A Study of the city of Vigo's contribution to climate change

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Foreword

In this book on climate change, we have expressed the purpose of any human activity which implies raising our citizens' awareness of life in our cities as achieving a permanent balance between rights and duties. Therefore, the best contribution towards improving our citizenship is made by re-shaping individuals through a comprehensive education. This civic education must be understood as a process: learning to know oneself, learning to plan one's life, learning to collaborate with others, learning to live as a social being, learning to live.

Taking all that into account, the basic principles on sustainability provided by the EU common standards rely upon the quest for a social, economic and environmental balance that should rule any human activity. These principles are enshrined in wider projects involving all sectors of a local administration, which uses them in its decision-making processes in order to achieve a better relationship between the administrator and the administrated. It is within this context that the A2, one of the five so-called “main or compulsory” EU standards, deals with the local contribution to global climate change. Its expression in quantitative terms is the methodology established by the IPCC (Intergovernmental Panel on Climate Change).

Thus, this standard quantifies mainly the anthropogenic emissions of carbon dioxide, nitrous oxide and methane within a dependent area, or within the area controlled by a given local administration. As the authority which operates closest to the citizen, the local administration plays a crucial role in the processes of lifestyle change, production change, change of consumer habits as well as in the patterns of distribution of space in order to favour sustainable development.

Right now, one of the most critical environmental problems is related to climate change, which is in turn a process aided by the emission into the atmosphere of gases generated by human activities mainly those of the energy sector. Cities are the most important foci of emission of these gases, principally because population and industries tend to become concentrated around them. This is the reason why it is very important for every town to keep check on the amount of its emissions that contribute to global climate change, and to try and cut them down as much as possible. In this way, they will try to solve a global problem with contributions from every single local organization.

The work led by Professor Espada Recarey has been extremely useful in carrying out an action plan for the town of Vigo. This plan was framed within the strategic document "Agenda 21" and determined the equivalent levels of carbon dioxide. It also analyzed different activities giving rise to this gas, as a first step towards designing an improvement plan that would include several measures to be taken for an adequate implementation of the Agenda.

It is a great pleasure for us to present this new development, which will undoubtedly be an outstanding contribution from the Valedor do Cidadán of Vigo to the public administrations that are responsible for managing this sustainability standard.

Javier Riera Nieves
Galician Foundation for a Knowledge Based Society
VICE-PRESIDENT

General approach

The year 2005 was characterized, from an environmental point of view, by an unprecedented display of information on all aspects of climate change. The provincial Government of Galicia, with the help of the Department of Environment and Sustainable Development, expects to promote this subject by means of informative campaigns that make clear the necessity to reduce the emission of gases which are causing this effect.

The city of Vigo is fulfilling its obligations on this fascinating and complex subject, using a calculation of the emissions elaborated methodologically by the IPCC (Intergovernmental Group of Experts on the Climate Change). Under these conditions they have taken into account the sectors related to a) Energy (Activities of incineration and escape emissions of fuels). b) Industrial processes. c) Use of solvents and other products. d) Agriculture. e) Changes of land use and forests. f) Treatment and elimination of residues. g) Others.

Given that energy activities constitute one of the main sources of emissions of greenhouse gases, these emissions were quantified for Vigo: carbon dioxide, methane and nitrogen oxides derived from electricity consumption with its correspondent correction factors, which deliver at first calculation, a quantity of 700,000 tonnes of CO2 equivalent (below the European average but above the national one). Emissions derived from incineration were also quantified with regard to the manufacturing industry as well as the construction industry. The figure was considerably lower than the European average and did not exceed 135,000 tonnes, in comparison to those emissions derived

from transport (air, road, railway and maritime) which amounted to almost 600,000 tonnes, slightly below the European and Spanish average.

The commercial, institutional and residential sectors contribute 150,000 tonnes, a figure close to the national average, while the figure from the fishing sector amounts to some 300,000 tonnes, an enormous quantity and considerably greater than the majority of the countries of the European Union.

Lastly, the contribution of the industrial, agriculture and cattle breeding sector is very small, a little more than 3,000 tonnes, 100 times less than the European average, while the figure from the treatment and elimination of residues, amounting to 85,000 tonnes is extremely high because of the incineration of natural products.

By means of compensation, the net absorption of carbon dioxide in the forest biomass resulting from the changes in the use of the land and forests is estimated at 23,000 tonnes, a quantity that helps to reduce, in a small way, the emissions of the gases that cause the greenhouse effect.

In conclusion, we can affirm that the net emissions are close to 1,900,000 tonnes of CO2 equivalent, which represents an average of 6.5 tonnes per head of population.

The reduction of these emissions has to be accomplished through coordinated actions of the autonomous and municipal administrations. The biggest efforts need to be realized in the sectors of electricity, transport and management of residues.

By means of an example we calculate that an increase of 12% in the use of public transport and a 20% increase in the occupation of private transport (carpooling) would result In a 7% reduction in the emission of gases, representing a considerable benefit to the environment.

Introduction

We define climate change as the phenomenon that changes the composition of the atmosphere at world level, added to the natural variability of the climate in itself, and that is observed over comparable time periods.

In the course of the 4,600 million years of the history of the earth, there have been very wide climatological fluctuations, provoking periods of prolonged drought or glacial eras that have modified the climate during certain stages, as well as the habitat of human beings.

As we have been able to conclude, climatological changes on our planet have been produced cyclically, although, apparently, not with the speed and intensity of these last decades. And it could be the actions of human beings that contribute a large part to this process of climatological change, with changes in temperature, precipitations and in the cloudiness of our planet.

The greenhouse effect

It is called the greenhouse effect because it describes the retaining of a part of the infrared radiation emitted by the earth's surface, preventing the heat of the sun received by the earth leaving the atmosphere and returning to exterior space.

This effect is produced by the accumulation of the non-diatomic gases present in the atmosphere, in a natural way, or by anthropogenic activities. Mainly they are steam (H_2O), carbon dioxide (CO_2), nitrogen oxide (N_2O) and methane (CH_4).

It is a phenomenon that is necessary for the survival on earth as, otherwise, too low temperatures would be produced. Nevertheless, the high concentrations of gases responsible for the "greenhouse effect" that nowadays are being produced by human activities, cause too much retention of radiation and so create an unbalanced increase in temperature that is called global warming.

The following table shows the main gases that contribute to the "greenhouse effect":

Gas	Source of emission	Lifetime (years)	Contribution to the warming (%)
Carbon Dioxide (CO_2)	Fossil fuels deforestation, destruction of soil	500	54
Methane (CH_4).	Cattle, biomass, rice fields, gasoline leaks, mining industry	7-10	12
Nitrogen Oxide (N_2O)	Fossil fuels, cultivations, deforestation	140-190	6
Clorofluorocarbonos (CFC 11, 12)	Cooling, air-conditioning, aerosols, foam plastics	65-110	21
Ozone and others	Photochemicals, cars, etc...	Hours-day	8

Other phenomena: the global darkening

Besides global warming another phenomenon has been discovered that until now was unknown: global darkening. It is a term that describes the decrease of the quantity of light that reaches the surface of the earth.

Although, just as with the greenhouse effect, the cause is atmospheric contamination, the consequences are totally the opposite: this process results in a cooling down of the surface of the earth by reducing the quantity of radiation from the sun.

Because they have not been paying attention to these data, researchers have underestimated the consequences of the greenhouse effect. Far from diminishing global warming, this new phenomenon only intensifies the greenhouse effect, as the decrease of temperature has a fundamental impact on the water cycles, by reducing evaporation and, thus, also precipitations.

Geographic consequences

Climate change is producing modifications in the world's geography. The droughts or floods that for a few years are ravaging certain areas or the rising of the sea level pro-

duce alterations in the surface and the water supply, affecting to a large extent the ecosystems.

Therefore we have to make the population conscious of the value of water and we have to search for non-aggressive solutions for the environment.

Socio-economic repercussions

The climatological change has repercussions to a large extent on the economies of individual countries, because of the measures that have to be taken under the new climatological system and the necessary strategies to slow down this change.

It is useful to remember that the industrialized countries produce 75% of the emissions, of which 94% have their origin in energy processes. This fact entails some considerations like:

a) The access to energy fundamentally favors the imbalance between the inhabitants of the developed countries and the third world. The first rely on a high energy consumption per person, while the second are limited to the subsistence minimum.

b) Location of energy sources converts some countries into suppliers and others into buyers and therefore depending on the countries that supply.

c) The geographic location of the fuels causes a large number of conflicts. The stability and peace of some countries with energy sources are broken and deteriorated, each time on more occasions.

In the case of Spain the allowed quantity of emissions for the period 2008-2012 has already been exceeded. Not modifying the growth rate of emissions supposes a cost that in 2010 will reach 1,500 million euros, 0.2% of the PIB or an increase of the public budget by 1.1%. Therefore, an increase in the demand for energy is predicted, which will have to be fulfilled without the help of hydroelectric energy, as this is diminishing through the decrease in precipitations.

Emission sources and reduction strategies

One of the most contaminating elements is the motorcar. This means of transport produces elevated quantities of CO_2 which necessarily have to be reduced. While we are

waiting for the improvement, and the introduction to the market at an affordable price of non-contaminating vehicles, such as the innovative electric cars or cars functioning on hydrogen, it is necessary to reduce the emissions generated now. An efficient measure would be the stimulating of public transport instead of private cars.

The use of ethanol and bio combustibles, instead of conventional petrol would also contribute to a reduction of the greenhouse gasses. The most important difference from fossil fuels is that they do not increase the net emissions of CO_2 as they have already been absorbed by plants. Moreover, it reduces the smog effect, that is to say, the incorporation of steam in the fog and the polyaromatic hydrocarbon levels by 75%.

Agriculture is the second source of emissions after the energy sector. The rice fields are big producers of methane (CH_4), that is why measures to reduce those emanation levels are being adopted.

The strategies related to the supply of energy include numerous fields. It is very important to obtain a total efficiency in the conservation and transformation of energy, preventing losses of this energy during industrial processes. Therefore, a modernization and renovation is necessary, as well in the design as in the industrial systems used. Ecological constructions, sustainable development and the sources of renewable energy, with an impact 37 times inferior to conventional energies, are fundamental to invert the global warming and to maintain an optimal relation with the ecosystem.

In Spain, the emissions for the CO_2 sectors are the following:

Energy processes: 32%; transport: 32%; industry: 19%; others: 10%; carbon: 7%.

We do have to take into account that the thermic power stations deliver the major part of the energy.

The solution is based on a bigger consumption of renewable energies, although as we can see in the following this consumption is reduced:

Origin of Spanish electricity: carbon: 30.77%; nuclear: 26.22%; hydraulic: 16.33%; natural gas: 7.92%; renewable energies: 7.69%; cogeneration: 7.15%; fuel-oil: 1.80%; residues: 1.58%; international exchange: 0.54%

Actions taken against climate change

1. Main international events in the battle against climate change

Summary of the actions, at world level, with reference to global climate evolution over time:

1972: United Nations Conference on the Human Environment (CNUMAH) in Stockholm.

1979: First world conference on the climate where the gravity of the problem is recognized.

