CLIMATE CHANGE AND AIR QUALITY IMPROVEMENT STRATEGY

INTRODUCTION

Climate change is one of the most important problems of humankind

Industrial development and consumption increase in our society has produced a great amount of greenhouse gas emissions that, due to its characteristics, contribute to the global heating of the planet.

Direct strategies will be necessary to reduce or avoid these emissions and, especially, changes in the perception of the problem by the population to put into practice adequate ways of action.

When talking about climate change and air quality, we are referring to two different but closely related concepts. The processesses that produce climate change and greenhouse gases as well as the other pollutants sent to the atmosphere from different sources are responsible of air quality.

Three main tools for the evaluation of air quality have been used by Zaragoza:

- The Emissions Register 2005 for knowing the emissions sent to the atmosphere by pollutants produced by human activities and other natural sources.

- The Air Pollution Control Network that gives immission level data of every pollutant allowing to value air quality in the city.

- PRECOZ, a prediction programme which allows to know 24 hours in advance pollution level in the city of Zaragoza. This programme is the result of a laborious data combination from the Air Pollution Control Network (Red de Control de la Contaminación Atmosférica), and the Emissions Register 2005.

Due to the evident need to implement mesures for the mitigation and adaptation to climate change, the City of Zaragoza has launched a global strategy for climate change mitigation and air quality improvement.

In order to prepare any strategy to improve a given activity or a determined situation, the first step is always to make an objective evaluation of the starting situation.

The Air Pollution Control Network allows us to know the immission level of every pollutant, making possible a first assessment of the air quality from which it can be inferred the weaknessess and strengths of the situation of the air in the city from an environmental point of view. For example, the most problematic pollutants and the

areas where they are produced can be differentiated depending on the type of activity, and offering a wider situation view.

With regard to the Climate Change and Air Quality Strategy –ECAZ- the evaluation of the starting situation has been completed with the implementation of the Emissions Register 2005, which has given us a diagnosis of the situation to adopt the adequate measures in every case.

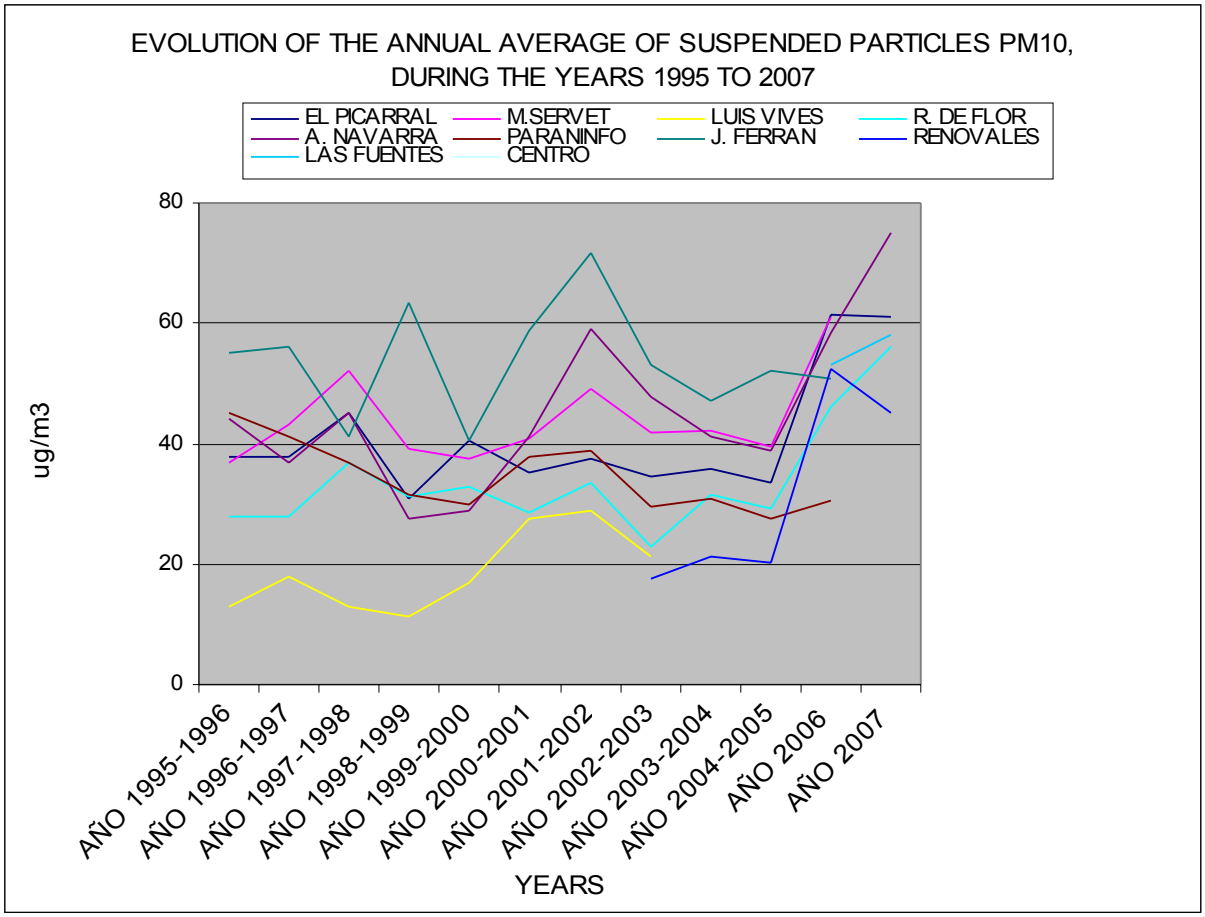
This strategy does not include economic plans since it is global and includes the analysis of the situation, action fields for subsequent concrete plans and programmes, every one of them including its own economic plan.

AIR QUALITY

EC Directive 96/62 on air quality and subsequent ones, establish some much more restrictive limit values for every pollutant than those from previous laws. Therefore, the achievement of the immission levels in general and especially of the particles is more difficult.

The implementation of the EC directive 1999/30 on the limit values of sulphur dioxide, nitrogen dioxide, and nitrogen oxides, particles and lead in ambient air, has also provoqued important changes in the location of remote measure stations which have passed from carrying out measurement in important specific pollution points to high pollution level points.

These graphics show the evolution of the average annual values of particles PM10, from 1995 to 2007.



It can be observed a stabilization of the immission levels of suspended particles (PM10) between 2002 and 2005 and an increase in that pollutant in 2005-2007.

This increase in particle levels is due to the big amount of works made during that period and the transformation process of the city which has provoked a strong increase of particles and road traffic problems.

On the other hand and taking into account the normal running of the city and in agreement with the register made, residential, institutional and services are the sectors that emit the biggest quantity of particles –2,455.99 tons/year- followed by the industrial sector with 784.39 tons/year, and mobility with 129.62 tons/year. Therefore, in order to reduce particle emission levels it will be necessary to focus the efforts on heating systems, particularly in the city centre.

Regarding nitrogen oxides, the effort has to be made in actions in the industrial sector which produces emissions of 4,507.07 tons/years, and mobility with 2,489 tons/year. In the residential sector the emissions are 559.21 tons/year of NOx.

In 2006 -year taken as a reference for the particles pollutant PM10- the values obtained in the above mentioned statation were these:

Station	Level measured Annual average	Annual average without cross-border contribution	No of overrunings	No of overrunings without cross-border contribution
El Picarral ES 1044A	64	59	211	203
Roger de Flor ES1047A	48	39	129	115
Renovales ES1641A	43	36	115	99

In part, these results are explained by a natural pollution produced by the arrival to the Iberian Peninsula of winds coming from the north of Africa. They are south and southeast winds which carry out air masses with a big amounts of particles, and sand from the desert which produce high immission levels in urban communities, among them in our city.

Without considering this cross-border pollution produced by air masses from Africa, both the average annual and the increase in the number of overrunnings is diminishing, although it continues to be over the number allowed by law.

The natural characteristics of Zaragoza surroundings -a steppe with scarce rainfall- also contribute to pollution. These characteristics as well as the winds that can blow in any direction, provoqued in 2005 and 2006 a great amount of particles in the air.

Besides that, from 2005 until now, the big urban transformation of the city -with projects such as PLAZA, Ecociudad Valdespartera, the restoration of areas nearby Delicias Intermodal Station, adaption of the riverbanks, the Expo, the fourth ring-road, the Technological Recycling industrial area, etc- have produced an increase in atmosphere pollution mainly of suspended particles and nitrogen oxides.

The adverse weather conditions were also important in the spreading of pollutants in the year 2006. The city registered approximately 34 foggy days –sometimes several days in a row as it happenned in December- and days with morning mist. During all those days, it was very difficult the spreading of the pollutants sent to the atmosphere.

Only during the central months of the year the sky were clear during the whole day and visibility was total.

The strength and direction of the wind is another very important factor for pollution spreading.

During the year 2006, an 85% of calm weather was registered.

NW wind (with a frequency of 19%), E wind (with 16%), and W-NW (with 13%) were the prevailing winds in the city. Speed was between 23 and 13 km/h.

There was 48 days with winds over 55 km/h and NW direction. Strong gusts of wind up to 70 km/h were registered also with NW, SW and SE direction.

The accumulation of pollution in conurbation areas is usually registered with adverse climate conditions such as it happens during calm weather.

Considering an average annual wind speed of 1.5 m/s or 5.4 km/h as a low speed, the annual average speed in the city of Zaragoza has been over that figure, but during the year, several calm days -with an average daily speed under that indicated- were registered. During those days, there was an increase in the immission levels of particles, producing average daily levels over 50 µg/m3 (daily average top value established by the EC directive) in the 80% of calm days.

The Instituto Nacional de Meteorología (today Agencia Estatal De Meteorología) has considered 2006 as a normal year from a hydrological point of view. Winter months have been dry, and July and September damp.

This situation produced an important lack of ventilation in the city and the re-suspension of a big amount of particles placed on the ground.

EMISSIONS REGISTER 2005

Cities must have precise diagnoses to evaluate the different states of work.

Emission registers are a first-rank environmental audit to define a strategy based on solid data and a starting point to produce plans and programmes for the sectors analyzed in order to reduce emissions sen to the atmosphere and improve air quality levels.

The city of Zaragoza produced its first register in the year 1991.This register only controlled and evaluated the most important industrial activities of the city.

The second was the Emission Register 1996. This was notably increased with a complete survey of activities related to the residential and mobility sectors, as well as the industrial –the most important of Zaragoza regarding combustion processes.

The Emissions Register 2005 has been more ambitious and has surveyed virtually every activity sector.

Both the E.R of 1996 and that of 2005 were prepared by using EU´s CORINAIR methodology as framework for the entire sector and for the emission factors compiled.

In certain sectors and pollutants, the register has been completed using the EPA methodology from the US Environmental Protection Agency, and with other data compiled from emissions registers such as EPER.

Finally, a top importance has been given, as far as possible, to determine real emissions data by the register books on atmosphere pollutants emissions.

1 METHODOLOGY

CORINAIR methodology -used from 1990- is the tool for preparing atmosphere emissions registers.

This methodology uses the SNAP nomenclature (Selected Nomenclature for Air Pollution) to fix the types of activities that potentially sent pollutants to the atmosphere, establishing for every one some factors to calculate the emissions produced.

In order to carry out a register of the emissions sent to the atmosphere, there are three fundamental steps:

- Definition of time, geographical, and technical fields
- Compilation of information
- Calculation of the emissions sent to the atmosphere and representation of the results.

1.1 DEFINITION OF TIME, GEOGRAPHICAL, AND TECHNICAL FIELDS

Regarding the previous register, the E.R 2005 has increased the space and time reference of the survey as well as its scope and the types of activities studied.

1.1.1 Pollutants registered

18 pollutants have been researched in the Emission Register 2005 compared to 10 in1996:

1996

- **CO_2**
- **CH_4**
- **N_2O**
- **SO_2**
- **NOx**
- **CO**
- **NMVOC**
- **Particles**
- **NH_3**
- **Pb**

2005

Those from 1996 and also…

- **SF_6**
- **PFCs**

- **CFCs**
- **HAPs**
- **SH_2**
- **Halogenated compounds**
- **Cl_2**
- **Heavy metals**

The heavy metals surveyed have been: arsenic (As), cadmium (CD), crome (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se), and zinc (Zn).

1.1.2 Geographical place

The development field in the year 1996 focused on emissions produced in the urban area whereas in the present-day register, all the municipal areas have been taken into account.

