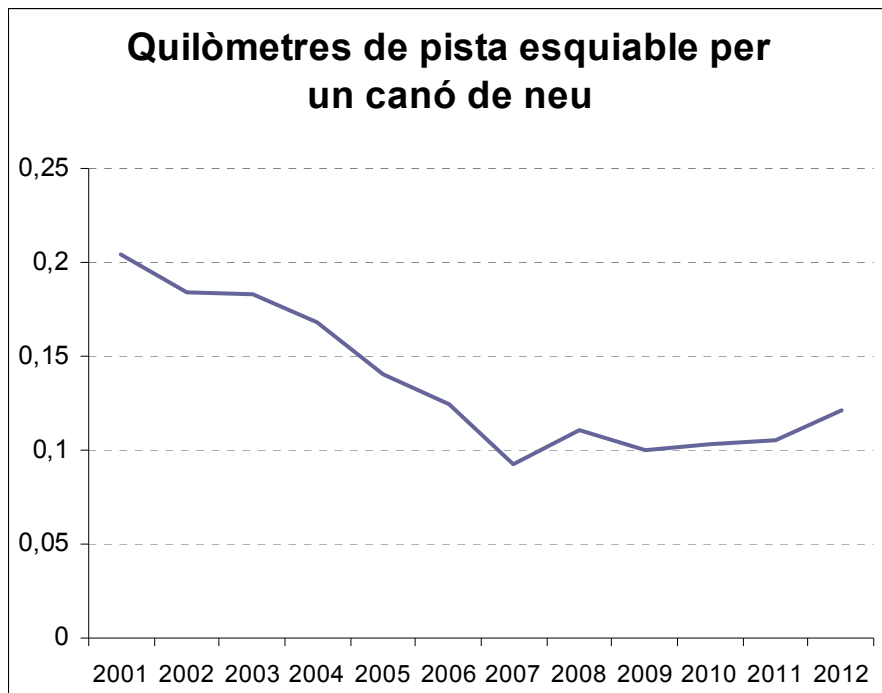**4. Source:** Idescat http://www.idescat.cat/pub/?id=aec&n=578&t=2011

**5. Methodology:** The Ministry for Business and Employment compiles the information in Idescat based on data from the Catalan Association of Ski Resorts and Mountain Activities and from the websites of ski resorts. In order to analyse the development, a "fictitious" value was attributed to 2010 due to the lack of data for that year.

**6. Data:**

|  | **Snow cannons** | **Total km** | **km / cannon** |
|---|---|---|---|
| **2001** | 1,600 | 326 | 0.20 |
| **2002** | 1,600 | 295.3 | 0.18 |
| **2003** | 1,638 | 300.3 | 0.18 |
| **2004** | 1,764 | 297.3 | 0.17 |
| **2005** | 1,806 | 253.8 | 0.14 |
| **2006** | 1,979 | 246.1 | 0.12 |
| **2007** | 2,136 | 197.6 | 0.09 |
| **2008** | 2,244 | 249.3 | 0.11 |
| **2009** | 2,300 | 230 | 0.10 |
| **2010 *** | 2,361 | 243 | 0.10 |
| **2011** | 2,422 | 256 | 0.11 |
| **2012** | 2,422 | 294 | 0.12 |
| * average values assigned based on other years | | | |

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## 7. Graphic representation:

**Kilometres of ski slope per snow cannon**

**Quilòmetres de pista esquiable per un canó de neu**



**8. Desired trend of the adaptation:** Ski resorts that are dependent on the use of snow cannons must diversify their activities to include mountain resorts.

The production of artificial snow, considered a poor adaptation, must entail an increase in the efficient use of cannons:

- an increase in the number of kilometres of slope achieved with the use of a cannon.
- a reduction in the number of cannons required for each kilometre of slope.

**9. Relevance of the indicator:** The practice is classified as a poor adaptation, but it is widespread. The use of cannons should incorporate technological advances to increase the kilometre of ski slope / cannon ratio.