1983: World Commission on the Environment and Development (Brundtland Commission)
- Underlines the necessity to start negotiations for a world pact on the climate.
- Investigates the origin and the effects of climate change.
- Scientific surveillance of the climate.
- Establishes international policies to reduce the emissions of gases with greenhouse effect on the atmosphere

1988: Establishment of the intergovernmental group for climate change (IPCC) for the programme of the United Nations for the environment (PNUMA) and the World Meteorological Organisation (OMM).
- Resolution 43/53: "Protection of the global climate for the present and future generations of humanity"

1990: First report of the IPCC on the evaluation of the science, the impact and the political responses to climate change
- This document is the basis on which to negotiate the Convention on the Climate

1992: Adoption of the Marco Convention on Climate Change (UNFCC) at the seat of UNO
- The world leaders agree on resolving to reduce the emissions of CO_2 to the 1990 level by 2000.

1994: The Marco Convention on Climate Change comes into force
- Main objective: Preventing a dangerous anthropogenic interference in the climate system, which threatens nature, the guarantee of food and economic development

1995: Second report of the Evaluation of the IPCC
- The Conference of the Parties (COP) replaces the INC as the sovereign organ of the Convention.

1995: COP-1, Berlin
- The governments come together and launch the Mandate of Berlin, preparing future commitments to the Convention.

1996: COP-2, Geneva.

1997: COP-3, Kyoto
- Governments adopt the text of the Protocol.
- Industrialized countries promise to reduce their emissions of greenhouse gases by at least 5% on the indices of 1990, from 2008 to 2012.

1998: COP-4, Buenos Aires
- Action Plan of Buenos Aires, with a time schedule for the implementation of the Kyoto Protocol, agreeing a term of two years for its implementation.

1999: COP-5, Bonn

- Governments continue negotiating aspects of the Agenda of Buenos Aires and the European Union announces its political objective to confirm the Kyoto Protocol in 2002.

2000: COP-6, The Hague

- Governments fail to reach an agreement on the principal themes of the Agenda of Buenos Aires. The COP does not stop the negotiations but postpones them to 2001.

2001: COP-6-5, Bonn

- The Conference of the Parties with the abbreviation COP-6-5 is convened again.
- The Kyoto Protocol is getting closer to ratification, with some modifications to the original text.

2001: COP-7, Marrakech

- Third report of the IPCC
- Identification of human contribution to world climate change.
- Attribution: "The major part of the warming up observed in the last 50 years", is caused by human activity which increases the pollution of global warming in the atmosphere.

2002: COP-8, New Delhi

- The European Union and Japan ratify the Kyoto Protocol. Two months later it is also ratified by Brazil.

2003: COP-9, Milan

- They make progress in tasks previous to the coming into force of the Protocol.

2004: COP-10, Buenos Aires

- They wait for the decision of Russia on the ratification of the Kyoto Protocol.

2008-2012: "First commitment period" of the Kyoto Protocol, in which the combined emissions of the industrialized nations have to be reduced by 5% below the levels of 1990.

2. The IPCC

The IPCC is an Intergovernmental Group of Experts investigating Climate Change. It is a specialized agency of the United Nations, created in 1998 by the World Meteorological organization (OMM) and the Programme of the United Nations for the Environment (PNUMA) which has its seat in Geneva.

Its main objective is to carry out periodic evaluations of air conditions and to help, with a scientific and technical approach, the Organs of the Marco Convention of the United Nations on the Climate Change. Its fundamental function is to try to understand the causes and effects of climate change in order to develop adequate responses

Three working parties in the IPCC are dedicated to three different aspects of climate change, especially those aspects considered to be of interest for governments.

- Estimation of the scientific aspects of the climate system and its processes, as well for natural climate change as for that induced by human activity.

- Analysis of the vulnerability of the natural and socio-economic systems to climate change and the possible strategies to adapt to the expected changes.

- Evaluation of the scientific, technological, environmental, economic and social aspects of mitigations climate change

From its creation, approximately every 5 years, the IPCC prepared a series of technical documents, special evaluation reports that have been put at the disposal of the international community, the political and scientific authorities and the public in general.

3. The Marco convention on climate change

1990: Resolution 45/212 of the United Nations creates an intergovernmental negotiation committee with the mandate to develop a Marco Convention on Climate Change.

1992: The adoption of the Marco Convention on Climate Change in New York.

I. Objective

"To attain the stabilization of the gas concentrations with greenhouse effect in the

atmosphere to a level that prevents dangerous anthropogenic interferences in the climate system. This level should be reached in a term sufficient to allow the ecosystems to adapt themselves naturally to climate change, assuring that food production is not threatened and allowing economic development to continue in a sustainable way".

II. Principles

- The protection of the climate system for the benefit of present and future generations.

- Collective but differentiated responsibilities of the Parties. The developed countries have to take the initiative.

- The precaution principle must not be used to postpone the measures against climate change when there is a threat of serious damage.

- The right of Parties to sustainable development.

- The cooperation to promote an international economic system that is open and suitable to the economic growth and sustainable development of all the Parties.

III. Commitments of Parties

The most important commitments are the following:

- The elaboration and periodic publication of international inventories of anthropogenic emissions of all gases with greenhouse effect that are not controlled by the Montreal Protocol.

- The elaboration and application of national programmes of measures for the alleviation of the climate.

- Communication to the Conference of the Parties of information concerning the application of the convention.

4. Kyoto Protocol

1997: First world commitment to slow down Climate Change in the COP-3, Kyoto, which gathered together representatives of 125 countries.

The Kyoto Protocol obliges the countries that ratify this protocol to reduce the emissions of the six gases that cause the greenhouse effect.

These six gases are the following:

- Carbon dioxide (CO_2)
- Nitrogen Oxide(N_2O)
- Methane (CH_4)
- Hydrofluorcarbonates (HFCs)
- Perfluorocarbonos (PFCs)
- Hexafluoruro of sulphur (SF_6)

The reference year is 1990, although for the fluor gases (HFCs, PFCs y SF_6) it is allowed to use 1995 as the base year.

Directly after the signing of the Protocol, a path was opened plagued with obstacles, that still continues. It will be during the period 2008-2012 when the countries concerned have to present the definitive results of their environmental policies. The global commitment is a 5, 2% reduction compared to the measured levels in1990, although in every country the quota varies depending on the contamination level in the past.

4.1 Flexibility mechanisms

The Kyoto Protocol establishes a commitment to a reduction of the emissions of the developed countries and formulates a series of mechanisms to facilitate the fulfilment of such commitments .

These mechanisms aim at a double objective: to facilitate for the developing countries and the economies in transition the fulfilment of their commitments for reduction of emissions, and to support a sustainable growth in the developing countries through transference of clean technologies. By this they contribute to reach the ultimate goal of the Convention of the Climate Change: the stabilization of the emissions of greenhouse effect gases.

The Kyoto Protocol introduced three “Flexibility mechanisms”.

I. The Mechanism of Clean Development

The mechanism of clean development consists of realizing projects in developing countries that produce a diminution of emissions additional to the one that should have

been produced on the supposition that conventional technology had been used, or not having stimulated the absorption-capacity of the forests. The diminution of emissions, obtained in that way, can be commercialized and acquired by public or private authorities in the industrialized countries or by economies in transition to fulfil the commitments of reduction.

II. Collective Application

The "Collective Application" is a programme of the Kyoto Protocol that allows the industrialized countries from 2008 on to fulfil a part of their obligations of reducing their emissions, by paying for projects that will reduce the emissions in other industrialized countries.

The sponsoring governments will get credits which they could apply to their emission objectives; the receiving nations will obtain foreign investment and advanced technology but no credits.

To proceed with the projects of collective application, nevertheless, the industrialized countries have to fulfil the requirements of the Protocol, with respect to the presentation of the exact inventories of the emission of gases and registers of the "units" and "credits" of emission.

III. Emissions Trade

Each of the industrialized countries will have emission objectives that have to be fulfilled, but it is very likely that there will be some countries that will do better than expected, and will be situated under their commited limits, while others can not fulfil their obligatory emission objectives.

The Protocol will allow the countries that have a surplus of emission units to sell this excess of capacity to the countries that otherwise do not reach the obligatory goal of reducing gas emissions.

The system also contemplates an additional mechanism called sink Interests:

IV. Activities CO_2 sink

It allows the acquisition of emission credits by eliminating additional CO_2 called "Units of exChange" (RMU), through activities related to the use of the land and forestry.

4.2 The coming into force of the Protocol

There are two preceding conditions for a real start of the Kyoto Protocol. First, the Protocol has to be ratified by least 55 countries and second, these countries have to assume 55% of the emissions of harmful gases in the world with the year 1990 as a reference.

Nevertheless, the road to the execution of the Kyoto Protocol has been marked mainly by the differences between the block of the United States, Japan, New Zealand, Australia and Canada, and the block formed by the European Union and the less developed countries that have been the first to ratify the commitments agreed in 1997.

The evolution of the process has been the following:

2002: The European Union ratifies the Protocol after its approval by the national parliaments. It is a big step forward to attain the coming into force of the Protocol as there are 69 countries involved (the first condition already obtained) and the European Union is the second biggest producer of CO_2 in the world. So already 26,6% of the total quantity necessary to start the Protocol has been accumulated.

The countries of the European Union accepted an 8% reduction for 2008-2012. Nevertheless in 1998, those 15 countries, all with different levels of development and different needs of energy consumption, reached an agreement to divide the assigned collective load in such a way that the majority has to reduce by more than 8% to allow 4 countries, Spain, Greece, Portugal and Ireland to reach lower objectives.

2002: The fourth biggest producer of CO_2 on the planet, Japan, joins the Protocol definitively. With this new incorporation, the quantity of greenhouse gases of the acceding countries is 35.8%.

2004: Canada (3, 3%) ratifies the Protocol after intense lobbying by the European Union.

2005: The coming into force of the Kyoto Protocol thanks to the accession of Russia. With the acceding of Moscow, which produces 17,4% of the harmful gases, the minimum necessary to start the Protocol is reached. Today, 141 nations producing together 61% of the gases in the world have ratified the Protocol of Kyoto, although the United States, guilty of an emission of 25%, still does not ratify the Protocol.

2008-2012: A period in which 30 developing countries are obliged to reduce by 5,2% their emissions of gases that cause the greenhouse effect, compared to 1990. Besides, 106 developing nations will be obliged to inform about their pollution levels and they have to report how they think they can diminish them.

4.3. The Spanish situation in relation to the Kyoto Protocol

Spain ratified the Kyoto Protocol in March 2002. It is the European country that has most increased its emission percentages. This situation is worrying, as Spain will be the country furthest from fulfilling its Kyoto commitments. This bad Spanish situation is in contrast with the expectations that the European Union offers as a whole. The majority of the emissions in Spain come from the energy sector, and therefore, the objective of Kyoto seems beyond the possibilities of the country.

5. European initiatives related on climate change

5.1 The European Programme in reaction to climate change

In Europe the struggle against climate change is a fundamental priority in the strategy of a sustainable development and it confirms the determination to fulfil the commitments of the Kyoto Protocol.

Already accepted and completed measures by the European Commission

- Directive on the trade in emissions.

- Communication and directive for the promotion of bio-fuels.

- Proposal of a Directive to promote the combined generation of heat and electricity (cogeneration).

- Communication on the taxes on vehicles.