1996
EMISSIONS IN THE URBAN AREA

2005
- **RURAL DISTRICTS**
- **INDUSTRIAL AREAS**
- **AIRPORT**
- **TRAFFIC IN ACCESS ROADS**
- **AIR TRAFFIC**

1.1.3 Survey reach and sectors studied

The focus of the survey has been increased taking into account -apart from the direct emissions of the Emission Register 1996- the indirect emissions derived from electrical consumption and the sink effect produced by vegetation:

1996
DIRECT EMISSIONS

2005
- **DIRECT COLLECTION OF CO_2**
- **INDIRECT EMISSIONS**

The sectors surveyed in the Emission Register 2005 are nearly all of those existing in Zaragoza.

1996

- **RESIDENTIAL SECTOR**
- **INDUSTRIAL SECTOR**

(combustion in big industries)

- **MOBILITY**

2005
Extension:

- **WASTE TREATMENT**
- **INDUSTRIAL SECTOR (production and combustion in the whole sector)**
- **FARM AND STOCKBREEDING SECTOR**
- **USE OF SOLVENTS**
- **DISTRIBUTION OF FOSSILE FUELS**

1.2 COMPILATION OF INFORMATION

For the application of CORINAIR methodology, an exhaustive compilation of information from very different parameters and every sector studied -corresponding to the diverse activities of SNAP- is necessary.

Basically, it has been used data and information given by the different municipal services and other institutions, as well as statistical data from the IAE – Instituto Aragonés de Estadística (Aragon Institute of Statistics) and the INE – Instituto Nacional de Estadística (National Institute of Statistics). Information coming directly from pollutant emission sources through surveys especially prepared and books for the register of emissions have been also compiled.

The strategy for compiling the information has been different in every target sector:

RESIDENTIAL, INSTITUTIONAL AND SERVICES SECTOR

3,000 surveys on residential combustion: household location, type of household, surface, orientation, number of people living there, fuel, time heating is on, hot water device, annual consumption of fuel and electricity, technical characteristics of the boiler.

Three different combustion surveys for the institutional and services sector (singular buildings) and classification into categories: schools and institutes, university, churches and heritage, hospitals, military equipments, culture and leisure, institutions, and others

INDUSTRIAL SECTOR

Classification taking into account SNAP nomenclature: food, concrete, glass, paper, metallic products, iron and steel industry, inorganic chemistry, organic chemistry, and others (not included in any other section)

Direct data from industries with two different questionnaires: sources of emission of the processes (specific for every activity), and combustion systems

Direct data from the Register Books on Emissions of Pollutants by Industries

Data of the European Pollutants Emission Register to the atmosphere -EPER

DISTRIBUTION OF FOSSILE FUELS

Storing of fuels. Store point for predistribution: volume of stored fuel

Petrol Stations: volume of fuel pumped

USE OF SOLVENTS AND OTHER PRODUCTS

Quantity of solvents consumed

Zaragoza´s census of population by district, sections and blocks applied to:

1. Dry cleaning. Perchloroethylene represents the 95% of the solvents used

2. Use of coolers and propellants. Use of HFCs, PFCs and SF_6

3. Use of solvents

MOBILITY

Survey on Mobility to depict Zaragoza traffic. IMD map (Average Traffic Intensity). City of Zaragoza.

Historic evolution of the IMD. City of Zaragoza

Speed map by routes. City of Zaragoza

Population and housing census by districts. Census districts and sections. IAE (Institute of Statistics of Aragon)

Municipal Vehicles Park. IAE

Registration of vehicles by types. IAE

General Statistics Yearbook. DGT (Dirección General de Tráfico)

Age of the vehicles by registration date. Website online motorway

National Car Fleet by province, type and fuel. DGT

National Fleet of Trailers and Semitrailers by province, type and fuel. DGT

Average temperatures in Zaragoza. Instituto Nacional de Meteorología

Number of airflies, fuel consumption, and characteristics of the airline fleet. Zaragoza Airport

FARMING AND STOCKBREEDING SECTOR

Number of hectares and types of fertilizers applied to dry-land and irrigated land

Number of cattle heads

Number of pesticides used

WASTE

Incineration of mud from water treatment: types of incineration, quantity of incinerated mud

Waste treatment: No of equivalent inhabitants

Tanks in dumps: waste quantity

Incineration in crematorium: Number of incinerations

1.3 DETERMINATION OF THE EMISSIONS

CORINAIR´s methodology and its emission factors has been adopted as a framework by all the sectors, even though, due to the diversity of sectors and pollutants, EPA methodology (US Environmental Protection Agency) and data compiled from emission registers such as EPER have also been used.

Unlike the calculations obtained by the emission factors CORINAIR and EPA are based on, priority has been given to real emission data compiled in the emission register books. Extrapolations have been carried out in concrete cases (industrial sector turnover).

RESIDENTIAL, INSTITUTIONAL AND SERVICES SECTOR

The residential sector includes urban districts, rural districts, and scattered homes:

From the survey on combustion in households, the average consumption of fuel (natural gaz and petroleum products) by person is calculated. Regarding solid fuel, the starting information comes from ashes baskets collected as urban waste in every building where coal is used as fuel.

After that, the annual emissions by person are calculated by applying CORINAIR factors.The analysis is rounded by population data coming from heating systems. Emissions by type of fuel and grid are calculated.

The institutional and services sector follows the same process, describing in detail every singular building.

INDUSTRIAL SECTOR

Direct calculation of the emissions from the available data.

CORINAIR methodology (European Environment Agency) is completed with EPA methodology (US Agency for Environmental Protection) in particles.

Extrapolation by sector according to the annual turnover

DISTRIBUTION OF FOSSILE FUELS

Emission of non-methane volatile organic compounds

Application of CORINAIR emission factors in fuel stored at petrol stations

USE OF SOLVENTS AND OTHER PRODUCTS

Others: paints, industrial degreasing, glues, graphic arts, chemical industry (pharmaceuticals…), household products, rubber and plastics, extraction of vegetal oil, leather industry, and pesticides.

Emission of non-methane volatile organic compounds

1. Dry cleaning. CORINAIR emission factor per head and year

2. Use of coolers and propellants. Government of Aragon Register

3. Use of solvents. CORINAIR emission factor for every country. Application by grid.

MOBILITY

Characterisation of the traffic, street measurement and cartography

Introduction of data in the computer system

Application of CORINAIR emission factors taking into account the age, cubic capacity, type of road, and type of vehicle

For air traffic, the emissions of the airport of Zaragoza are calculated by applying CORINAIR emission factor

FARM AND CATTLE BREEDING SECTOR

FARM:

Emission by application of inorganic fertilisers (NH3 and N20), organic (NH3 and N20), and pesticides (CH4 and COVNM)

Application of specific CORINAIR emission factors depending on certain parameters: hectares land use, quantity of fertilisers….

CATTLE BREEDING: Emission by enteric fermentation and administration of the fertilizers (COV and CH4)

Application of CORINAIR emission factors

WASTE

Application of CORINAIR emission factor for the incineration of mud coming from water treatment, waste water treatment, and incineration in crematorium

Direct data from the dump tank

2 RESULTS

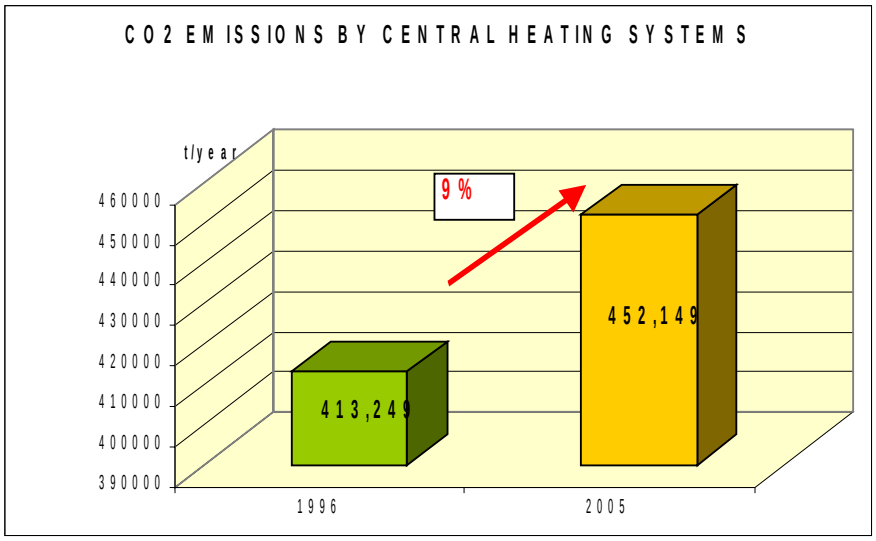
2.1 COMPARATIVE OF EMISSION REGISTERS (ERs1996 – 2005)

When studying the emission registers, a fundamental aspect is to analyze the evolution of pollutant levels while being registered.

The Emission Register 2005 of Zaragoza, with the important above mentioned expansion, cannot be directly compared to the Emission Register 1996. Therefore, a

comparison of emissions in both registers after the first analysis has been implemented, considering only the sectors studied in the ER of 1996.

The following graphics show the results:



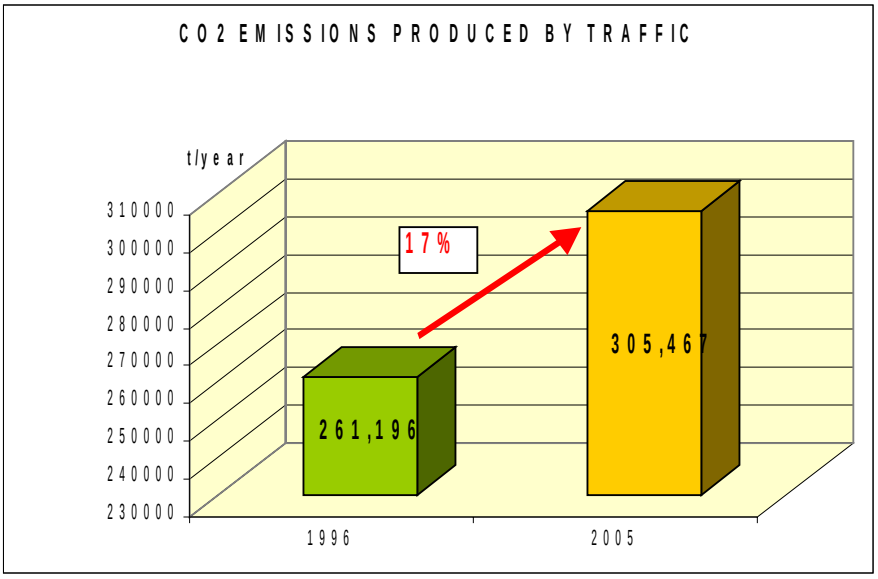
ER.1996:

Survey on several grids and extrapolation to the rest of the city (urban area)

I.E.2005:

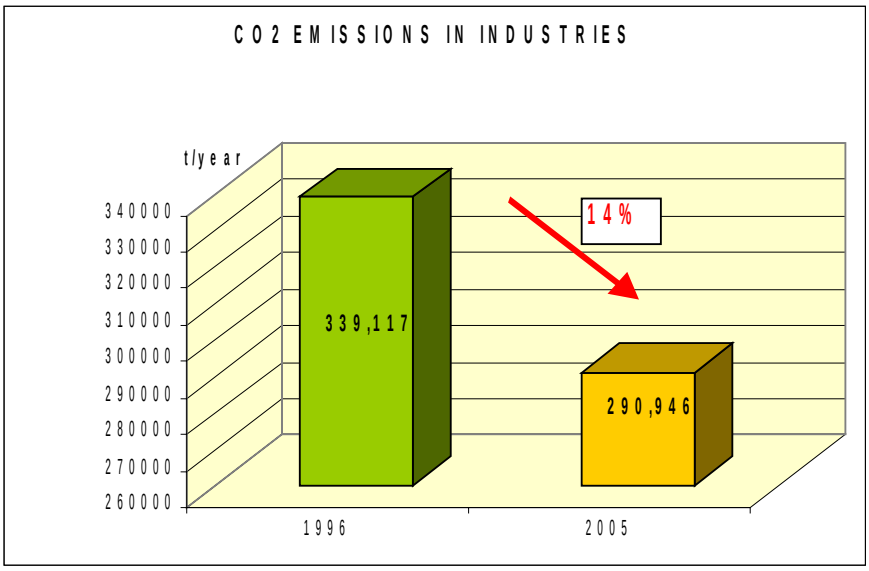
IAEST statistical data-crossing: with real data obtained by survey (urban area)

The graphic shows **urban area** data for years 1996 and 2005



E.R.1996- E.R.2005:
Survey on urban road traffic

The graphic shows a comparison of emissions inside the **city,** in 1996 and 2005



I.E.1996:

Survey on the combustion systems of the 5 main industries of the city

I.E.2005:

Contact with 170 firms, including the urban centre, industrial areas, and districts.