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## URBAN PLANNING AND HOUSING

### 1. Sector indicator:

**pu2 - Volume of water billed in the household sector in Catalonia (m³)**

### 2. Operational objective of the ESCACC: To increase the adaptive capacity.

### 3. Measure:

− To promote savings and efficiency in the use of water (grey-water separation, rainwater tanks, use of reclaimed water, etc.) and energy.

### 4. Source: Catalan Water Agency (official economic and socio-economic data, environmental control data, data from supramunicipal bodies on supply).

### 5. Methodology: The methodology is established in the Catalan River Basin District Management Plan.

### 6. Data:

| Year | Volume of water billed in the household sector (m³) |
|------|----------------------------------------------------|
| 2003 | 415,179,274 |
| 2004 | 415,337,247 |
| 2005 | 410,340,200 |
| 2006 | 410,081,200 |
| 2007 | 408,770,528 |
| 2008 | 397,481,847 |
| 2009 | 400,793,161 |
| 2010 | 398,544,684 |
| 2011 | 397,495,491 |
| 2012 | 397,523,841 |

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## 7. Graphic representation:

**Volume of water billed in the household sector in Catalonia (m$^3$)**
Year
Volume of water billed in the household sector in Catalonia (m$^3$)



**Volum d'aigua facturada pel sector domèstic (m3)**

Legend: Volum d'aigua facturada pel sector domèstic (m3)
X-axis: **Anys** — 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012
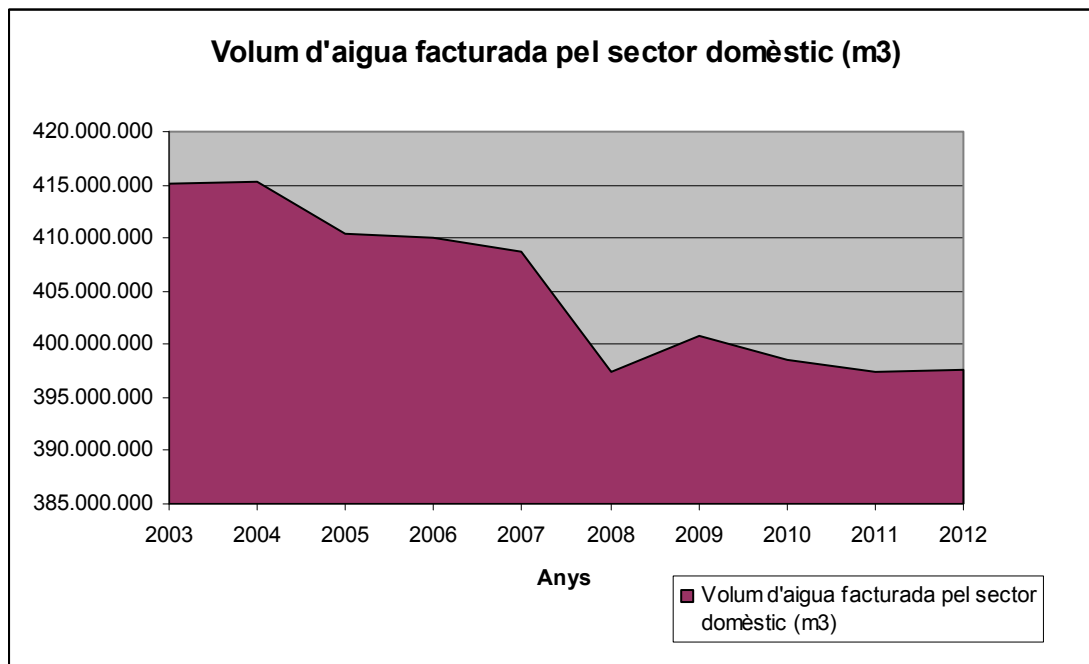
**8. Desired trend:** A reduction in the volume of water billed in the household sector in Catalonia.

**9. Relevance of the indicator:** This is a good indicator for the sector, since greater savings and efficiency will make urban areas more resilient to the anticipated impacts of climate change (i.e. a reduction in resources and greater competition for resources).