Additional measures that are being analysed:

- Flexible mechanisms**:** the incorporation of the mechanism of Clean Development and the Collective Application in the European Union (ECC).

- Farmland**:** improvement of agricultural practice to reduce emissions.

- Sinks: analysis of the potential of the European forests to capture carbon.

5.2 European Agency on the Environment

The objective of the European Agency on the Environment is to provide the European Community and its Member States with:

- Objective, reliable information comparable on a European scale, which permits the taking of the necessary measures to protect the environment, to evaluate its application and to guarantee good information on the situation of the environment.

- Technical and scientific assistance.

5.3. Other initiatives

Green book on renewable energies: Its objective is to achieve that renewable energies increase from 6 to 12% of the total consumption before 2010.

Action Plan to improve the energy efficiency of the EU: It wants to reduce the energy consumption by 100 million tons of oil equivalents.

The white book of the commission on the European policies on transport: It proposes a series of measures to promote the use of more ecological means of transport.

The Marco Programme on R+D: It stimulates the investigation of new technologies related to climate change.

European strategy for the sustainable Development (EDS): It wants to encourage and coordinate economic and social policies to reach a sustainable development.

6th action programme on environmental matters (6 · PMA): to plan objectives and environmental priorities in the short term as an integrated part of the strategy of the European Community for a sustainable development.

6. Specific initiatives by Spain related to climate change

6.1 National Climate Commission

1992: Creation of the National Climate Commission added to the Ministry of Public Works, Transport and Environment.

- To collaborate on the elaboration of the National Climate Programme and to advise the government on policy with regard to climate change and response strategies.

In the fight against climate change it is believed to be necessary that the autonous communities, the Spanish Federation of Municipalities and Provinces, the representatives of the research sector, the social agencies and the non-governmental organizations cooperate with the several departments concerned with the General Administration of the State.

The following functions in the struggle against climate change are entrusted to the National Climate Commission:

- The elaboration of the Spanish Strategy to fight climate change.

- The realization of the follow-up and evaluation of the Spanish Strategy.

- The elaboration of proposals and recommendations to define policy and measures dealing with climate change in the scientific fields of climate change, impacts and adaptation strategies and strategies to limit greenhouse gas emissions.

6.2 Spanish Office on climate change

2001: Creation of the Spanish Office on climate change as a dynamic instrument to find answers to this phenomenon.

Its functions are:

- To carry out the follow-up of the CMCC and to stimulate the policy and measures for its correct application in Spain.

- To act as a focal point of the Ministry of Environment.

- To assume the institutional representation in the matter of climate change within the international forums.

- To advise the different organs of the public administration.

- To colaborate with the autonomous Communities on the analysis and on the repercussions climate change could bring about.

- To make contact with the different administrations, NGO's public and private institutions and authorities and social agencies.

- To realize technical and executive functions of the Secretariat of the National Board on the Climate.

6.3. Other initiatives at a national level to reduce greenhouse gas emissions (GEI):

Strategy of energy saving and efficiency in Spain (2004-2012) in order

to reduce the consumption of energy through three fundamental measures:

- To guarantee the energy supply.

- To improve competition with an efficient consumption of supplies.

- To stimulate the protection of the environment.

Plan "Strategy of energy saving and efficiency": its main objective is to decrease energy consumption. It affects the sectors that consume a lot but encourages those companies that apply energy saving measures through grants and fiscal exemptions.

Approval of the "law of prevention and integrated control of contamination", that obliges companies to declare the quantity of polluting gases they generate. This law aims at the prevention and reduction of contaminating elements in the environment. Companies need an integrated environmental authorization, and those who consume resources in a way that is optimal for the environment will be rewarded.

6.4 Actions of the government of Galicia (xunta)

On an autonomous level it is the Centre of Sustainable Development (CEDES) of the Department of the Environment that is in charge for all questions related to climate change.

The efforts of the government of Galicia in the fight against climate change are reflected in the following actions:

- In the document "Actions of the government of Galicia with regard to the phenomenon of Climate Change", the Galician government explains its initiatives to combat this global phenomenon.

- The Publication "Draft for the elaboration of the Galician Strategy against Climate Change" is the orientating document of the actions Galicia has to undertake to face this phenomenon.

- Publication of the "Inventory of Greenhouse Gases in Galicia".

7. Calculation of emissions – General Approach

In February 2000 the third Conference of Cities and Villages towards sustainability was celebrated in Hanover (Germany), in which a balance was drawn up on the Campaign of Sustainable Cities during the previous years. The initiative of a follow-up "Towards a profile of local sustainability; common European indicators" was completed in December 1999 and was launched officially and accepted voluntarily by the European local authorities present at this conference.

In this connection and as a result of the initiative "Towards a profile of local sustainability; common European indications" appears with indicator A-2: "Local Contribution to Global Climate Change" attempting to quantify the emissions of greenhouse gases in every city.

This indicator fulfils these principles:

Social equality and inclusion:

Access to all basic necessary services at affordable prices, for example, education, employment, energy, health, housing, schools and transport.

Local/global relation:

Satisfaction of local needs at a local level, from production to consumption and elimination, plus satisfaction of the needs that can not be satisfied locally in a more sustainable way.

Local economics:

Adaptation of the capacities and local necessities to the availability of jobs and other facilities, in a way that least damages natural resources and the environment.

Protection of the environment:

Adoption of an ecosystematic approach; reduction to the minimum of the use of natural resources and land, of the production of waste materials and of contaminating emissions and so stimulating biodiversity.

The A-2 indicator attempts to measure CO_2 equivalents: it refers mainly to the anthropogenic emissions of carbon dioxide, Nitrogen Oxide and methane. It measures those emissions in a area controlled by the **local administration.**

The local activities whose emissions have to be measured will include those that entail the use of fossil fuels (coal, petroleum, natural gas) for energy (transport included) and the local management of waste materials.

The emissions of CO_2 - attributable to the energy sector are the main cause of the greenhouse effect. So, the energy sector, together with the control of waste materials, represents the main field of action for the local administration.

Human activities contribute remarkably to climate change; the following are of major importance:

- **Consumption and use of fossil fuels**

Different sectors whose activities contribute to the production of emissions:

- Industry, through industrial uses (from the production of electricity to the production of steam for example)

- The housing and commercial sectors (heating, air-conditioning, electrical appliances)

- Transport (cars, motorcycles, trucks)

- **Production and emission of CFC gases**

The activities that produce these gases are:

- The fabrication of rigid foam, plates and flexible mouldings.

- Refrigeration systems.

- The cleaning of electronic equipment, for example.

- **The burning of biomass**

These emissions are produced through:

- Deforestation (forest fires, transformation of the forest into arable land or pasture).

- The burning of biomass as household energy for heating, cooking etc.

- **Agrarian Practices**

- The extension of rice fields.

- The increase in the number of livestock (especially ruminants).

- **Other activities**

Most important in this group are the emissions of methane originating from rubbish dumps.

If we calculate the contributions per inhabitant, Asturias is in first position with some 30 tons of CO_2 eq. while Galicia, taking an average position within the 17 autonomous communities, contributes 14 tons of CO_2 eq.

Methodology

In this study the intention is to follow the existing international, national and regional standards, as far as the availability of information allows.

In this set up use was made of:

- The "Reference Manual of the Intergovernmental Panel on Climate Change, IPCC".

- The "Inventory of greenhouse gas emissions in Spain in the period 1990-2003" (Undertaken by the General Secretary for the Prevention of Contamination and Climate Change, of the Ministry of the Environment).

- The "Inventory of greenhouse gas emissions in Galicia"

(Carried out by the Board of Environment of the Government of Galicia.)

Normally, to analyse the traditional contaminants that affect atmospheric quality, an inventory of the activities that produce the emissions in the area is made, and they quantify the associated generated emissions in that area.

Nevertheless, from a perspective of local sustainability it is more correct to calculate the associated emissions, keeping in mind not only the emissions that are actually generated in the area, but also those being generated outside that area but still being a responsibility of the municipality. "The principle of responsibility substitutes the geographic principle".

Reference also has to be made to the availability of data. On numerous occasions the data are not available on a local scale, but they are on a regional or national scale. In this case a derived approach could be useful, starting at a wider territorial level applying substitution variables (number of inhabitants, companies depending on the studied sector).

Finally, we point out that although the A-2 indicator is mainly aimed at the determination of the CO_2 and CH_4 emissions derived from the energy and waste sectors respectively, it is thought to be more accurate to treat the CO_2, N_2O and CH_4 emissions in all the proposed activities by the IPCC for which existing data are available. So the calculation procedure is not complicated and more realistic results are obtained.

The calculation of emissions in the international field is based on a methodology elaborated by the IPCC and is adopted by different industrialized countries to work out their inventories of greenhouse gases.

DISTRUBUTION BY SECTOR

1. Energy

- A. Combustion Activities
  - 1. Industries of the energy sector
  - 2. Manufacturing and construction industries
  - 3. Transport
  - 4. Other sectors
  - 5. Others
- B. Gas escapes from fuel
  - 1. Solid fuel
  - 2. Petroleum and natural gas

2. Industrial Processes

- A. Mineral products
- B. Chemical industry
- C. Metal production
- D. Other industries
- E. Production of halocarbons and SF_6
- F. Consumption of halocarbons and SF_6
- G. Others

3. Use of solvents and other products

4. Agriculture

- A. Intestinal fermentation
- B. Control of manure
- C. Cultivation of rice
- D. Farming lands
- E. Planned burning of savannah
- F. Burning farm residues in the countryside
- G. Others

5. Change of the use of land and forestry

- A. Changes in the stocks of forest and other wood biomasses
- B. Reconversion of forests and prairies

C. Abandonment of farm land
D. Emissions/ attractions of CO_2 in the soil
E. Others

6. Treatment and elimination of waste products

A. Deposit in rubbish dumps
B. Treatment of waste waters
C. Incineration of rubbishD. Others

7. Others

This project intends to determine the anthropogenic emissions of greenhouse gases (especially directed at CO_2, CH_4 and N_2O) of the municipality of Vigo, creating, in this sense, a frame of reference that permits to determine which are the most important sectors causing this problem and to guide, in this way, the direction of actions.

The quantitative determination of the emission of the municipality could be used as a reference in the future to study the evolution in the different sectors over time. In this way the repercussion of the different action measures to reduce the emission of greenhouse gases could be evaluated.

Therefore, the main aim of the A-2 indicator is to show the level of the emission of greenhouse gases of a specified city and its tendency to finally be able to reduce the emissions to an adequate level that could establish a balance in the environment.

Inventory of greenhouse gas emissions in the municipality of Vigo

The calculation of the emissions in the municipality of Vigo will follow, as far as possible, the proposed structure for the IP which has been adopted at international level.

DISTRIBUTION PER SECTOR

1. Energy

- 1.1. Industries of the energy sector
- 1.2. Manufacturing and construction industries
- 1.3. Transport
- 1.4. Other sectors

2. Industrial processes

3. Use of solvents and other products

4. Agriculture

- 4.1. Domestic livestock

4.2. Burning agricultural residues in the open field
4.3. Farmlands

5. Change in the use of land and forestry

6. Treatment and elimination of waste products
6.1. Treatment of waste waters
6.2. Incineration of waste

We also have to take into account that not all gases contribute in the same way to the greenhouse effect. Therefore, the international authorities have worked out a table of equivalents in which the warming potential of every gas is compared with the CO_2 equivalent.