The graphic presents a comparison between emission data of **combustion** systems and the **5 companies** surveyed in 1996 and 2005.

Important differences can be pointed out, both in the methodology used and in the reach of every sector for calculation of the emissions in the three sectors surveyed in the E.R of 1996:

In the residential sector and for the E.R 2005, it was used a cross of statistical data from the IAESTand fuel consumption by census districts, with real consumption data obtained by survey.

The analysis of road traffic was also used in the urban area, the city districts and the roads crossing the municipality.

In the E.R 2005 and in order to calculate industrial emissions, 170 firms – including the city centre, industrial areas, and rural districts- were contacted.

We can only compare CO2 emissions coming from the sectors and fields researched by the Emission Regiser 1995, obtaining an increase of 3.5% of global emissions, whereas emissions per person drop a 5.82%.

↑ Total of CO_2 emissions

↓ CO_2 emissions per person

1996 . **1.68 t CO_2/person·year**

2005 . **1.59 t CO_2/person·year**

2.2 EMISSIONS REGISTER 2005

Eighteen pollutants were analysed in the E.R of 2005, from which only 6 are greenhouse gases (GHG): carbon dioxide CO_2; methane CH_4; nitrous oxide N_2O; sulphur hexafluoride SF_6; hidrofluorocarbons HFCs, and perfluorocarbon PFCs

The following graphic shows the emission of greenhouse gases:

EMISSIONS (t/year)	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
DIRECT EMISSIONS: TOTAL	1,754.290.51	17,598.47	156.64	21.73	0.16	0.23
RESIDENTIAL, INSTITUTIONAL, AND SERVICES SECTOR	463,946.78	1.40	60.46	0	0	0
INDUSTRIAL SECTOR	671,755.44	37.89	21.41	0	0	0
DISTRIBUTION OF FOSSIL FUELS	0	0	0	0	0	0

USE OF SOLVENTS AND OTHER PRODUCTS	0	0	0	21.73	0.16	0.23
MOBILITY	526,133.29	74.48	51.12	0	0	0
WASTE TREATMENT	92,455.00	17,381.20	23.64	0	0	0
FARM AND STOCKBREEDING	0	103.50	0	0	0	0
NATURAL EMISSION SOURCES	0	0	0	0	0	0
DIRECT COLLECTION OF CO2: SINKS	-301,808.00	0	0	0	0	0
INDIRECT EMISSION BY ELECTRICITY CONSUMPTION	407,674.88	2.44	39.01	0	0	0
GLOBAL BALANCE: NET TOTALS	1,860.157.38	17,600.91	195.64	21.73	0.16	0.23

The emissions from the rest of registered pollutants are these:

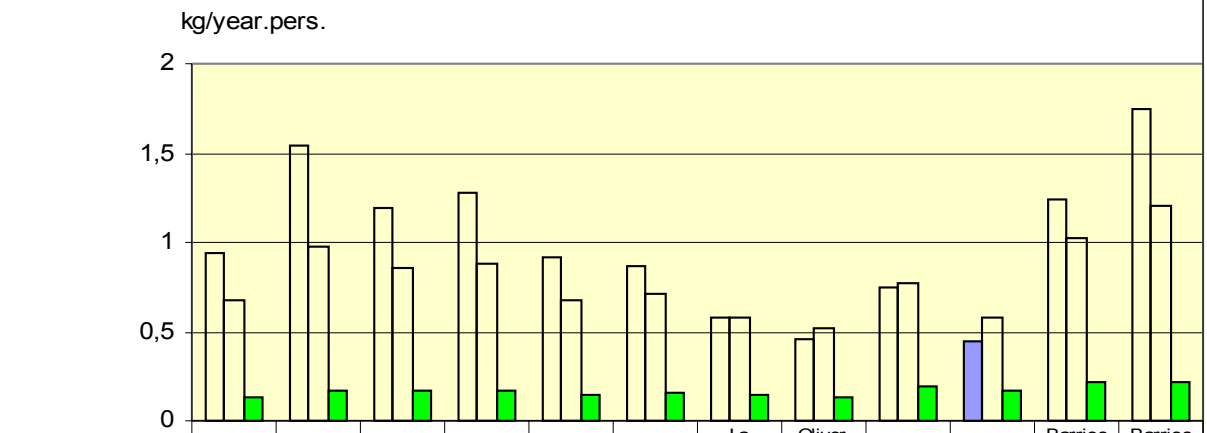
EMISSIONS (t/year)	CO	Partícles	SO_2	NO_X	COV	COVNM	HAPs	NH_3	Halogen compou
DIRECT EMISSION: TOTAL	9,853.17	3,367.66	1,344.67	7,557.39	30,739.88	13,141.41	1.73	207.67	17.59
RESIDENTIAL, INSTITUTIONAL AND SERVICES SECTOR	116.98	2,445.99	630.86	559.21	258.82	257.42	0	0	0
INDUSTRIAL SECTOR	1,581.20	784.39	494.4	4,507.07	3,083.07	3,045.18	0	0.02	0.14
DISTRIBUTION FOSSIL FUELS	0	0	0	0	581.64	581.64	0	0	0
USE SOLVENTS AND OTHER PRODUCTS	0	0	0	0	8,246.00	8,246.00	0	0	0
MOBILITY	7,903.37	129.62	22.84	2,489.01	1,044.12	969.64	1.73	39.97	0
WASTE TREATMENT	251.62	7.66	196.56	1.59	17,383.40	2.2	0	0	17.45
FARMING AND CATTLE BREEDING	0	0	0	0.5	142.83	39.33	0	167.68	0
NATURAL EMISSION SOURCES	0	0	0	0	0	0	0	0	0
INDIRECT EMISSION ELECTRICITY CONSUMPTION	70.34	2610.10	90.52	599.97	1731.41	1728.97	0	0	0
GLOBAL BALANCE: TOTAL	9,923.51	5,977.76	1,435.19	8,157.06	32,471.28	14,870.38	1.73	207.67	17.59

2.2.1 Residential sector: municipal districts

Every district of the residential sector has beeen analysed with the results reflected in the following tables which show annual emissions per person of the most important pollutants in this sector: CO_2, NO_X, SO_2 and particles.

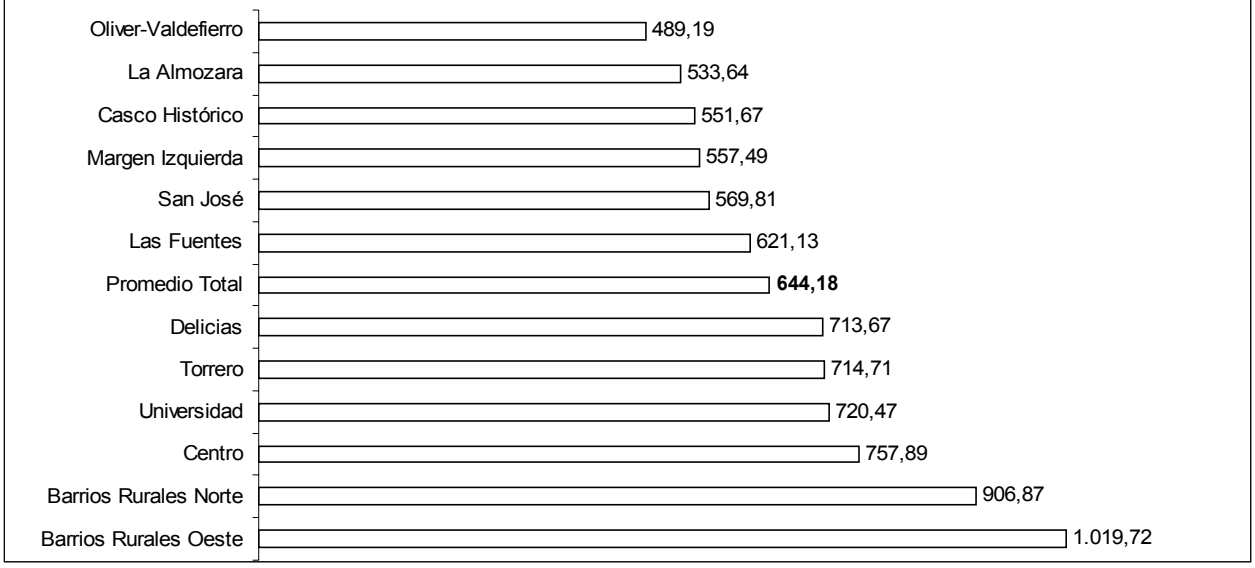
It is important to make it clear that the high quantity of emissions in rural districts are due to the fact that all the boilers analysed use solid fuel or gas oil -in any case natural gas- and also that population is scattered all over the area.

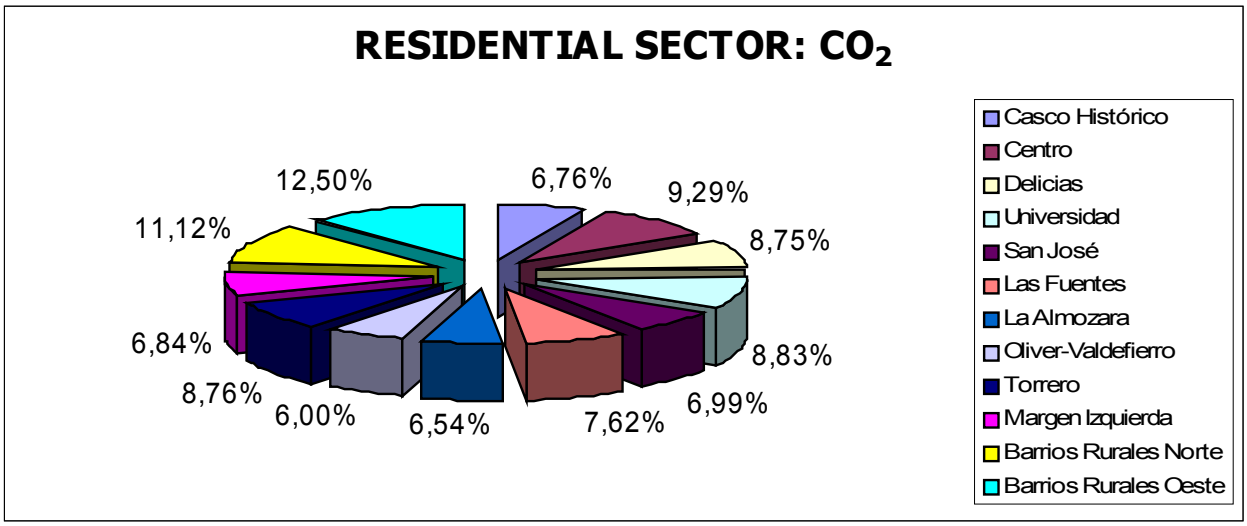
RESIDENTIAL SECTOR: EMISSION POLLUTANTS



	Casco Histórico	Centro	Delicias	Universidad	San José	Las Fuentes	La Almozara	Oliver-Valdefierro	Torrero	Margen Izquierda	Barrios Rurales Norte	Barrios Rurales Oeste
SO2 (Kg/año·hab)	0,942	1,544	1,195	1,276	0,911	0,87	0,581	0,458	0,741	0,441	1,24	1,752
NOx (Kg/año·hab)	0,67	0,97	0,859	0,885	0,678	0,712	0,583	0,516	0,774	0,581	1,022	1,208
CO (Kg/año·hab)	0,133	0,17	0,171	0,172	0,139	0,156	0,145	0,134	0,196	0,163	0,22	0,221