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## 1. Sector indicator:

**pu3 - Final energy consumption of the household sector in Catalonia**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

## 3. Measure:

- To promote savings and efficiency in the use of water (grey-water separation, rainwater tanks, use of reclaimed water, etc.) and energy.

**4. Source:** Catalan Energy and Climate Change Plan 2013-2020.

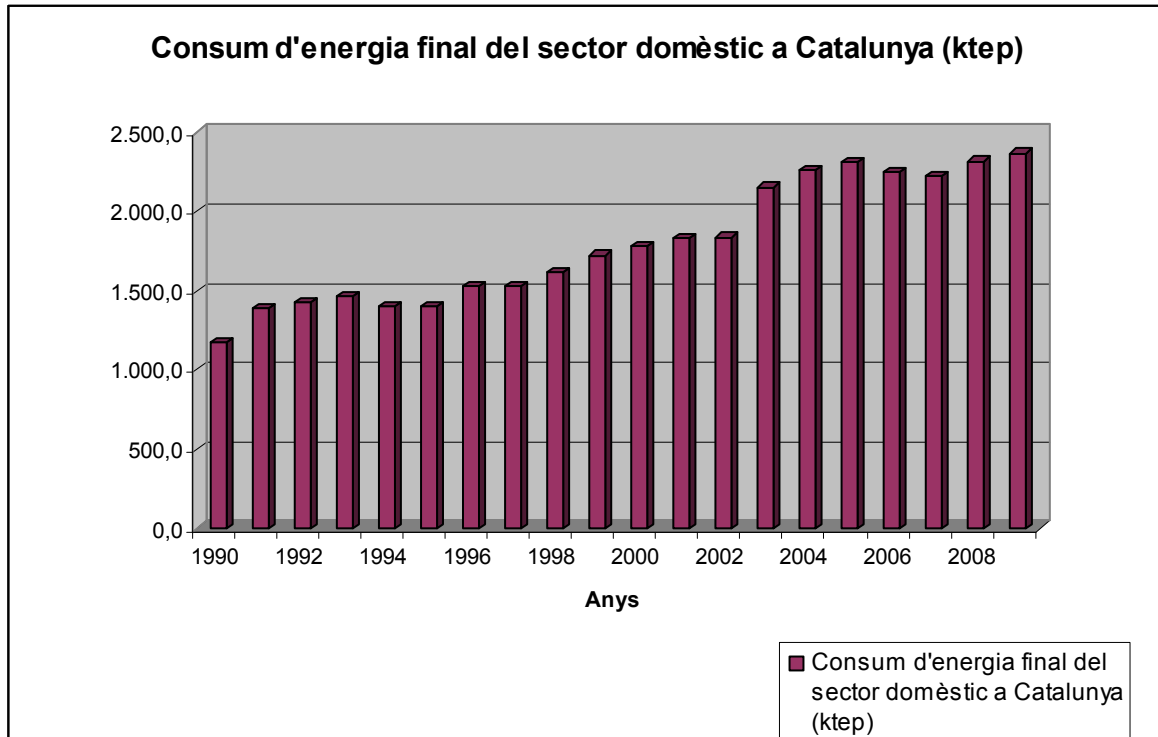**5. Methodology:** Set out in the Catalan Energy and Climate Change Plan 2013-2020.

## 6. Data:

| Year | Final energy consumption of the household sector in Catalonia (ktoe) |
|------|------|
| 1990 | 1,177.8 |
| 1991 | 1,389.2 |
| 1992 | 1,429.0 |
| 1993 | 1,460.4 |
| 1994 | 1,405.6 |
| 1995 | 1,407.0 |
| 1996 | 1,530.7 |
| 1997 | 1,525.8 |
| 1998 | 1,621.4 |
| 1999 | 1,724.3 |
| 2000 | 1,778.8 |
| 2001 | 1,832.7 |
| 2002 | 1,838.1 |
| 2003 | 2,155.8 |
| 2004 | 2,260.5 |
| 2005 | 2,314.4 |
| 2006 | 2,248.5 |
| 2007 | 2,219.9 |
| 2008 | 2,318.4 |
| 2009 | 2,370.6 |

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## 7. Graphic representation:

**Final energy consumption of the household sector in Catalonia (ktoe)**
Year
Final energy consumption of the household sector in Catalonia (ktoe)



**Consum d'energia final del sector domèstic a Catalunya (ktep)**

Legend: Consum d'energia final del sector domèstic a Catalunya (ktep)

X-axis: Anys

**8. Desired trend:** A reduction in the final energy consumption of the household sector in Catalonia.

**9. Relevance of the indicator:** This indicator provides an idea of the importance of saving energy in the home and moving towards a more sustainable energy model, both of which are key issues in adaptation to climate change impacts.