Warming up potential of the different GG (Greenhouse gases)

Gas	
CO_2	1
CH_4	21
N_2O	310

1. Energy

1.1. Emissions in the industries of the energy sector

In this sector we can include all those industries that emit greenhouse gases proceeding from the burning of fossil fuels in activities of extraction of this fuel or energy production industries.

In the municipality of Vigo there are no industries of this type, but the principle of responsibility obliges it to consider the emissions derived from the use of energy due to activities in the selected area, whether generated within the considered area or outside. Therefore, the emissions consequent on electricity generation can be considered as the responsibility of the municipality of Vigo.

In the following table the electric energy delivered by FENOSA to the municipality of Vigo is described in detail (average global values in 2003-2004).

SECTORS	CONSUMPTION (KWH 10^3)
Agriculture, cattle breeding, forestry, hunting and fishing	730
Extraction of oil	78
Nuclear fuels and other energies	5
Production and distribution of electricity	1000
Gas works - gas distribution	74
Mines and quarries (Not energy related)	0.2
Ironworks and foundry	681
Non-ferrous metallurgy	765
Glass industry	140
Cement, lime and plaster	24
Other construction materials (tiles, fireproof materials, etc.)	12,750
Chemistry and petrochemistry	1,300
Machinery and transformers	20,050
Ship construction and repairing	18,200
Construction of cars and bicycles	229,000
Construction of other means of transport	710,000
Food, drinks and tobacco	41,000
Textile industry, clothing, leather and shoes	1,650
Wood and cork industry (except furniture works)	2,500
Cellulose, paper and cardboard	240
Graphic arts and publishing	4,250
Plastic industry, rubber and others not specified	10,080
Construction and public works	12,050
Railway transport	1,223
Other transport companies	2,045
Hotel business	54,635
Trade and services	269,600
Administration and other public services	110,890
Street-lighting	25,490
Domestic electrical appliances	378,200
Not specified	3,903
No record	5,628
TOTAL	**1,918,181.2**

It is also necessary to add to electricity consumption the losses derived from its transport and distribution. These losses, of about 4.2 % (INEGA – consumption in Galicia) entail that for 1,918,181 · 10^3 kwh to arrive in Vigo, 1,998,744 · 10^3 kwh must be made available.

Once we know the data of electricity consumption, it is necessary to know the proportion-of energy from every type of power station.

The 3 types of power station that contribute most to the distribution of electricity in the municipality of Vigo are Thermo electrical energy from coal, Hidro energy and wind energy, with respectively 45.00%, 26.0% and 11.45%.

Through the data of combustion energy it is possible to calculate the emissions of CO_2 equivalents, applying the emission factors provided by the IPCC or by the EMEP/CORINAR Guide. Thus we obtain the following data:

Type of power station: Thermo electrical from coal (lignite), thermo electrical oil products and cogeneration with fuel oil, cogeneration with Diesel oil, cogeneration with GLP and cogeneration with natural gas.

- Emissions of CO_2 derived from electricity consumption: $693 \cdot 10^3$ Tn
- Emissions of CH_4 derived from electricity consumption: $6.3 \cdot 10^3$Tn
- Emissions of N_2O derived from electricity consumption: $7.5 \cdot 10^3$Tn

As not all gases contribute in the same way to the greenhouse effect, it is necessary to apply correction factors, obtaining:

- Emissions of CO_2 equivalents derived from electricity consumption: 706.8 10^3 Tn

To compare the emissions of Vigo with those found in Spain as a whole, as well as with the average of the 15 countries of the E.U., the next illustrative table serves:

Place	**Tn CO_2 equivalent/inhabitant**
Vigo	2.36
Spain	2.15
UE-15	3.17

1.2. Emissions derived from combustion in manufacturing and construction industries

To calculate the total amount of emissions, the emission factors obtained by the IPCC, CORINAIR or of EPA-FIRE will be applied. **In the period of estimated reference, the emissions reached a value of $132.8 \cdot 10^3$ Tn of CO_2 equivalent.**, coming from the consumption of combustibles: Diesel oil C, Fuel oil, Natural gas and GLP.

Following the same methodology, the emissions of Vigo compared with those emitted in Spain and in the E.U. are described in the following table:

Place	**Tn CO_2 equivalent/inhabitant**
Vigo	0.44
Spain	1.59
EU-15	1.54

1.3. Emissions in transport

These are the emissions produced in all transport activities including civil aviation, road transport, rail transport, navigation and others.

I. Air transport

We can classify the aviation emissions in two groups referring to their respective operations: the landing-taking-off cycle and the cruising speed cycle. The landing-taking off cycle (LTO) includes all the activities near the airport at a height below 1,000 m. Therefore the activities of rising and descending are included. On the other hand, the cruising speed cycle includes all activities that take place above 1,000 m.

The traffic at the airport of Peinador is practically totally related to the municipality of Vigo; therefore, referring to the principle of responsibility, we can consider the emissions of the airport as belonging to Vigo.

In our case, we assign the emissions derived from the cycles LTO (kg /cycle LTO) to Vigo, using emission factors of the EMEP / CORINAIR guide and the proportionate number of cycles for AENA in the airport of Peinador during the reference period.

- **The emissions derived from aviation activity in the municipality of Vigo contribute $17.9 \cdot 10^3$ Tn CO_2 equivalent.**

II. Road transport

In this sector it is very difficult to calculate the emissions of every vehicle, given the high number of variables, like the characteristics of each vehicle and the style of driving of the user.

To calculate the emissions, it was preferred to use the sources of the AUTOIL II Programme as opposed to those of the IPCC, as the first uses more exact data, because they consider a higher number of categories, and moreover they refer to Spain, while the IPCC covers Europe in general.

The sources of data of the AUTOIL II programme proportion the emission factors and the average of kilometres driven, classifying the vehicles in specific categories: gasoline passenger car, diesel passenger car, light truck(< 3 t), heavy truck (>3 t), buses and motorcycles.

According to the IEG (Galician Statistical Institute), using information provided by the DGT, the vehicle park in Vigo is distributed in the following way: gasoline passenger cars (71,504), diesel passenger cars (71,104), light trucks (< 3 t) (15,938), heavy trucks (>3 t) (1,744), buses (245) and motorcycles (10,136).

To make an accurate approximation it is necessary to make a distinction between petrol passenger cars and diesel ones. For the municipality of Vigo we use the proportion of the province of Pontevedra, where the distribution is very close to 50 % (50.14 % in favour of petrol cars) with 71,104 diesel cars and 71,504 gasoline cars.

In the case of trucks, vehicles of less than 3 Tn constitute 90.14 % of the total number, up to 15,938, while those with a weight superior to 3 Tn represent 1,744 vehicles.

With the characteristics of the vehicle park in Vigo and using the data of the AUTOIL II Programme for the emission factors and kilometres driven by every vehicle, we can obtain the emissions from road transport:

- Emission of the equivalents derived from road transport: $550.7 \cdot 10^3$ Tn

III. Railway transport

The emissions of railway transport are a consequence of the use of engine fuel. In the municipality of Vigo there is only one railway company, RENFE (National Network of Spanish Railways).

To make the calculation of emissions, it is necessary to have the at one's disposal data on the number of trains of every line as well as the amount of kilometres covered in every journey. This information as well as the consumption of fuel will be given by the railway company.

Supposing that to enter and leave the municipality of Vigo the trains have to cover a distance of approximately 7 km, the annual fuel consumption of the railway traffic can be extrapolated, taking into account the annual transportation of passengers to an amount of 7.574 and goods, 765.

Using the previous information, the total emissions of railway transport can be obtained using the emission factors that appear in the EMEP / CORINAIR Guide. This gives the following result:

Total consumption of diesel: 103,53 Tn

- Emissions of railway transport: 0.366 · 10^3 Tn CO_2 equivalent.

IV. Sea transport

In this part are included the emissions produced by vessels that emit contaminating gases.

We consider that the sea-transport includes the traffic of passenger and goods without taking into account the fishing sector that will be dealt with in a following section. This difference between them is logical, as the transport ships are big ships passing through while the activity of the fishing boats, although fishing in waters outside Vigo, is a consequence, exclusively of this city.

The information on harbour traffic was extracted from the "Annual Report of the Harbour of Vigo, 2004", published by the Harbour Authority of Vigo.

For the calculation of emissions the EMEP / CORINAIR Guide is being used, which presents the consumption values in register tons per hour according to the type of tonnage of the ships. Therefore, it is necessary to estimate the speed of the ship and the extent of the area of influence of the harbour of Vigo.

The traffic of the harbour of Vigo is distributed as a function of the BRT (gross registered tons) of every ship. The boats are ordered in 6 different categories, with their number indicated between brackets: a) < 2,000 (835), b) 2,001-5,000 (398), c) 500-10,000 (347), d)10,001-25,000 (508)., e) 25,001-50,000 (219), f) >50,000 (89).

The average distance was 11 miles at a speed of 17 knots.

The total fuel consumption was 1,821.50 Tn.

- The emissions of this sea traffic were 5.8 · 10^3 Tn of CO_2 equiv.

V. Summary of the transport sector

- Emissions of CO2 equiv. from air and road transport, railway and sea transport: 574.8 · 10^3Tn.

It has to be underlined that road transport contributes 96.6% of all emissions in this sector.

The following table shows the comparison with Spain and the E.U.:

Place	Ton CO_2 equivalent/inhabitant
Vigo	1.92
Spain	2.30
UE-15	2.29

1.4. Other sectors

I. Commercial Sector / institutional and residential

The main sources of greenhouse gases in this sector are heating equipment and kitchen firewood .

In this sector, the most consumed fuels are diesel C, the GLP (liquid oil gases), natural gas and the biomass. This last is not taken into account as the INEGA only considers a considerable consumption in rural centres of less than 2,000 inhabitants. The conditions are not met by the municipality of Vigo.

After obtaining the consumptions per type of fuel and sector for the province of Pontevedra it is necessary to relate them with those of Vigo. The interpolation is done starting from the fraction of inhabitants of the municipality in the whole province in case of domestic consumption (in the year 2004 Vigo had 31.73% of the provincial population), while in the case of services the proportion of service companies has been used as criterion (Vigo has 37.62 % of the provincial service companies). To combine both factors (because they both refer to the same energy consumption) a different weight was given to every contribution according to of its participation in the final consumption of energy (in 2004 in Galicia, 11% of the final energy consumption corresponds to the service sectors while 19% was the responsibility of the domestic sector).

Once the consumption data for every type of fuel are obtained, it is sufficient to apply the emission factors received from the IPCC, EMEP / CORINAIR or the EPA-FIRE to calculate the total emissions.

The emissions resulting from the residential/ institutional and domestic sectors derived from the burning of fossil combustibles reached the 155 · 10^3 Tn of CO2 eq.

In the same way as we calculated before, the results found for Vigo (Tn of CO_2 eq. / inhabitant) compared to Spain and the EU are recorded in the following table:

Place	Tn CO_2 equivalent/inhabitant
Vigo	0.52
Spain	0.62
EU-15	1.58

II. Activities in the agrarian and fishing sectors

To obtain the emissions of greenhouse gases in these sectors the consumption of fuel, is used that basically consists of diesel oil B.