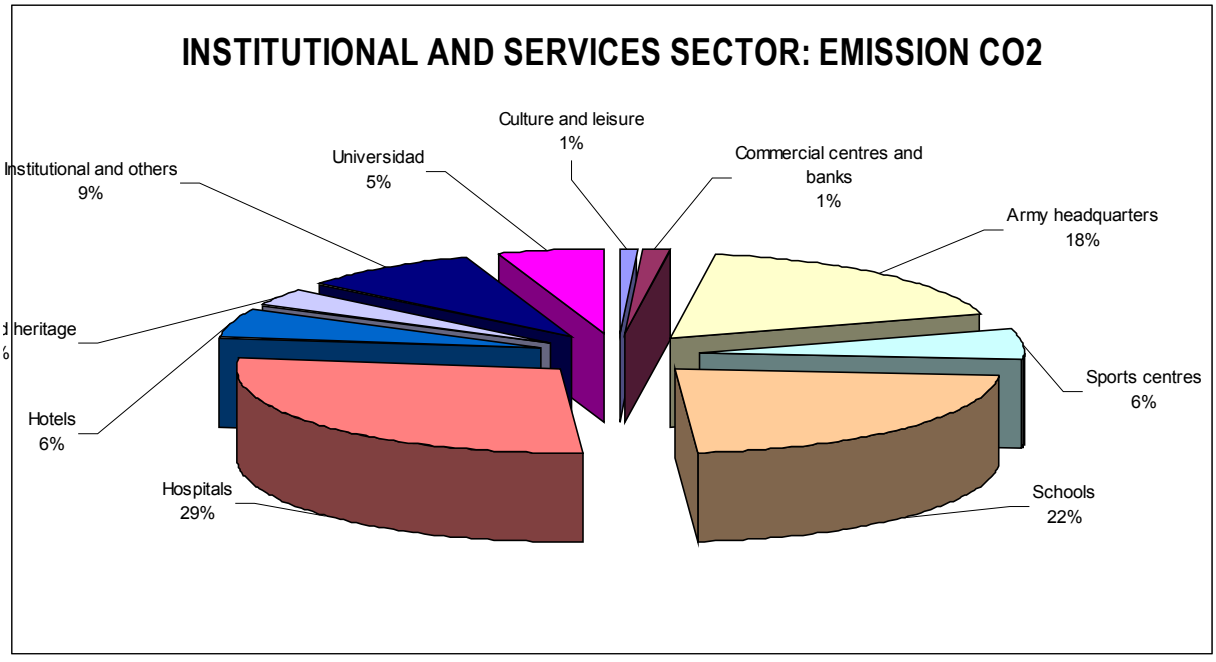
RESIDENTIAL SECTOR. :CO2 emissions by inhabitant and district (kg/inhab·year)





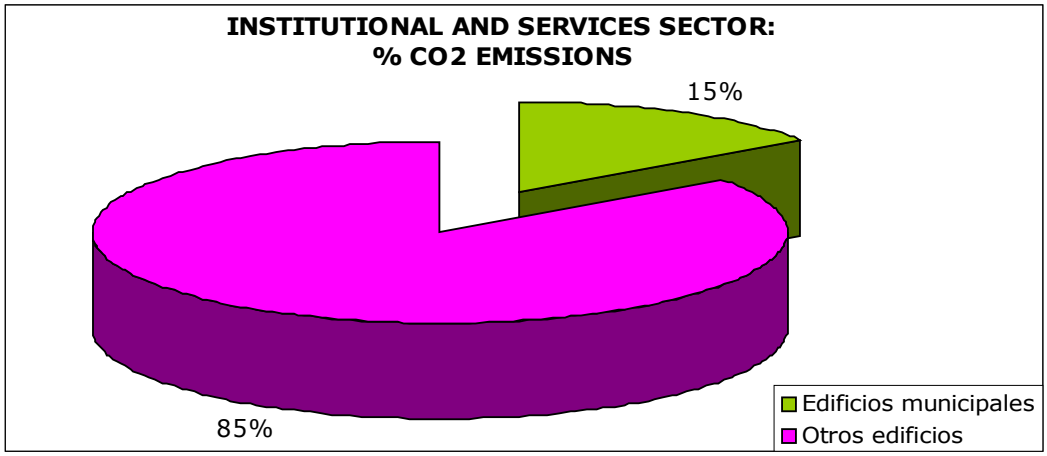
2.2.2 Institutional and services sector

Hospitals -with a 28%- are the main CO_2 producers In the institutional and services sector. The culture and leisure sector has the smallest percentage, with a 0.72%.

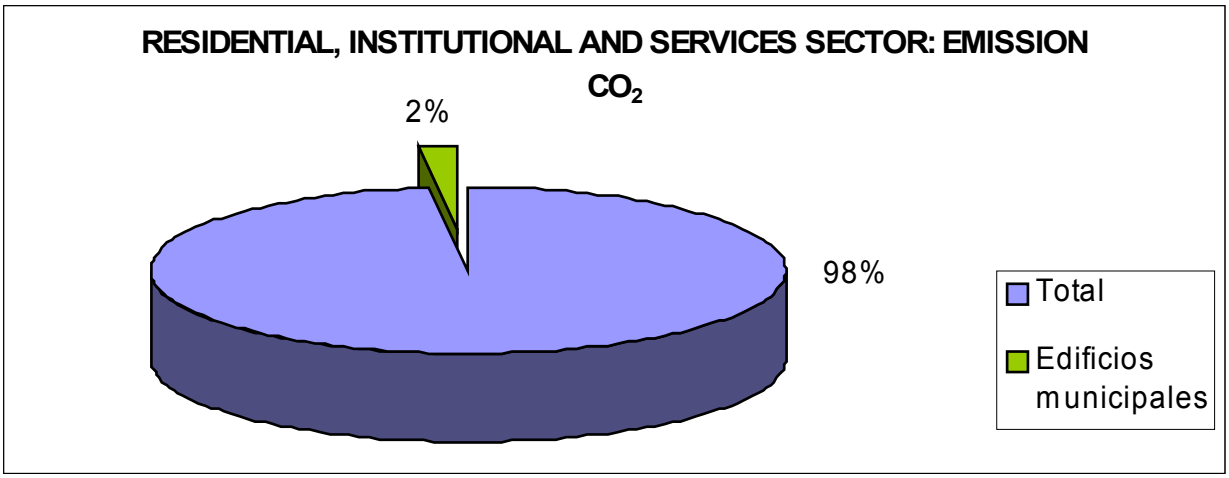


The emissions from municipal buildings represent the 8% of the whole sector of institutional buildings and services, with a total of 5,960.07 tons/year.

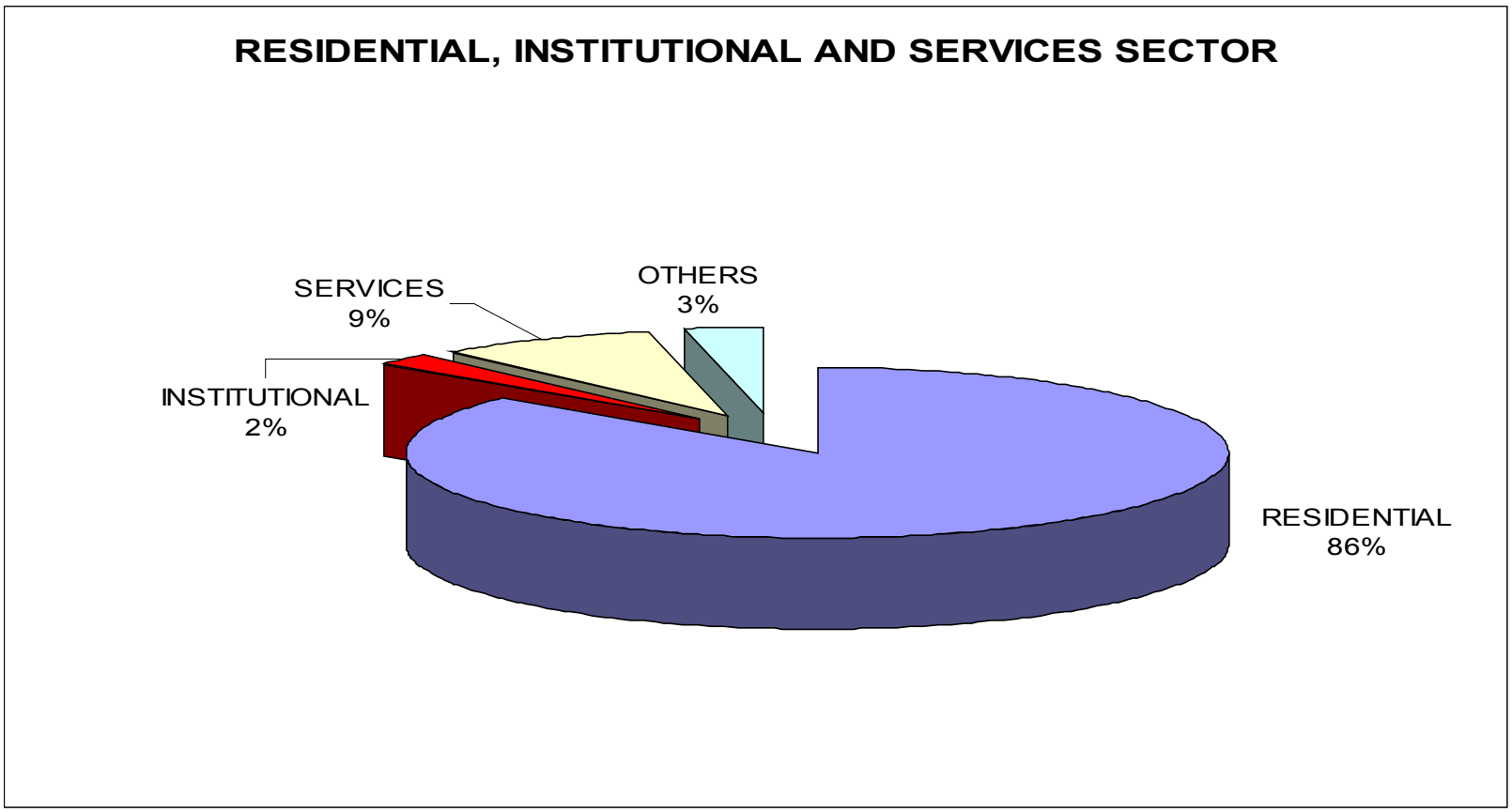
Adding to this figure the emissions sent by the municipal schools managed by the City of Zaragoza, the quantity will be a 15% of emissions in the institutional buildings and services sector. The following graphic presents the total of emissions:



But, taking into accout global emissions in the residential sector and in the institutional and services buildings, CO_2 emission represents a 2%:



The emissions from the residential, institutional and services sector comes mainly from the residential field with an 86%. After that, the highest number corresponds to the services: schools, hospitals, malls, banks, hotels, sports centres, and culture and leisure centres, other military buidings, heritage, the church, and finally the institutional buildings with a 2% of emissions.



2.2.3 Mobility

The biggest part of the emissions from the mobility sector corresponds to road traffic. The emissions coming from air traffic have been analised, but not those from the railway sector.

Traffic emissions has been surveyed through the implementation of partial analyses which reflect the characteristics related to biggest emissions according to the kind of vehicle, type of road, etc, in order to obtain the most complete information for carrying out actions for improving air quality.

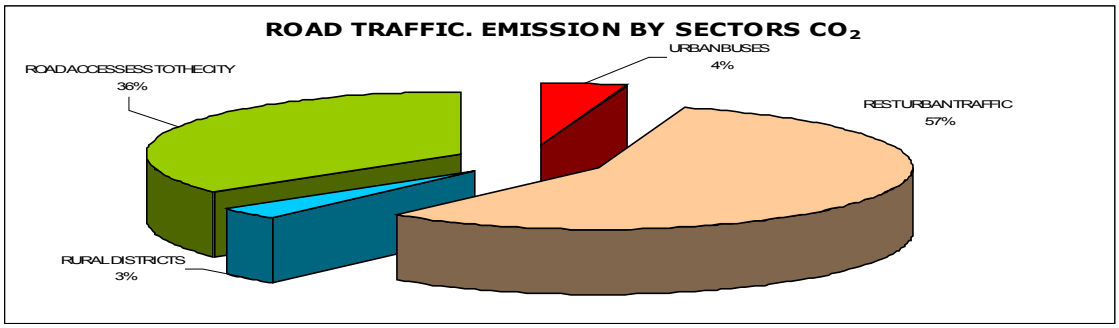
The emissions produced by road traffic and city buses –split up from the rest of city traffic and air traffic- are these:

Direct emission to the atmosphere (t/year) produced by road traffic							
	CO2	CO	Particles	SO_2	NO_X	VOC	NMVOC
URBAN BUSES	22,090.86	49.05	6.73	0.71	180.53	22.42	20.19
REST OF CITY TRAFFIC	283,376.39	4,509.54	72.06	8.26	910.27	638.13	590.41

Direct emission to the atmosphere (t/year) produced by road traffic							
	CO2	CO	Particles	SO_2	NO_X	VOC	NMVOC
RURAL DISTRICTS	16,544.96	263.29	4.21	0.48	53.15	37.26	34.47
ROAD ACCESSES TO THE CITY	178,365.48	2,964.60	46.63	5.46	1,262.95	340.38	319.62
AIR TRAFFIC	25,755.60	116.89		7.92	82.22	5.94	4.95
TOTAL TRAFFIC	526,133.29	7,903.37	129.62	22.83	2,489.12	1,044.12	969.64

In the case of CO_2 emissions produced by traffic, the highest rate belongs to the urban agglomeration, whereas access roads represent half that number.