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## 1. Sector indicator:

**pu4 - GHG emissions from the residential sector**

**2. Operational objective of the ESCACC:** To increase the adaptive capacity.

## 3. Measure:

– To move towards a more diversified, decentralized, low-carbon, economically dynamic, socially inclusive and environmentally consistent energy model, as provided for in the PECAC.

**4. Source:** Fourth progress report on the Kyoto objectives.

**5. Methodology:** The analysis presented in this report is based on information from the National Greenhouse Gas Inventory for the period 1990-2011 (2013 version) from the Ministry of Agriculture, Food and Environment (MAGRAMA), broken down by autonomous communities, as well as data from the Catalan Ministry of Land and Sustainability (DTES) on the emissions trading scheme and forecasts made by the Catalan Office for Climate Change.
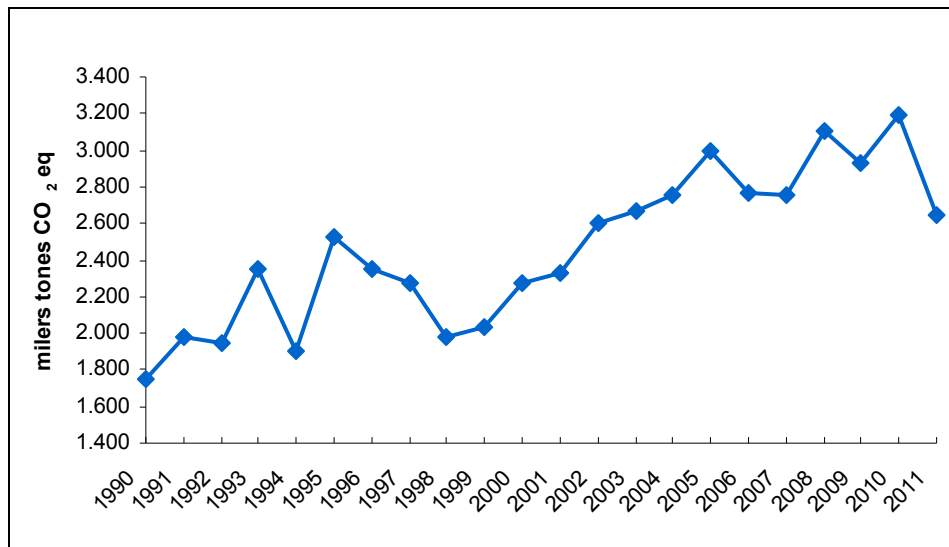
## 6. Data:

| Years | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| **Tonnes of $CO_2$ emitted by the residential sector** | 1,749.3 | 1,977.3 | 1,951.4 | 2,353.1 | 1,902.2 | 2,529.0 | 2,354.4 | 2,270.1 | 1,984.5 |

| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|
| 2,031.6 | 2,273.2 | 2,327.8 | 2,600.2 | 2,671.0 | 2,752.5 | 2,995.1 | 2,761.8 | 2,750.1 |

| 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|
| 3,101.8 | 2,928.5 | 3,195.3 | 2,650.2 |

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## 7. Graphic representation:

Thousands of tonnes of $CO_2$-eq



**8. Desired trend:** A reduction in GHG emissions from the residential sector

**9. Relevance of the indicator:** The indicator shows the residential sector's contribution to greenhouse gas emissions. In order to move towards a lower-carbon society that is more resilient to and prepared for the impacts of climate change, the residential sector must aim to make savings in resource usage and to reduce greenhouse gas emissions from fossil fuels.