The data of the consumption per sector were facilitated by the INEGA. The agrarian and fishing sector consumed 247.6 Ktep of diesel oil B in the province of Pontevedra. As no account was taken of municipal data, it is necessary to make an approximation for each of the sectors. The factors that will be used to estimate the consumption will be the cultivated area in the case of the agrarian sector and the percentage of fish unloaded in the provincial harbours for the fishing sector.

The cultivated areas in the province of Pontevedra and in the municipality of Vigo are 6,.523 and 393 Ha, respectively. From the cultivated areas of every territory approximate values of the consumption in this agrarian sector can be obtained, that practically correspond with 53,300 and 320 Tep, also respectively.

With those data of annual consumption and using the emission factors/ Kg of combustible (norms IPCC and EMEP / CORINAIR), **the emissions of greenhouse gases, represented per Tn of CO_2 eq. acquire the value of 0,99 · 10^3**

In connection to the data related to the consumption of the fishing sector, according to the information provided by the Ministry of Development 49.52 % of fresh and frozen fish of the Province of Pontevedra was unloaded in Vigo. Determining a relation

between fishing activity and its contribution to energy consumption, in this specific case the following values for the consumption of diesel oil B, are found: $194 \cdot 10^3$ y $96 \cdot 10^3$ Tep, respectively for the province of Pontevedra and the city of Vigo. Following the same method of the emission factors / Kg of fuel, we see that **this sector contributes $297 \cdot 10^3$ Tn of CO_2 eq.**

Therefore **the agrarian and fishing sector of Vigo contribute emissions of about $298 \cdot 10^3$ Tn of CO_2 eq.**

The comparison between Spain and the E.U. is indicated in the following table:

PlaceTn CO_2 equivalent/inhabitant: Vigo, **1.00** Spain, **0.24** EU-15, **0.17**

2. Industrial Processes

In the municipality of Vigo there are no industries that emit large quantities of emissions in their industrial processes (cement industries, metallurgical industries, chemical products...)

3. Solvents

This is the sector presenting the lowest quantity of emissions because of the consumption of this type of product.

In the municipality of Vigo no important source of emissions related to these products is observed.

4. Agriculture

In this paragraph we have to take into account the emissions proceeding from the five following sources:

- Domestic livestock: intestinal fermentation and use of manure
- Rice cultivation: irrigated rice fields
- Necessary burning of savannah land
- Burning agricultural waste in the open field
- Farmland

In the case of Galicia and specificaly in the case of Vigo, only three of the five sources can be considered, as in the municipality the cultivation of rice does not exist, nor the burning of grassy plains. So we concentrate our study on the emissions proceeding from livestock, farmland and the burning of agricultural residues.

4.1. Domestic livestock (Intestinal fermentation and use of manure)

In this paragraph we talk about the emissions of methane, and nitrogen oxide proceeding from two sources: intestinal fermentation and the use of manure. The quantity of liberated methane depends on the type, age and weight of the animal, as well as on the quantity and the quality of the food eaten.

After determining the number of livestock of each species, we apply some coefficients of gas emissions taken from the tables of the IPCC for Western Europe. In Vigo the methane emissions of the intestinal fermentation are 33 Tn/year, with the data obtained from the type of cattle and its number (data of the Galician Institution of Statistics)

The methane proceeding from the use of manure is produced by the decomposition of this matter in anaerobic conditions. To make an adapted approximation, the average monthly data are used. By virtue of those data, the region is classified in cold zones (less than 15 ºC), moderate zones (between 15 and 25 ºC) and warm ones (more than 25 ºC). On the other hand, the values of the climate institute of Vigo will be taken as a reference (data facilitated by the Ministry of Agriculture and Fishing that have been extracted from the Service of Cartography SIGA).

Once having obtained these data, the emission factors for each category of livestock are multiplied to get the total amount of emissions proceeding from the use of manure that acquires a value of 9.80 Tn/year of CH_4.

Different systems of the use of manure exist (SME), as we speak about the N_2O emissions that proceed from here and we have to pay attention to the classification, by the Ministry of Environment which sees Galicia as a western European zone (and not a Mediterranean one). We distinguish systems of liquid type, daily fertilization, solid stock and dry parcels, meadows, pastures and others.

To make the calculations of the emissions it is necessary to dispose of data on the number of livestock and on the distribution in terms of percentage of the use of the different manures (SME), which are provided by the IPCC for the distinct regions, in this case Western Europe.

The excreted nitrogen in the five applied systems of the SME is about 160 Tn/year. From this value on, the quantity of nitrogen oxide that is formed, taking into account the emission factor for each one of the five systems (Kg N_2O-N/Tn N), brings us to a value of 0.65 Tn N_2O.

So, the total contribution of the livestock sector to the emission of greenhouse gases, is reflected in the **amount of $1.1 \cdot 10^3$ Tn of CO_2 eq,** in which the intestinal fermentation contributes 64 %.

4.2. Burning of agricultural residues in the open field

There are no data available in the municipality of Vigo on the burning of farm residues but we can say that they have a very low value due to the low agrarian activity in Vigo. As an example, they established that, in Galicia, **the emissions of this sector were 11,510 Tn of CO_2 eq**, in the year 2000 and in 2002 Vigo occupied 0.08 % of the total cultivated areas of Galicia. Using the cultivated areas as a criterion of comparison, Vigo would correspond to 9.6 Tn of CO_2 eq, a quantity that can be considered negligible.

4.3. Farmlands

Here, we calculate the emissions proceeding from the land. The direct emissions of agrarian land are included (excluding the effects of the tending of animals), the direct of N_2O of land dedicated to animal production and the indirect effects proceeding from the nitrogen used in agriculture.

To calculate the emissions it is necessary to take into account the following data:

- Total of artificial fertilizers that are used.
- Number of livestock within the following categories: non dairy livestock, dairy cattle, poultry, sheep, pigs and other animals.
- Production of dry vegetables and soya beans.
- Dry production of other crops.
- Areas of cultivated land.

Direct emissions of N2O from agrarian land.

The direct emissions are mainly due to four factors: artificial fertilizer (FSN), manure (FE), nitrogen fixing crops (FBN) and residues of crops (FRC).

I. Artificial fertilizer (FSN)

In Vigo the cultivated areas is 394 Ha (data of the IGE) with the use of fertilizers (FSN) of 20.2 · 10^3 Kg of N, taking into account that the average consumption of nitrogen manure in Galicia is equal to 57.2 Kg/Ha.

II. Manure (FE)

The manure is calculated from the excreted N starting from the correction factors, like the nitrogen used as a fuel, the excretion during the tending and that is emitted in the form of NH_3 and No_x. With those considerations, approximately 123 tons of manure are used.

III. Harvest waste (FRC)

To calculate the contribution of nitrogen from harvest waste (FRC), we must have at our disposal the production data of dry vegetables and soya (kg/year) and of the production of other crops (kg/year).

In Vigo, the production of crops, is approximately 7,4 · 10^3 Tn. Considering only the dry material, the crops which fix Nitrogen, and those that do not, we get 10.5 · 10^3 Kg N/year derived from the harvest waste.

IV. Nitrogen fixing crops

To know the total contribution of the nitrogen in nitrogen fixing crops (FBN), we have to know the production of dry vegetables and soya. In this case we have to take into account that in Galicia only dry beans are cultivated, an unrepresentative quantity in the municipality of Vigo.

So the direct emissions of N_2O proceeding from farmland , like the types of contribution of N to the soil already mentioned (FSN, FE, FRC) with its corresponding factors of direct emissions (Kg N_2O -N / Kg N, that corresponds with 0.0125), a value of 1.9 .10^3 Kg is obtained.

Finally, summarizing, a) the direct emissions proceeding from the animals as, b) the indirect ones related to the atmospheric deposition of NH_3 and N_xO_y and, c) leaching, we find the following:

The emissions of N_2O resulting from keeping animals according to of the excreted nitrogen and the emission factor is about 2.40 Tn. These emissions from

atmospheric deposition, where the quantity of nitrogen from fertilizers and the manure that has been evaporated is considered, is corresponding with 0.32 Tn of N_2O (Tn N_2O -N / year) and, in the derivatives of leaching,the emissions of N_2O are about 1.20 Tn.

Starting from all those data the emissions of CO_2 equivalents of the farm land of Vigo can be calculated, taking into account the converted factor Tn N_2O — Tn CO_2 eq. **The resulting value is 2.2 Tn.** When we add to this quantity the amounts of the use of manure and of intestinal fermentation, the final number will be **3.3 Tn** CO_2 equivalent.

The following table summarizes the comparative results:

Place	**Tn CO_2 equivalent/inhabitant**
Vigo	0.01
Spain	1.04
EU-15	1.09
EU-25	1.03

To compare the emissions per inhabitant in the various territories, it is established that Vigo is an atypical case as its contribution is situated, in relative terms, 100 times below those found in many other geographical zones. These data are a consequence of the reduced agrarian activity and livestock breeding in the municipality.

5. Changes in the use of the land and forestry

Human activities, and in particular the changes of land cultivation, are altering the natural values of the interchanging of carbon between the atmosphere and the biosphere and so are favouring the accumulation of CO_2 in the environment.

The carbon absorption in the forests depends on different parameters as for example the occupied areas, the species, the growth rate which are also influenced by different climate characteristics like precipitation and temperature. Because the acquisition of these data is so difficult the calculations have uncertainties and errors but, nevertheless, form a starting point for the carrying out of future corrections.

The case of Vigo is more complicated because we do not dispose of any specific data for some variables. Therefore, we applied some extrapolations of the data from the province of Pontevedra.

Tree-covered areas in the municipality of Vigo (Ha)	**1989**	**1999**
Area of forest	3,003.0	3,229.0
Wooded areas	1,417.5	2,359.1
Percentage of wooded areas	47.20 %	73.06 %

The tree covered areas in the municipality of Vigo in the year 2004 was about 2,892 Ha. The variation of tree covered areas can be attributed fundamentally to human activities like reforestation and the management of forest exploitations (in Vigo it is estimated at about 2,900 Ha.). So the areas that must be taken into account for the calculation of the absorption of CO_2, will be 1,400.58 Ha.

To obtain the area for each species (pinus pinaster, pinus radiata, eucaliptus spp., quercus suber, castanea sativa and alnus glutinosa) we use provincial approximations supposing that the distribution over the area is similar to the provincial total.

The CO_2 absorptions derived from anthropogenic forest activities reach a value of 33.6 · 10^3 Tn , the pinus pinaster and the eucalyptus spp. being the principal contributing species, with 44.17 % and 36.13 %, respectively.

On the other hand, the tree covered forest areas of Vigo consists of 1.02 % of the area of Pontevedra. It is this coefficient of forest contribution the one that will be used to calculate the amount of commercial wood and that of firewood.

The reduction of forest biomass in Vigo, starting from the six mentioned species is 7.6 · 10^3 m^3 and 0,48 10^3 m^3 of timber and firewood, respectively.

The reduction of CO_2 stocked in the forest biomass in Vigo is 10.6 · 10^3 Tn. A calculation that has been realized by the quantities of BEF (tn/ m^3), dry biomass (Tn) and consumption (Tn) obtained for each of the six reference species.