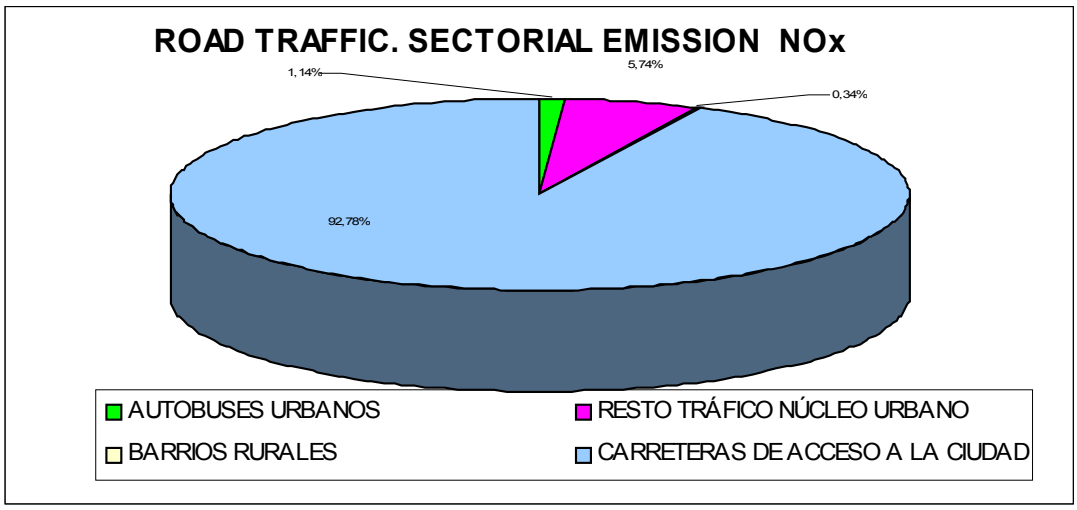
Regarding CO_2, the emissions by sector are showed in this graphic:



The rest of pollutants present similar results as CO_2.

Nevertheless, when talking about nitrogen oxides, we find a notable increase on the percentage of emissions in access roads where the speed allowed is higher.

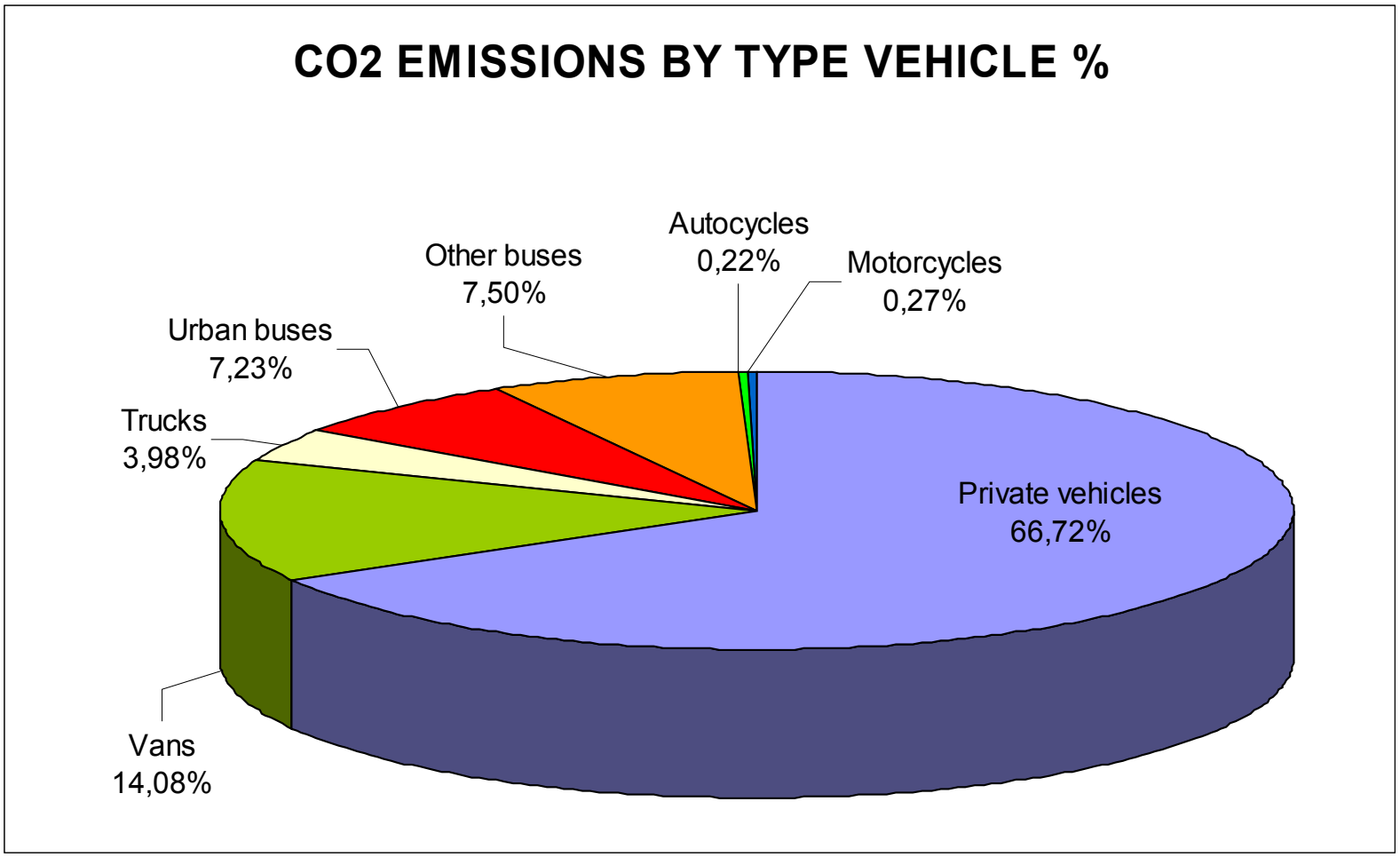
It must also be taken into account that, in those access roads, not all the vehicles registered produce the same quantity of emissions, since they are not only vehicles that drive in and out of the city, but also vehicles passing through the urban area.



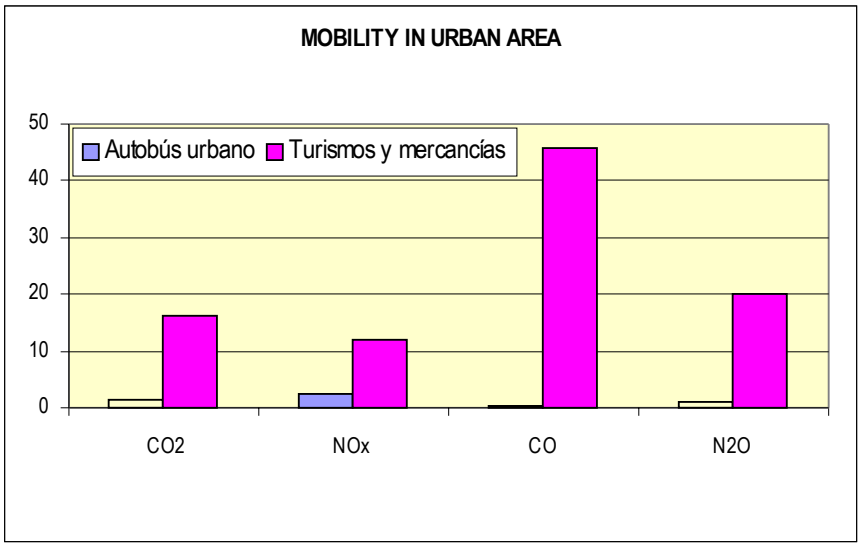
The Emission Register 2005 -as that of 1996- includes the characteristics of the road traffic in the metropolitan area, presenting, among others, the following characteristics:

- In the urban area of the city of Zaragoza, vehicles make approximately 1,020 million km.
- 20% of those kilometres are made by vehicles more than 10 years old
- 58% of those kilometres are made by vehicles less than 5 years old
- 76% of the kilometres are made by cars
- 4% of the kilometres are made by collective means of transport (urban and other kind of buses)
- Vehicles for transporting goods (vans and trucks) make 15%
- 4.4% made by motorbykes and autocycles

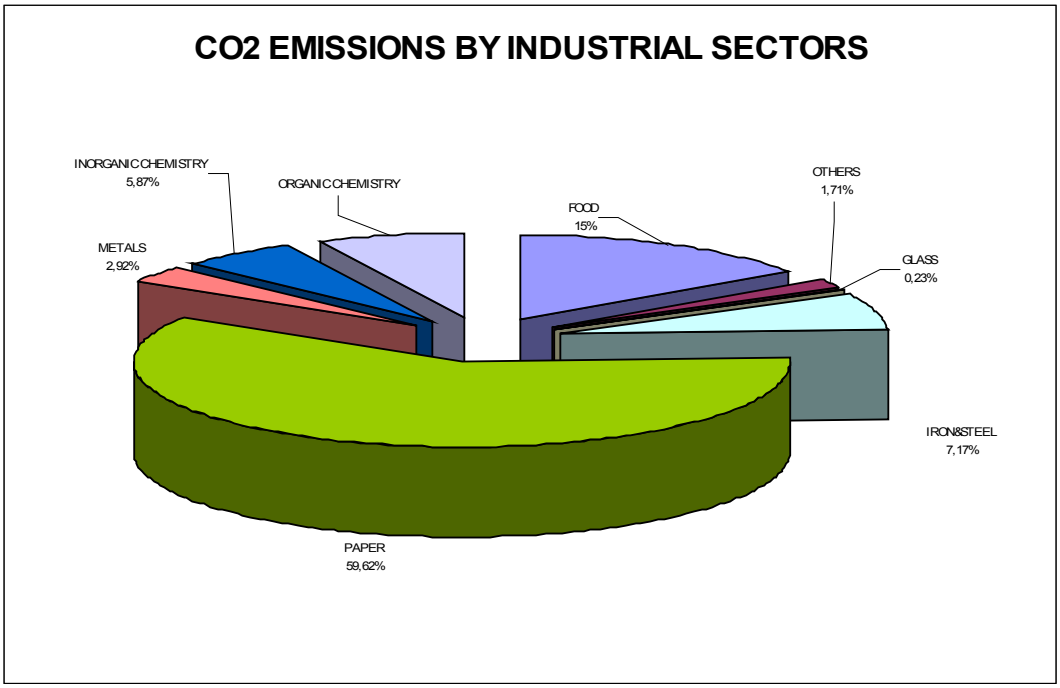
If we represent the percentage of every kind of vehicle, it can be observed that private cars are the main producers of CO_2 emissions, with a 66.7%.



And, sticking to the emissions produced in the city, the following graphic shows that the biggest part of pollutant emissions are coming from private cars and goods vehicles.



2.2.4 Industrial sector

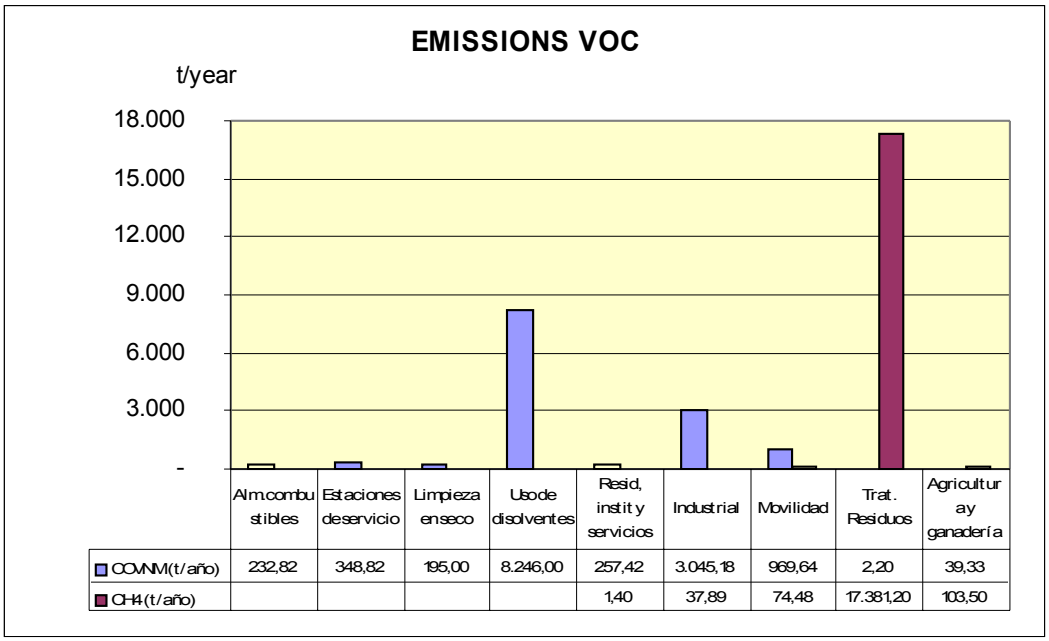


Among the emissions from this sector, we can diferentiate those produced by process sources and those from combustion sources.