Therefore, **the net absorption derived from the woodcutting and firewood were 23.0 · 10^3 Tn of CO_2**, a quantity that helps to reduce, partly, the global emissions of the greenhouse gases of anthropogenic origin.

6. Treatment and elimination of waste

In this part we will separate (following the methodology of the IPCC) the emissions proceeding from the stockpiling of waste in rubbish dumps, from the treatment of liquid effluences and those from the incineration of waste.

In the management of waste, the most important gas generated is methane. 5 to 20 % of the methane produced by man is the consequence of the anaerobic decomposition of waste, especially in the rubbish dumps and in the treatment of waste waters.

In addition to the methane we can also observe the emission of carbon dioxide in rubbish dumps and waste waters as well as in the incineration of waste, while the nitrous oxide is only emitted in important quantities in the treatment of waste waters and in incineration.

Due to the coming into force of the Plan for Solid Urban Waste of the government of Galicia that proposed to close all the rubbish dumps, the waste products of the municipality of Vigo are now transferred for their incineration to the installation of Cerdeda, belonging to Sogama.

Therefore we can conclude that the control of waste in the municipality of Vigo is based on the treatment of waste waters and on the incineration of waste.

6.1. Treatment of waste waters

The treatment of waste waters with an elevated content of organic material can produce a considerable amount of methane. In all, it represents between 8% and 11% of the methane emissions of the whole world (IPCC).

In the municipality of Vigo the industrial companies do not generate waste that has to be treated separately. So we can include the purification of industrial effluents with domestic waste waters.

The emissions caused by the treatment of urban waste waters in Vigo, concentrated only in the purification plant of Lagares, are 8,200. 90 and 6 Tn of CO_2, CH_4 and N_2O, respectively. They produce **emissions of $12 \cdot 10^3$ Tn of CO_2 equiv.**

6.2. Incineration of waste

According to reports of the cleaning department of the Municipality of Vigo the following RSU were collected: a) 120,011 Tn of garbage (rubbish from the green containers), b) 1,570 Tn of domestic equipment, c) 3,732 Tn of paper and cardboard, d) 494 Tn of packaging, e) 1,224 Tn of glass and f) 37 Tn of batteries.

Starting from the very conservative hypothesis that only the waste from the green containers will be incinerated; we will calculate the emissions caused by the incineration of 120,011 Tn of waste products. We have to take into account that, in 2001, 41 % of the incinerated garbage was of natural origin. That is why the emissions of CO2 derived from this type of waste are to not taken into account.

Emissions caused by the incineration of RSU products in Vigo (period 2003 /2004)

Gas	Tn	Tn CO_2 equiv.
CH_4	0.371	7.79
CO_2	69,744.39	69,744.39
N_2O	12.00	3,720.34
Total emissions of CO_2 equivalent		**73,472.52**

The emissions caused by the incineration of RSU products were 69.7, 3,7 and 0,008 · 10^3 Tn of CO_2, N_2O y CH_4, respectively, contributing to a total of **73.5 · 10^3 Tn of CO_2 equivalent.**

6.3. Summary of waste

Making the general calculation of this sector we see that between the purification of the waste waters and the incineration of waste the emission level increases to 85.5 · 10^3 Tn of CO_2 equivalent. When we look at the different contributions of every type of emission in this sector, it is clear that the emissions produced by the incineration of waste dominate. (73.5 10^3 Tn compared to the 12.9 · 10^3 proceeding from waste waters)

Making a comparison between the emissions caused by the management of waste with those found in Spain and the EU , we observe the following result:

Place	**Tn CO_2 equivalent/inhabitant**
Vigo	0.28
Spain	0.27
EU-15	0.26

7. Summary of emissions

Sectors generating CO_2 emissions		10^3 Tn of CO_2 equivalent.
Electricity consumption		**706.8**
Incineration in manufacturing and construction industries		**132.8**
Transport		**574.8**
	Air transport	17.9
	Road transport	550.7
	Railway transport	0.4
	Sea transport	5.8
Residential/institutional and domestic derived from the incineration of fossil fuel		**155.0**
Agriculture and fishing		**298.0**
	Agriculture	1.0
	Fishing	297.0
Livestock (intestinal fermentation and use of manure)		**1.1**
Incineration of agricultural residues		**11.5**
Nitrogen fixing crops		**2.2**
Treatment of waste waters		**12.0**
Incineration of residues		**73.5**
TOTAL		**1967.7**

Changes in land use and forestry	**10^3 Tn of CO_2 equivalent**
Absorption through anthropogenic activities in the forests	33.6
Reduction of the stock of biomass in the woods	10.6
The net absorption derived from cuting timber and firewood	**23.0**

NET TOTAL of EMISSIONS: 1.944,7 · 10^3 Tn of CO_2 equivalents

Comparison of the emissions of the various territories

Place	**Tn CO_2 equivalent/inhabitant**
Vigo	**6.5**
Spain	9.4
EU-15	10.9
EU-25	10.8

When we look at the contribution of the different gases to the emissions, we observe in leading position CO_2 with 98% of the emissions, followed by N_2O with 1.7% and CH_4 with 0.3%. The negligible contribution of gases like methane and nitrogen oxide to the emissions of Vigo is due to the negligible agrarian and cattle breeding activity that

is one of the main sources of these gases, and it is also due to the inexistence of rubbish dumps that form an important centre of methane emissions. This fact is made clear in the following table, where the participations of every gas in Spain and the EU are given.

Gas	UE-25	UE-15	España	Vigo
CO_2	82,5%	82,5%	82,5%	98,0%
CH_4	8,3%	8,0%	9,2%	0,3%
N_2O	7,9%	8,0%	7,0%	1,7%

The analysis per activity allows us to determine the main causes of emissions.

The consumption of electricity is the main cause of the emissions with 36.3% of the total, followed by transport with 29.5 %. The major fishing activity in Vigo converts this sector into an important centre of emissions, producing 15.3 % of the whole.

The next table shows in detail the percentage of every sector and its contribution to the emission of greenhouse gases.

Activities Responsible for the emissions		**%**
Electric consumption		**36.3**
Burning in manufacturing and construction industries		**6.8**
Transport		**29.5**
Air transport	0.9	
Road transport	28.3	
Railway transport	0.0	
Sea transport	0.3	
Residential/institutional and domestic derived from the incineration of fossil fuels		**7.9**
Agriculture and fishing		**15.3**
Agriculture	0.0	
Fishing	15.3	
Livestock (intestinal fermentation and use of manure)		**0.1**
Burning of agricultural residues		**0.6**
Nitrogen fixing crops		**0.1**
Treatment of waste waters		**0.6**
Incineration of residues		**3.7**

8. Comparison with other regions and cities

The methodology used in the calculation of the different values is worked out by the IPCC and completed by the Guide EMEP / CORINAIR Guide. Using the same methodology the results are comparable but we have to take into account that with a smaller geographical area, the degree of representativity is also smaller.

The initiative ECI (European Common Indicators), that includes the A-2 indicator (Local Contribution to Global Climate Change) counts upon the participation of diverse European cities (in total 148 local authorities).The data obtained by the municipalities were collected between 1998 and 2004 apart from some exceptions like Catania (1997), Saragossa (1996) and Ferrara (1995).

The applied methodology consists in calculating the CO_2 emissions **derived from energy burning of the industrial, domestic, transport and tertiary sectors and on top of this the methane emissions proceeding from the rubbish dumps**. In order to be able to compare the case of Vigo with the rest of the municipalities we will have to take into account the CO_2 emissions of energetic origin of the corresponding sectors.

The urban areas considered possess different geographical contexts, with different climates, housing structure, urban communications.... so that their energy necessities are conditioned by their infrastructures.

The urban areas whose emissions exceed 9 Tn per inhabitant are Pori (Finland), Turku (Finland), Bristol (Great Britain) and Ferrara (Italy). The elevated emissions of Pori are caused by the high industrial activity that reaches almost a quarter of the total emissions. In Turku it is the domestic consumption that attracts attention by exceeding 3 Tn per inhabitant. In Bristol the emission values are higher than the average in all sectors, obtaining an absolute maximum value in transport. The Italian cities of Ferrara, Parma and Verbania, with emissions superior to 8 Tn per inhabitant, are strongly influenced by industrial consumption.

CO_2 –Emissions of the European cities participating at the ECI initiative (Common European indicators)

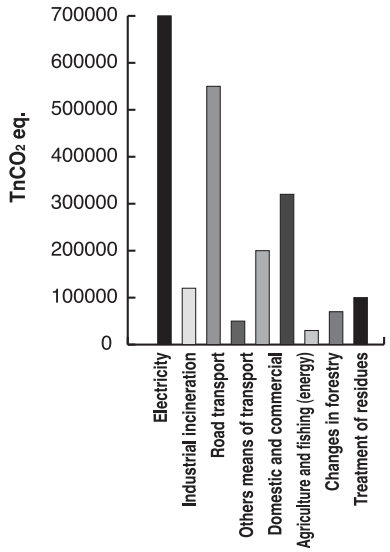
City	Tn CO_2/hab.	Country	City	Tn CO_2/hab.	Country
Oslo	2,47	Norway	Vitoria-Gasteiz province	7,23	Spain
Pamplona	3,51	Spain	Torino	7,58	Italy
Blagoevgrad	3,6	Bulgary	Aarhus	7,73	Denmark
Barcelona	3,6	Spain	Haemeenlinna	7,81	Finlandia
Vaxjo	3,79	Sweden	Burgos	8,04	Spain

Estocolmo	3,89	Sweden	Parma	8,39	Italy
Malmö	4,79	Sweden	Tampere	8,58	Finland
Catania	4,97	Italy	Verbania	8,62	Italy
Vigo	**5,51**	**Spain**	Maribor	8,73	Slovenia
Pavia	5,97	Italy	Milán	8,81	Italy
Biscaia	6,43	Spain	Ferrara	9,17	Italy
A Haia	6,69	Netherlands	Bristol	9,37	Great Britain
Gdansk	6,94	Poland	Turku	10,7	Finland
Ancona	7,02	Italy	Pori	11,9	Finland

The Spanish and Swedish cities plus Oslo and Blagoevgrad, are the urban areas with a lower level of emissions, mainly situated under the average of 6.78 Tn. It is strange that Scandinavian cities like Stockholm, Vaxjo and Oslo, with very low temperatures, have reduced emission values (only compare with their Finnish neighbours). This is due to the fact that in Sweden and Norway the main source of energy is hydroelectricity. The reduced values of the Spanish cities (Pamplona and Barcelona) are principally caused by climate conditions. In the case of Barcelona the low emissions of the domestic and commercial sectors are (in addition to the favourable climate) due to the extensive use of natural gas (6 % of the consumption of the sectors). In transport, the low emissions are caused by the fact that only 22 % of the population uses private transport in their daily journeys.

As we can see, Vigo is situated in the low category with its 5.51 Tn of emissions, while the average is 6.78 Tn. If we compare the emissions with the Spanish cities we observe that, with similar climates Vigo presents more emissions than Pamplona and Barcelona, but less than Vitoria and Burgos. The higher emission of Vigo compared with Barcelona is due to the lower use of natural gas and public transport; while the higher emissions presented by other Spanish cities are characterized by their high industrial activity.

9. Follow-up filing card

DEFINITION OF THE CALCULATION MODE	GRAPHICAL REPRESENTATION
Emissions of CO_2, N_2O and CH_4 produced by the following sectors: Electricity Industrial incineration Road transport Others means of transport Domestic and commercial Agriculture and fishing (energy) Agriculture Changes in forestry Treatment of residues Calculation method: Methodologies used in the: "Emissions inventory of GEI for Galicia" "Reference manual of the IPCC" "Emissions inventory of GEI for Spain"	**GEI emissions in the municipality of Vigo (as example)** 
Objective: Climate Change **Responsible unit:** Council of Vigo. Department of Environment **Last updating:** **Observations:** for all mentioned sectors the emissions CO_2, N_2O and CH_4 have been calculated	

To carry out a follow-up of the indicator some methodological filing cards will be used as a model, specifically those of the RESPECT program ("Reference of evaluation related with the environmental politics of the territorial communities") by 30 European cities that have participated in its design. These filing cards are accompanied with other supplements that allow the evaluation of the evolution of the indicators, such as the accomplishment of the imposed objectives.

The municipality of Vigo

1. Situation

The municipality of Vigo is situated in the south-west of Galicia, on the left bank of the river-mouth* of Vigo, of a latitude of 42º 14´ N, a longitude of 8º 40´ O and an altitude of 0 to 450 m. above sea-level.

Vigo is bordered in the north by the Atlantic Ocean, in the north-east by the municipality of Redondela, in the east by Mos, in the south by O Porriño and Gondomar and in the south-west by Nigrán, occupying a total surface of 108.13 km^2 , of which 6.34 km^2 belongs to the Cíes Islands.

The peninsula of Do Morrazo on the opposite bank of the river and the Cíes Islands in the river-mouth are important features.

2. Climate / temperature / precipitacion / sun / wind

The average annual temperature is 14.8 ºC. This indicates that the city enjoys a mild climate, annually as well as daily, which could be described as an oceanic climate with transition to a mediterranean climate: mild temperatures, high precipitations and some summer dryness, all of this with the particular properties generated by its position in the river-mouth of Vigo, together with those of the other river-mouths that are part of

the "Rías Bajas".

The average annual precipitation is over 1200 mm in the centre of Vigo, 1400 mm in Peinador airport and 1600-1800 mm in the higher situated zones of the Sierra del Galiñeiro and its surroundings. Rainfall occurs throughout the whole year, but is more prevelant during the winter months. In summer the major concentration of solar radiation has been measured at about 330 cal/cm^2/day, especially in the months of July and August. The average amount of hours of sunshine throughout the whole year is 2.392**.

The area in which the city of Vigo is situated is influenced by the positional changes of the anticyclone from the Azores. Therefore, in winter, a soft wind blows from a South Westerly direction, while in summer it takes a northerly direction. The latter brings the superficial warm waterlayer in summer, through which the coldest one appears. Clouds do not form and this causes summer dryness. The average windspeed in the province of Pontevedra is 3 m/s, with predominating periods of calm and south-western and northern winds.

General characteristics of the municipality of Vigo

Latitude	42º 14' N
Longitude	08º 40' W
Altitude	0 a 450 m.
Total surface	108.13 Km^2
Average annual temperature	14.8 ºC
Average annual rainfall	1,450 mm
Average amount of hours of sunshine	2,392 h.
Average windspeed	3 m/s
Wind direction	SW (winter), N (summer)
Inhabitants	293,725
Demographic density	2,692.25 hab./km^2.
Average age	38.2

3. General description of the river-mouth of Vigo

General characteristics of the river-mouth of Vigo

Latitude	42º 09' y 42º 21' N
Longitude	8º36' y 8º54' W
Maximum width	5.2 Km
Minimum width	600 m
Total longitude	32 Km
Total surface	176 Km^2
Total volume	3,177 Hm^3

4. Morphology: relief in Vigo / Geology

The city of Vigo is on various levels. The centre is situated on the slopes of the Castro mountain, providing slope inclines of up to 15%

The coast line presents a secondary relief of large importance in the city centre, which separates the river-mouth of Vigo from the Fragoso Valley. The city centre has two important topographic points, the aformentioned Castro (147m) and La Guía (124 m).

Roughly, we can divide the morphology into 3 parts:

- Coast: southern bank of the river-mouth. Consisting 20 sandy plains from Sai·ns to Teis, 2 coastal parts of sedimentation and 3 of erosion.

- Valleys: The Fragoso valley and the Miñor Valley.

- Mountain: The interior has a hilly relief. The highest summits are those of the Galiñeiro (705 m), Monte Alba (524 m), Monte Cepudo (526 m), Montes de Coruxo (450m, 439m, 436 m) and Madroa (340 m).

Looking at its geology we can divide the city into two areas: the east, with an almost complete domination of rocks, that establish a rough and steep appearance and the west, with granite rocks, showing a softer landscape.

* River-mouth: Penetration formed by the sea at the coast, due to the submergence of the coastal part of a basin of rather steep stones (RAE).

5. Hydrography.

Together with the rivers, there are different humid areas, waterlayers, springs and up to 11 basins of hydrographic sectors. This gives us an idea of the high hydric biodiversity of the council of Vigo.

The main rivers are the Lagares and the Miñor or Amial, with their respective affluents the Eifonso and the Barza.

Within the humid areas we should mention the Xunqueira do Lagares and the basin of Zamáns, for their beauty as well as for their biological diversity.

6. Vegetation

In the municipality of Vigo there is a big vegetal diversity, which includes indigenous species and others imported for industrial use.

The native forest can be divided into two important parts: the oak woods (carballeiras and fragas) and the river bank woods. The first consist of small isolated woods, surrounded by fast growing trees. In the river bank woods we find woody, bushy formations situated in water-related areas, mainly the banks of the rivers. They have a broadleaved vegetation and are a habitat for an extensive fauna.

There are also different policies of reforestation being carried out, with conifer formations of pinus pinaster, pinus radiata and pinus pinea. The next important variety is the eucalyptus (eucaliptus globulus), an imported species that was introduced in the ecosystem for its fast growth. It occupies almost 250.000 hectares of land close to the coast, below 600 meters.

As has already been indicated, the humid areas and land covered with water in the superficial layers are very abundant and a specific vegetation comes along with them: brañas and humedales extend themselves in various areas of the municipality, creating an ideal surrounding for the migrating birds and microscopic fauna. The main areas here are the humedales of Goberna and the Xunqueira do Lagares.

On the coast, although it has undergone lots of modifications, we still can find some vegetation related to dunes and beaches. This coastal vegetation, however,

** Data obtained by the Galician Meteorological Office.

at this moment only exists on the Cíes Islands and the Dunes of Fontaíña, with species like the Ammophila arenaria. On the sandy plain of Samil can be found a unique dune line on top of a fossilized dune, with a very important geomorphological value.

The ornamental flora of the municipality is a list of very important specimens: 226 different species plus 12 hybrids, with a total number that has been rising up to 4.259, without including those that are younger than 20 years.

7. Distribution of land

Distribution of land in the council of Vigo

Forest	39.1%
Cultivated ground	31.00%
Other ground	28.80%
Grass land	1.1%

The main parts of the lands of the municipality are occupied by forest, followed by cultivated surface. The emphasis has to be put on the high percentage of "other surface", dedicated mainly to urbanised and industrial land.

8. Forest patrimony /agrarian patrimony

The mountains represent almost a third of the municipal surface. These are considered to be of major importance to the environment, society and the landscape.

The council of Vigo posesses a mountain chain that encloses the whole municipality, except the open side at the river-mouth. It represents almost 2,600 ha of the 10,934 total. The ownership of these mountains is fundamentally municipal, belonging now to the neighbouring communities with parochial character, whose objective is to conserve those natural resources.

Main forest soils

Mountain	Parish	Tree types	Ha
Mountains of Coruxo eucalyptus, elms.	Coruxo	Pine, mixed mass and	231,0
Mountains of Oia	Oia	Pine, eucalyptus, chesnuts, elms.	81.0
Mountains of Saians	Saians	Pine, eucalyptus, chesnuts, elms.	49 .0
Alba and Cepudo	Valladares	Pine, eucalyptus, chesnuts, elms.	225.0
Fonte Fría and Zondal	Valladares	Pine, mixed mass of eucalyptus, elms.	293,7
Carballiño, Castro and others	Comesaña	Pine, mixed mass of eucalyptus,	46,4
Galiñeiro	Zamáns	River vegetation, cultivation, grass-land, pine and eucalyptus	300,0
Fonte Cobas, San Ciprián, Sobreira and others	Beade, Bembrive, Valladares and Zamáns	Pine, eucalyptus, chestnut and sobreira	500,0
Gorxal and Meixueiro	Cabral and Lavadores	Eucalyptus	29.4
Cotogrande and others	Cabral	Pine and eucalyptus. Reforestation of nut trees, plane tree and American oak	170.0
Madroa,Vixiador, Bandeira and others	Madroa, Candeán and Cabral	Pine, chestnut and acacia. Reforestation with chestnuts, bidueiros, sobreira and holly	150.0
Mountain of the Sierra	Sárdoma	Eucalyptus	6.5

It has to be mentioned that all these forest grounds have a limited diversity, fundamentally reduced to pines and eucalypus. The larger variety in the past has disappeared favouring industrial grounds and other non-native species of much faster growth like the eucalyptus and the acacia, which impoverish the soil and invade grounds dedicated to fragas y carballeiras (oak woods). Another problem that is becoming very alarming is the environmental impact provoked by the larger quantity of forest-fires that every year destroy hundreds of hectares of forest.

The municipality of Vigo owns afforrested parks in practically all its parishes (except Alcabre, Navia and Matamá) distributed around the whole area. A surface of 1,060,536 m^2 has been measured. This corresponds with a content of 3.8 m^2/inhabitant.

In the zone which surrounds the city center 4 big green zones represent the town's lung: Castrelos, El Castro, La Guía and Samil. Together, they occupy 840,366 m^2, which corresponds with a standard of 3 m^2/inhabitant.

There are also smaller parks, that improve city-quality: A Riouxa, A Bouza, Isaac Peral, Alameda and Montero Rios, for example. They occupy, approximately, 485,000 m^2, corresponding with a standard of 1.68 m^2/inhabitant.

In total, the green zones contain 8 m^2/inhabitants. This represents 65 % of the whole surface per inhabitant.

The property of the agrarian patrimony however is completely fragmented, like almost all Galician agrarian land, that has been structured in minifundios. Divisions of the rural patrimony in farms are too small to be treated mechanically. 99.84% of the parcels consist of 0.1 to 5 ha and only 0,05% exceeds 100 ha.

The oblong and narrow parcels, grouped in small units and perpendicular to the roads, are dominant. It is a part time agriculture with poli-harvest, with a tendency towards autoconsumption. The most abundant harvest is the maize that occupies 63.61 % of the agrarian surface, followed by the vineyards with 14.28 %.

At the moment the problem in the agrarian sector is the loss of agrarian activity, due to the crisis in this sector, the strong influence of the city and the wrong utilization of the existing means.