The different sectors of the industries of the city produce the following CO_2 emissions.

2.2.5 Emissions of volatile organic compounds

Volatile organic compounds (VOCs) are the result of adding up non-methane volatile organic compounds (NMVOCs) and methane (CH4).



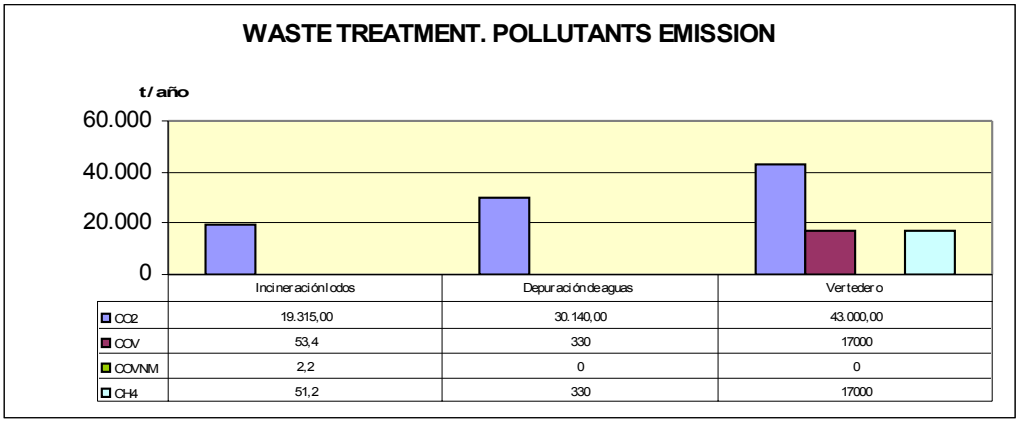
There are several sectors that produce NMVOCs, mainly industrial activities

In the mobility sector, emissions from those substances are produced both by road traffic and by the distribution of fossil fuels in petrol stations and when storing them.

As regards methane –the second most importan greenhouse gas- the biggest quantity is produced by the waste treatment sector and more concretely by dumps.

2.2.6 Waste treatment

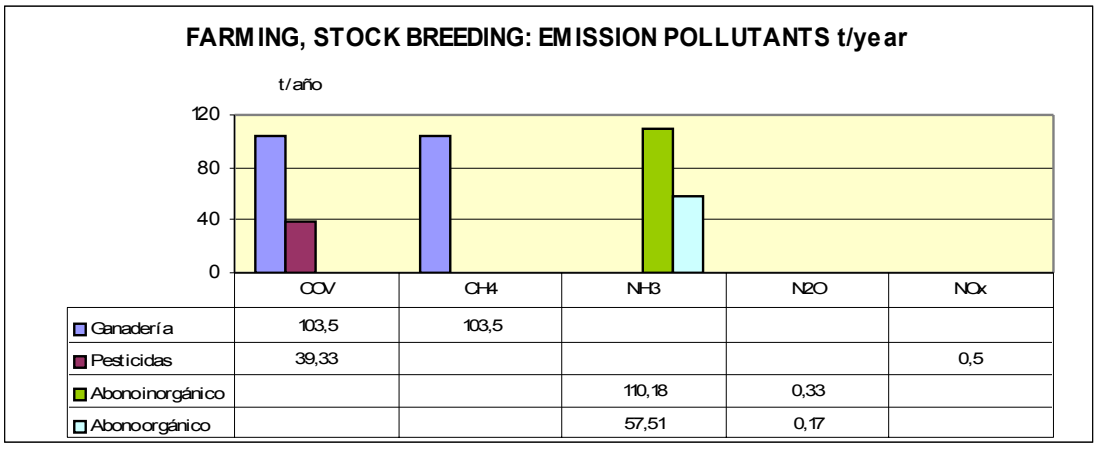
The above graphic shows that the main emissions are produced by carbon dioxide and volatile organic compounds -mainly methane- with a small amount of other VOCs in the case of sludge incineration.



2.2.7 Farming and stockbreeding sector

In this sector, the most important emissions are those from volatile organic compounds and ammonia. non-methane volatile organic compounds are produced by pesticides whereas methane comes from stockbreeding.

Fertilizers produce ammonia and nitrous oxide that, even though in small quantity, they have a high heating power.

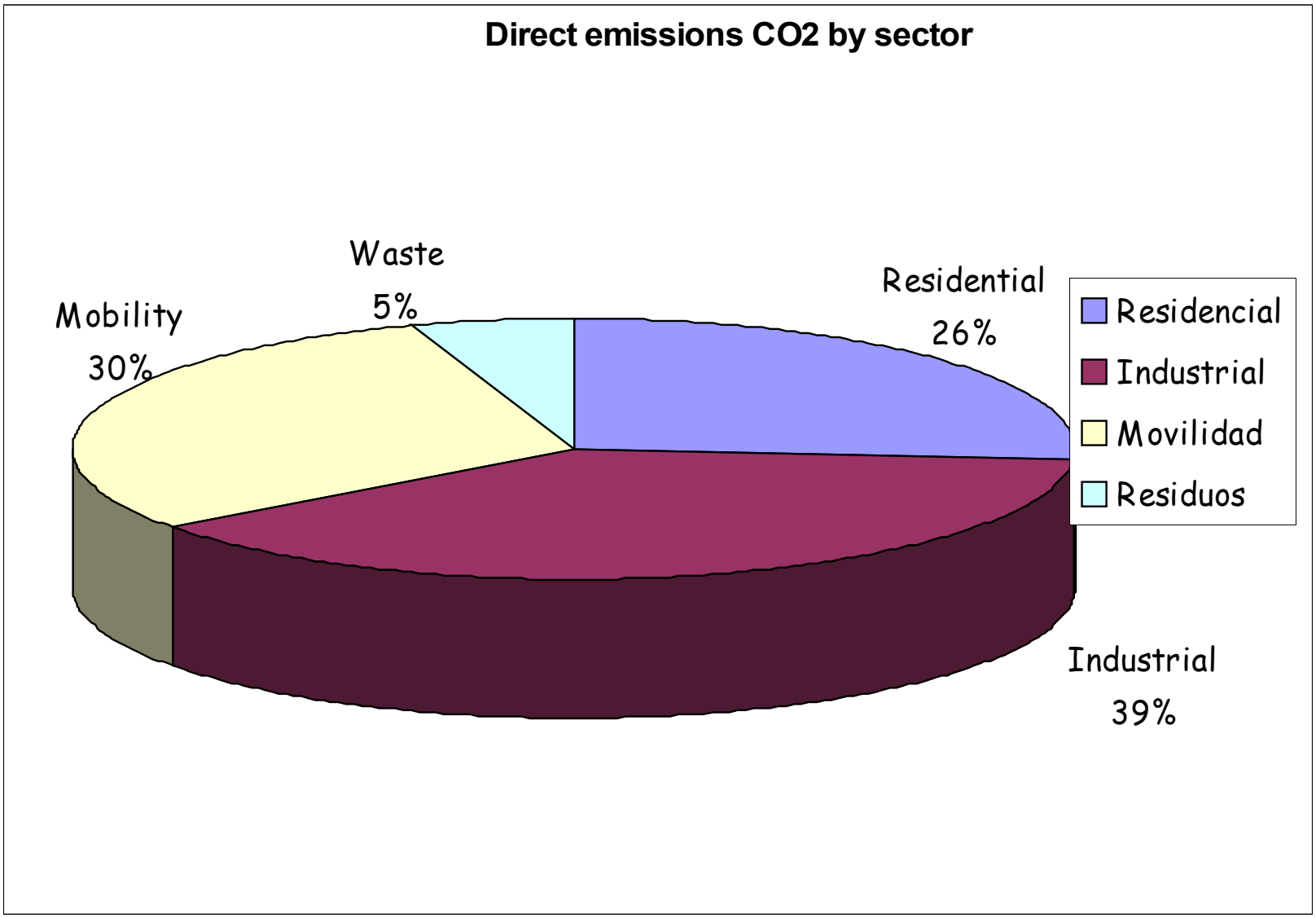


2.3 GLOBAL BALANCE OF CO_2 EMISSIONS

From the point of CO_2 –as main pollutant and responsible of climate change- as far as direct emissions is concerned, the main producer is the industry sector (38.3%), whereas there are big differences between residential, institutional and services sector (26.44%), and mobility -with nearly a 30%.

In the global balance, direct emissions represent the 94.3% of the total amount, taking into account indirect emissions due to electricity consumption (21.92%), whereas the 16.20% of the emissions produced are collected by sinks.

GLOBAL BALANCE OF EMISSIONS	CO_2 (t/year)	%EMISS.
DIRECT EMISSIONS:TOTAL	**1,754.290.46**	**94.31**
RESIDENTIAL, INSTITUTIONAL AND SERVICES	463,946.73	24.94
INDUSTRIAL SECTOR	671,755.44	36.11



MOBILITY	526,133.29	28.28
WASTE TREATMENT	92,455.00	4.97
DIRECT COLLECTION OF CO_2: SINKS	**-301,808.00**	-16.22
INDIRECT EMISSION: ELECTRICITY CONSUM.	**407,674.88**	21.92
GLOBAL BALANCE: TOTAL	**1,860.157.34**	

3 REPRESENTATION OF THE RESULTS. CARTOGRAPHY

Once the emissions are known after the application of the methodology from the available data, and the results have been analysed, a cartographic representation is made through ArcView from the SIG programme (Sistema de Información Geográfica).

The city is divided into grids of 500 x 500 metres to establish the emissions produced in everyone of them. Therefore, the grid is the spatial unit to calculate the emissions of every pollutant and parameter in order to know and analize them both globally and independently. UTM localization coordinates have been assigned to the precise emission sources.

In every grid can be known the concentration emitted globally or by every activity sector.

The register includes a basis of general maps, including cartography, division into grids, and land uses.

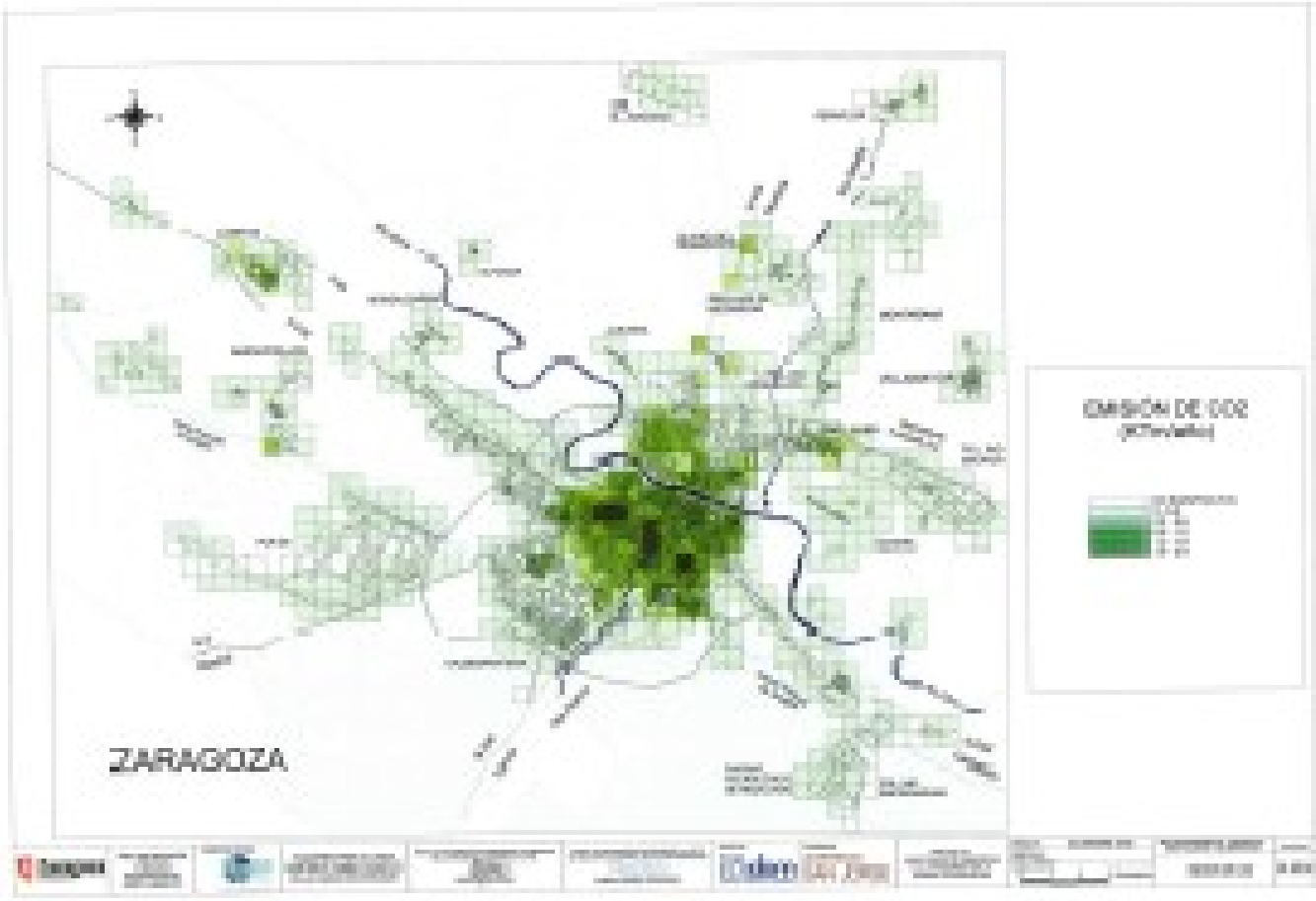
There is a layout plan for the residential and industrial sector, use of solvents, waste treatment, farm and stockbreed sector, and carbon sinks.