9. Fauna and cattle-breeding

Galicia is one of the areas with the highest biodiversity of amphibians and reptiles. Vigo enjoys abundant birdlife thanks to the colonies of birds on the Cíes Islands and the humedales.

Cattle-breeding is obviously a residual activity, with small exploitations of calves and other farm animals for home use.

10. Establishment system / the territorial model

The basic structure of the rural area surrounding Galicia is dominated by the establishment system. It is an administrative local demarcation, although it misses the explicit legal acknowledgement, that corresponds with a territory assigned to a church. Nowadays it's a territorial unit totally identifiable with the population.

There are two clearly differentiated zones: a city center, structured in districts, and the remaining parishes that form the dispersed city.

There are 17 zones considered as part of the dispersed city, divided in two lines, one close to the city center and urbanly extended formed by Alcabre, Navia, Comesaña, Matamá, Castrelos, Sárdoma, Lavadores and Teis, and the rest, basically rural: Zamáns, Beade, Valladares, Bembrive, Candeán ,Cabral, Coruxo, Oia and Saiáns.

The municipality has 293,725 inhabitants (1-1-2005) and the population of the metropolian area of Vigo is estimated at 423.821 inhabitants. Its demographical density is 2,692.25 hab./km^2. The average age of the population is 38.2 years but only 61.3 % were born in Vigo.

11. Industrial establishment in the municipality of Vigo

The various industrial zones are divided into different enclaves within the municipality of Vigo. Those with a major physical appearance are the ones that correspond to the following sectors: the coastal area (in between Bouzas and el Berbés), installations in the Franco zone (Balaidos, Alcabre), the valley of Lagares (industrial implantation all along its length from Cabral to Samil), Lavadores-Cabral, Comesaña-Caramuxo and the new technological park (Beade).

The council of Vigo is the main industrial centre in Galicia, being the centre of an important socio-economical area that extends from O Morrazo to Portugal.

The most important industries are the automotive industry, ship construction and supporting industries. Vigo owns one of the three francas zones that exist in Spain. It is a taxfree area to facilitate trade. The companies which are established in this area can act without any limitation.

The original establishment is situated in the industrial area of Balaídos, with 1,000,000 m^2 next to another 30,000m^2 exclusively dedicated to storage-capacity. It is the economic and industrial centre of Vigo and here are situated some of the most important companies of the city, such as the second most important factory of the PSA Peugeot Citroën group in Europe, which occupies a surface of 635,000m^2 (producing in 2004 a total of 458,550 vehicles, of which more than 88% were exported).

Companies in the industrial zone of Balaídos

Alservi, S.L.	Automotive-industry
Carnessa, S.A.	Distribution of ceramical products
GEFCO ESPAÑA, S.A.	Storage of automotive parts
GKN driveline Vigo	Automotive-industry
Maviva, S.A.	Storage of automotive parts
Peugeot Citroën automóviles España, S.A.	Automotive- industry
Pilkington Automotive España, S.A.	Storage of automotive parts
Saint-Gobain Cristaleria	Storage of automotive parts

In relation to the automotive-industry there are two important companies in the new technological park of Beade-Valladares: the Japanese multinational Denso, with a surface of 11,000m^2 ,constructing airconditioning installations and the German company Benteler, which produces chassis and steel axles in an installation of 40,000 m^2. A lot of companies chose the city of Vigo for its strategic position close to the harbour and the proximity of the PSA Peugeot-Citroën one of their biggest clients.

There has also been a commercial area created in Bouzas that functions as a logistics platform. It's mainly set up in an area of 100,000m^2 owned by the PSA-group for delivering, through the harbour zone, all the vehicles they produce. In this area are also situated a larger number of export and import companies.

Another important sector within the industry of Vigo is the ship building industry. The companies Factorías Vulcano S.A. and Hijos de J. Barrera S.A. are the two biggest ship-yards in town.

Another one of Vigo's driving powers is the fishing industry. As well the extractive industries, the fishermen and the ship-owners, there are commercial businesses: the exchange, and the canning industry.

Principal companies in the fishing industry

Bernardo Alfageme S. A.	Preserves and prepared food (Miau)	Export and interior trade
Eduardo Vieira S. A.	Frozen products	Covers the whole process from the shipping fleet to the sale to the client. Export and interior trade
Ibérica de Congelados, S.A.	Frozen fish	Ship-owner that covers the whole process
Marfrío Pesca S.A.	Frozen fish	Covers the whole process. Import,export and interior trade
Hijos de Carlos Albo S.A.	Preserves and prepared food	Export and interior trade

The harbour and the airport of Vigo

The harbour of Vigo is the most important fishing port in Europe and its strategic situation allows it to be the focus of all maritime transport of goods in an extensive zone, with the arrival of more than 2,000 ships a year.

Vigo has more than 9 km of tie-up wharfs. The main traffic consists of granite, obtained from the quarries of Porriño, fish and car exports. There has recently been a big growth in the container transport industry in Vigo. The diverse wharfs that are part of this harbour are, from west to east:

- Terminal of Bouzas: It is divided into two zones, one destined for traffic and a wharf for repairing; the wharfs of Beiramar and O Berbés, for the tying-up of fishing boats (coasters and ocean vessels); a transatlantic wharf; a sports wharf; the wharfs of O Areal, commercial and varied. In total more than 1,500 metres long, equipped for a general cargo and flow, with railway connection.

- Terminal of Guixar: Wharf of 769 metres, for container traffic, with railway connection.

The international airport of Vigo-Peinador is situated between two municipalities of Vigo: Redondela and Mos, in the province of Pontevedra, nine kilometers from the city-centre of Vigo. It has a runway of 2,500 metres and access and stretch of a rolling track that forms a platform with one of the beginnings of the runway.

In 2005, the airport of Vigo received 1,108,718 passengers, dealt with 18,853 movements of aircraft and 1,363 tons of cargo.

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ENCLOSURE I

BASIC GUIDE LINES RELATED TO CLIMATE CHANGE

EUROPEAN UNION

A. ENERGY

Directive 2003/96/EC of the Council on 27th October 2003 in which the communal system of taxation of the energy products and electricity is restructured.

Directive 2001/77/EC of the European Parliament and the Council of 27th of September 2001, related to the promotion of electricity generated by sources of renewable energy in the interior market for electricity.

Proposal of the Directive of the European Parliament and the Council on the stimulation of cogeneration: about the basis of the demand for usable warmth in the internal energy market.

Communication of the Commission – Energy for the future: sources of renewable energy – White Paper for a common strategy and a plan of action.

B. GAS EMISSIONS

Decisions on the Follow-up Mechanism of the emissions of GEI in the EC: **93/389/**EEC. Decision of the Council, 24th June 1993, concerning a follow-up mechanism of the CO_2 emissions and of other greenhouse gases in the Community.

1999/296/EC: Decision of the Council, 26th April 1999, in which the decision 93/389/EEC is modified, concerning a follow-up mechanism of the CO2 emissions and of other greenhouse gases in the community.

2004/280/EC: Decision of the European Parliament and the Council, 11th of February 2004, concerning a follow-up mechanism of the emissions of greenhouse gases in the Community and the application of the Kyoto Protocol.

Directive 2004/101/EC, of the European Parliament and the Council, 27th of October 2004, in which Directive 2003/87/EC is modified, with the establishment of a regime for the trade of rights of greenhouse gas emissions in the Community with respect to the mechanisms of the projects of the Kyoto Protocol.

Decision of the Commission of 27th December 2004, concerning the national plan of assignment of rights of greenhouse gas emissions notified for Spain confirmed by Directive 2003/87/EC of the European Parliament and the Council.

COM (2005) 35 final, SEC (2005) 180, Communication of 9th February 2005 of the Commission to the Council, to the European Parliament, to the Economic and Social Committee and to the Committee of the Regions, "Winning the fight against Global Climate Change"

Decision of the Commission 2005/166/EC, of 10th February 2005, in which are established application dispositions of the Decision nº 280/2004/EC of the European Parliament and the Council, concerning a mechanism to follow-up the emissions of greenhouse gases in the Community and for the application of the Kyoto Protocol.

Directive 2003/87/EC of the European Parliament and the Council, 13th October 2003, in which a regime for the trade of rights of greenhouse gas emissions is established in the Community and in which the Directive 96/61/EC of the Council is modified (Text concerning the effects of the EEE)

Orientations for the member States on the application of the criteria of the enclosure III of the Directive 2003/87/EC in which a regime for the trade of rights on the emission of greenhouse gases in the Community is established and in which Directive 96/61/EC of the Council is modified, and circumstances in which the existente of force majeure was demonstrated.

Directive 2001/81/EC of the European Parliament and the Council the 23rd October 2001 on the national maxima of emission of determined atmospherical contaminants.

Directive 2001/80/CE of the European Parliament and the Council, 23rd October 2001, on the limitation of emissions in the atmosphere of determined contaminating agents, proceeding from big incineration installations.

Directive 96/61/CE of the Council of 24th September 1996 concerning the integrated prevention and control of the contamination (IPPC).

Decision of the Council 2002/358/EC, 25th April 2002, concerning the approval, in the name of the European Community, of the Kyoto Protocol of the Marco Convention of the United Nations on the Climate Change and the joint implementation of the contracted compromises.

C. TRANSPORT

Directive 2003/30/EC of the European Parliament and the Council, 8th May 2003, concerning the stimulation of the use of bio fuel and other renewable combustibles in transport.

Directive 2000/304/EC: Recommendation of the Commission, 13th April 2000, on the reduction of the CO_2 emissions by cars (JAMA) [notified with the number C (2000) 803] (Text concerning the effects of the EEE).

Directive 2000/303/EC: Recommendation of the Commission, 13th April 2000, on the reduction of the CO_2 emission by cars (KAMA) [notified with the number C (2000) 801] (Text concerning the effects of the EEE).

Directive 1999/125/EC: Recommendation of the Commission of 5th February 1999 on the reduction of CO_2 emissions produced by cars [notified with the number C (1999) 107] (Text concerning to the effects of the EEE).

D. RESIDUES

Directive 1999/31/EC of the Council of 26th April 1999 concerning the dumping of residues.

E. RESIDENTIAL, COMMERCIAL AND INSTITUTIONAL

Directive 2002/91/EC of the European Parliament and the Council, 16th December 2002, concerning the energy efficiency of the buildings.

Directive 2000/55/EC of the European Parliament and the Council, 18th September 2000, concerning the energy efficiency requirements of the ballasts of fluorescent lights.

Directive 1996/57/EC of the European Parliament and the Council of 3rd September 1996, concerning the requirements of energy efficiency of fridges, freezers and combined electrical household appliances.

F. AGRICULTURE AND CATTLE BREEDING

Directive 91/676/EEC of the Council, 12th December 1991, concerning the protection of waters against contamination produced by nitrates used in agriculture.

ENCLOSURE II

COUNTRIES IN WHICH LOCAL AUTHORITIES HAVE JOINED THE ECI PROJECT (EUROPEAN COMMON INDICATORS)

Albania
Austria
Bulgaria
Czech Republic
Croatia
Denmark
Finland
France
Greece
Hungary
Italy
Latvia
The Netherlands
Norway
Poland
Portugal
United Kingdom
Rumania
Slovakia
Slovenia
Spain
Sweden
Ukraine