Sources are also localised in the first four sectors and there is also a map for every pollutant registered.

For mobility, apart from maps for every pollutant, there are others with traffic flow as well as propolsals for the reorganization of the bus service, pedestrian networks, commuter train, light rail, etc.

There are also seven global contribution emission maps from eleven of the pollutants registered.

As an example, the global maps of CO_2, NO_x and particles, as well as a map with the emission of those three pollutants in the residential, mobility, and industrial sectors are included.


ZARAGOZA

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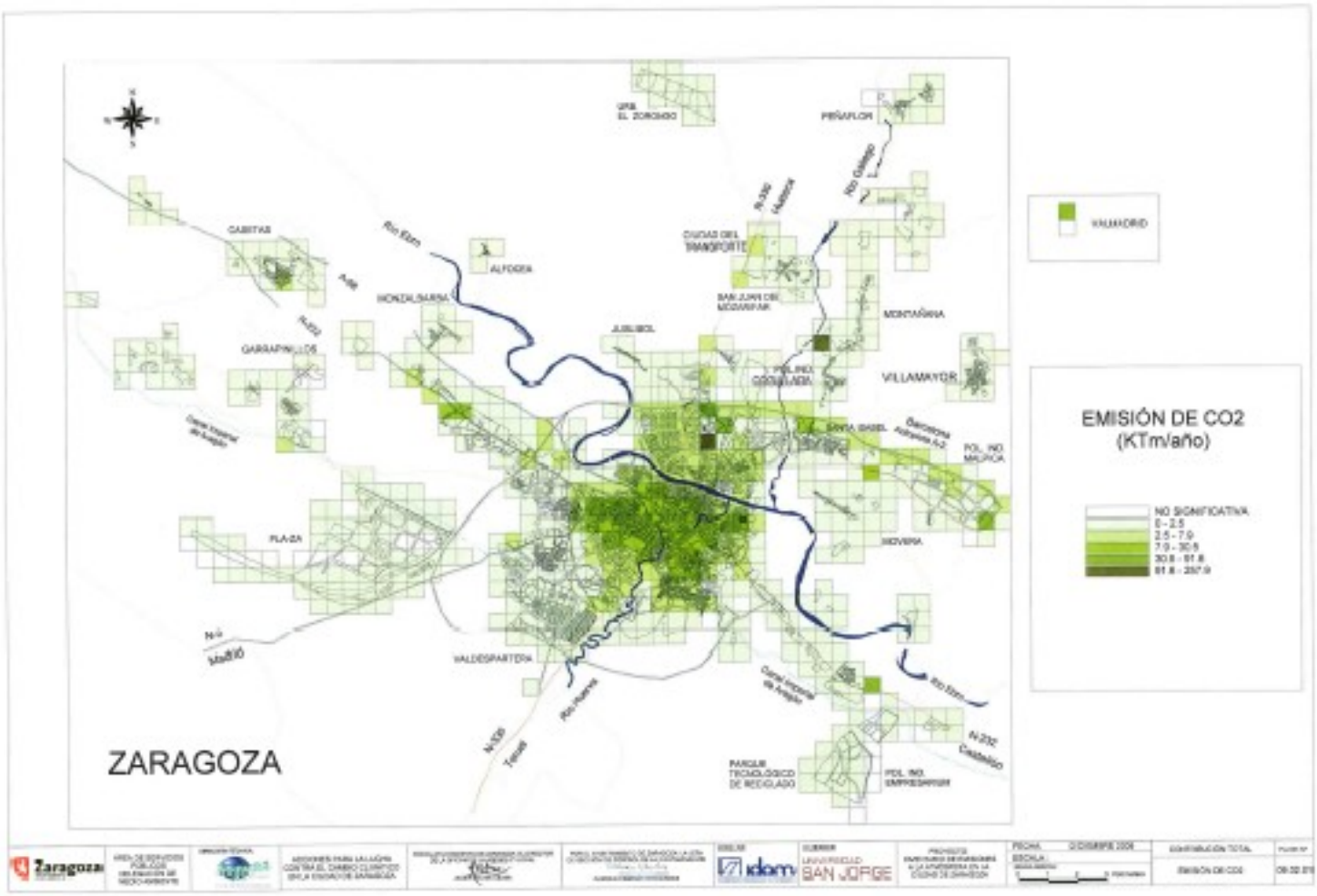
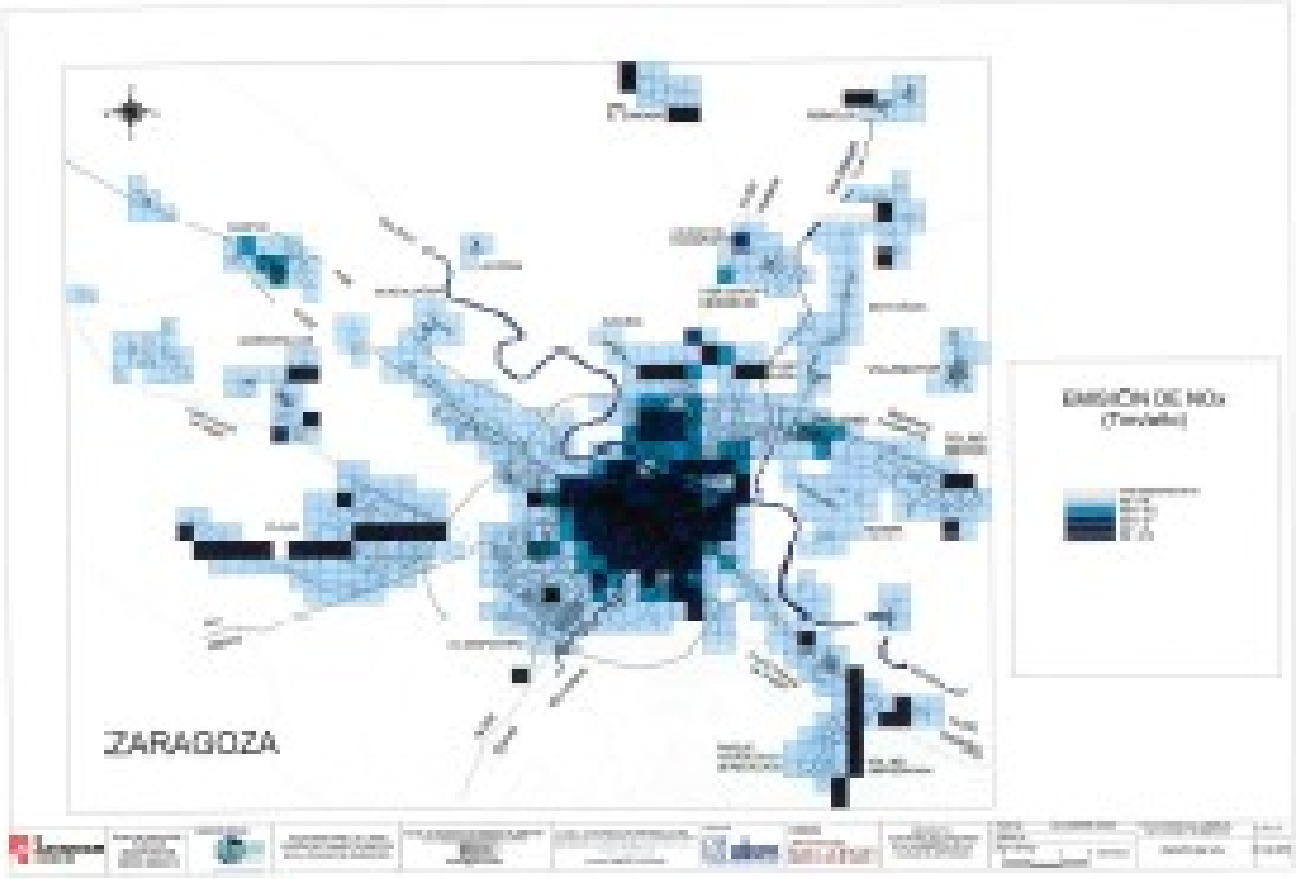
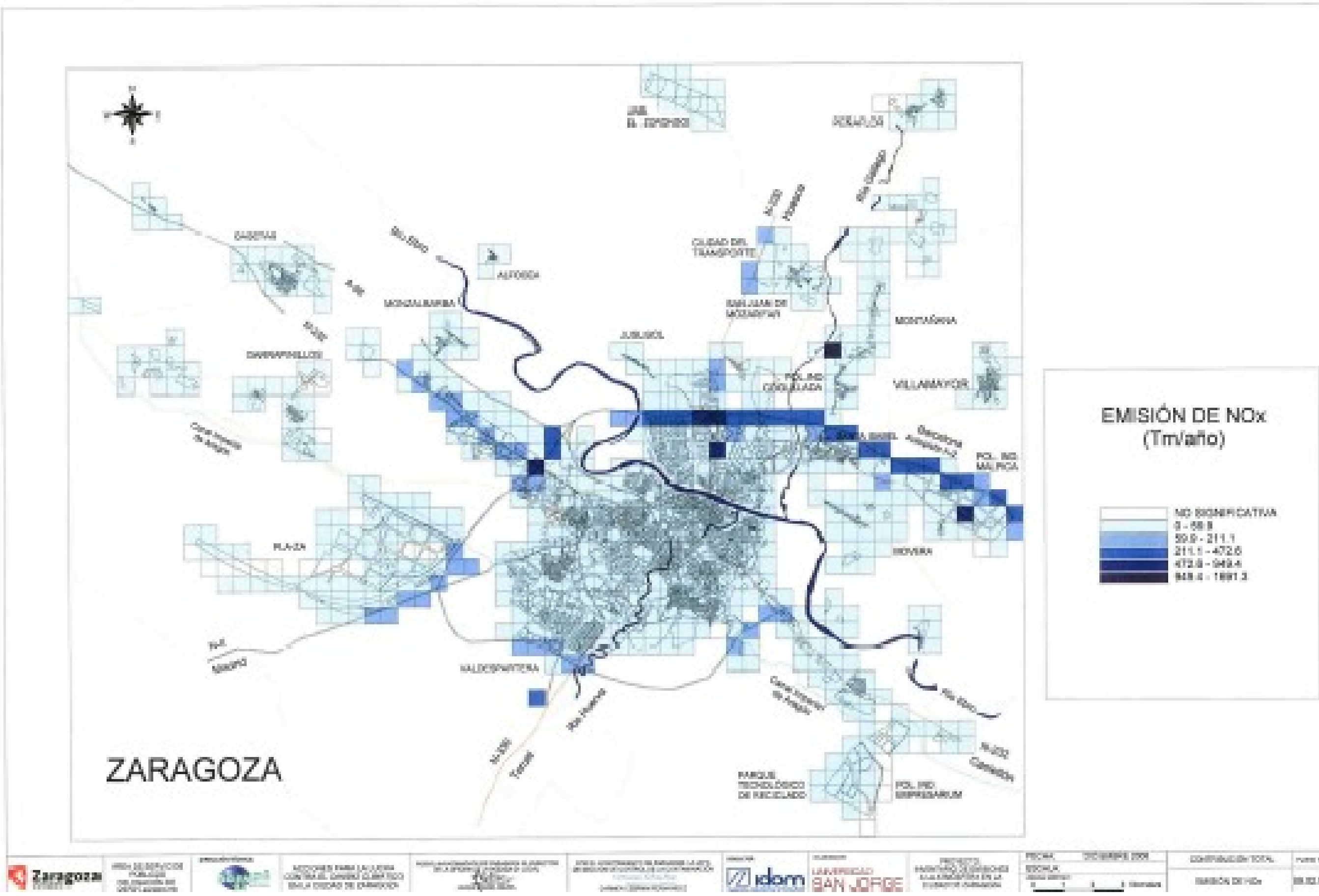
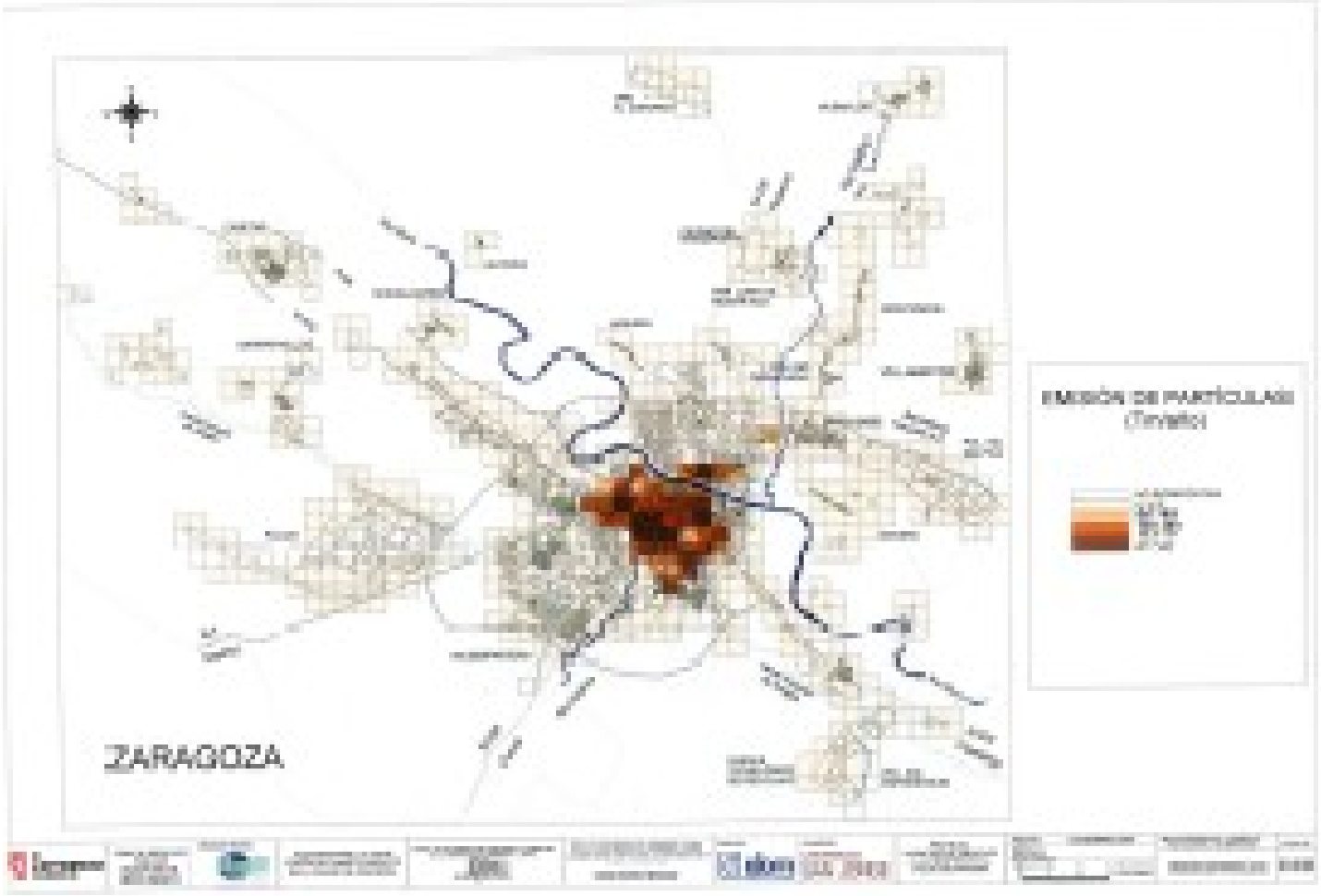
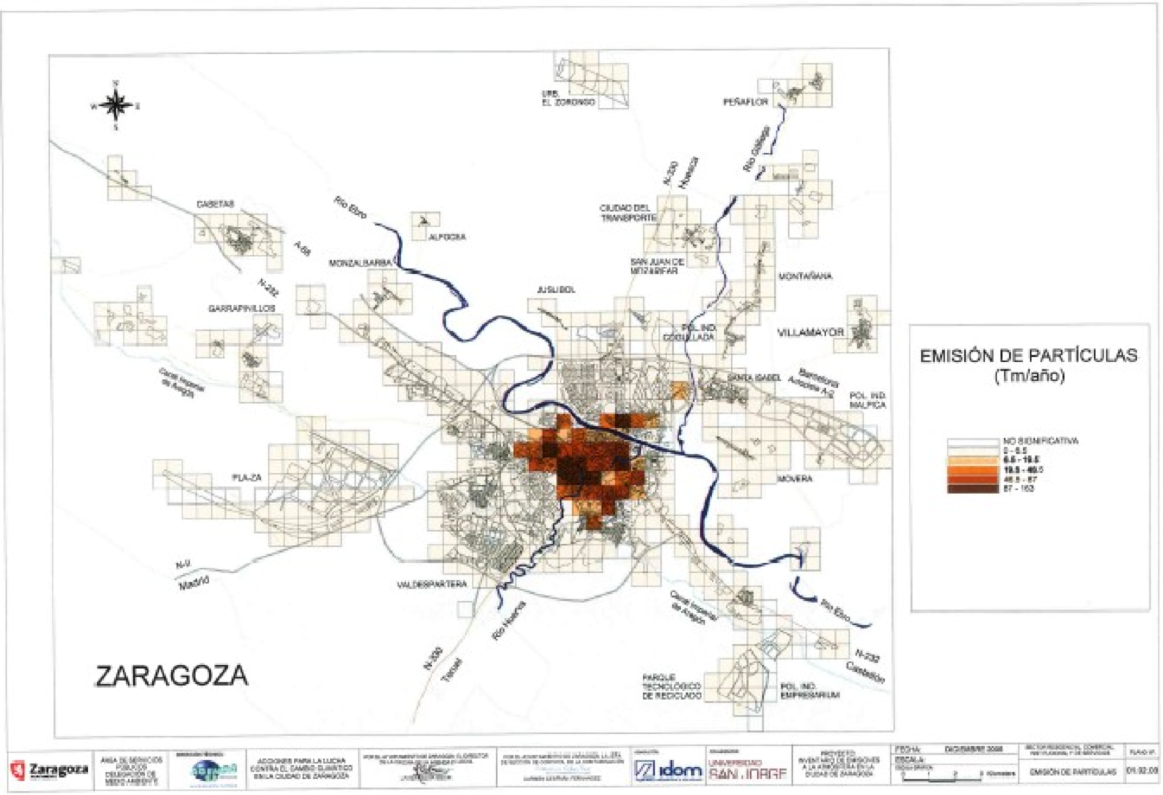

ZARAGOZA
EMISIÓN DE CO2
(KTm/año)
NO SIGNIFICATIVA
0 - 2.5
2.5 - 7.9
7.9 - 30.8
30.8 - 91.8
91.8 - 257.9
VALMADRID
CABAÑAS
GARRAPINILLOS
ALFOZEA
MONZALBARBA
PEÑAFLOR
MONTAÑANA
VILLAMAYOR
SANTA ISABEL
MOVERA
PLAZA
VALDESPARTERA
Río Ebro
Río Huerva
Canal Imperial de Aragón
PARQUE TECNOLÓGICO DE REOLADO
POL. IND. EMPRESARIUM
POL. IND. MALPICA
Zaragoza
idom
UNIVERSIDAD SAN JORGE


ZARAGOZA


EMISIÓN DE NOx
(Tm/año)
NO SIGNIFICATIVA
59.9 - 211.1
211.1 - 472.6
472.6 - 949.4
949.4 - 1691.3
ZARAGOZA
CASETAS
GARRAPINILLOS
MONZALBARBA
ALFOCEA
PLAZA
VALDESPARTERA
JUSLIBOL
CIUDAD DEL TRANSPORTE
SAN JUAN DE MOZARRIFAR
POL. IND. COGULLADA
MONTAÑANA
VILLAMAYOR
PEÑAFLOR
SANTA ISABEL
POL. IND. MALPICA
MOVERA
PARQUE TECNOLÓGICO DE RECICLADO
POL. IND. EMPRESARIUM
Zaragoza
idom
UNIVERSIDAD SAN JORGE
EMISIÓN DE NOx


ZARAGOZA
EMISIÓN DE PARTÍCULAS
(Tn/año)


EMISIÓN DE PARTÍCULAS
(Tm/año)
NO SIGNIFICATIVA
0 - 6.5
6.5 - 19.5
19.5 - 46.5
46.5 - 87
87 - 152
ZARAGOZA
URB. EL ZORONGO
PEÑAFLOR
Río Gállego
N-330 Huesca
CIUDAD DEL TRANSPORTE
SAN JUAN DE MOZARRIFAR
MONTAÑANA
VILLAMAYOR
POL. IND. COGULLADA
SANTA ISABEL
Barcelona Autovía A-2
POL. IND. MALPICA
MOVERA
JUSLIBOL
Río Ebro
ALFOCEA
MONZALBARBA
CASETAS
A-68
N-232
GARRAPINILLOS
Canal Imperial de Aragón
PLA-ZA
N-II Madrid
VALDESPARTERA
N-330 Teruel
Río Huerva
Canal Imperial de Aragón
N-232 Castellón
PARQUE TECNOLÓGICO DE RECICLADO
POL. IND. EMPRESARIUM
Zaragoza
ACCIONES PARA LA LUCHA CONTRA EL CAMBIO CLIMÁTICO EN LA CIUDAD DE ZARAGOZA
idom
UNIVERSIDAD SAN JORGE
FECHA: DICIEMBRE 2008
ESCALA:
EMISIÓN DE PARTÍCULAS
01.02.09

4 CONCLUSSIONS FROM THE EMISSIONS REGISTER 2005

We highlight the following conclussion of the analysis of the ER 2005:

a) The industrial sector presents the highest emission levels of pollutants such as CO_2, NO_X, heavy metals, and the full emission of SH_2.

b) Emissions of CO_2 per person have beem reduced a 14% in the industrial sector in relation to the previous register.

c) CO_2 emissions in the residential sector have increased 9% from 1996, date in which the previous register was made.

d) The residential, institutional and services sector stands out by the emission of particles mainly due to coal consumption for heating.

e) The increase of CO_2 emissions from the previous register is very important in the mobility sector: 17%.

f) An 80% of CO_2 emissions are produced by the mobility sector.

g) Mobility also contributes in an important way to NO_X, 32.93%; N_2O, 32.64%; and CO_2 29.9%

h) Waste treatment -mainly dumps- produces a 98% of CH_4.emissions.

i) The rest of the emissions of other greenhouse gases registered
- sulphur hexafluoride SF_6, hidrofluorocarbons and perfluorocarbons- are produced by the use of solvents.

j) The emission of non-methanic volatile organic compouns (NMVOCs) are mainly due to activities that use solvents.

k) The farming and stockbreeding sector produces the biggest quantity of ammonia emission, NH_3, with an 81%.

l) Indirect emissions due to the use of electricity represent the 18.86 of the total atmosphere emissions, without taking into account the sink effect of plants. The percentage represented by renewable energies in the total of direct energy consumption (biomass) is about 2%.

m) City vegetation contributes to the sink effect, collecting a 16% of CO2.emissions.

Apart from general conclusions, the ER 2995 allows us to draw others more concrete:

a) Emissions produced by the municipal services and buildings of the City of Zaragoza, represent around a 2% of CO_2 and other pollutants of the residential, institutional and service sector.

b) By districts, the highest number of CO_2 emissions from the residential sector is produced by Delicias district, and for the rest of pollutants, the lowest is also produced in western rural districts.

c) Nevertheless, if we analyse emissions per inhabitant, the highest figure comes from western rural districts -with 1,019.75 kilogramms per inhabitant and year of CO_2 - and the lowest from Oliver-Valdefierro district. Both conclusions are characteristic of rural districts, with a low and scattered density of population, where gas oil and solid fuels are mainly used.

d) Regarding industry, the highest emission of CO_2 corresponds to the paper sector (59.62%), and food (15.18%), which is reasonable taking into accout that these sectors include the majority of the big industries of the city.

e) It can also be highlight in Zaragoza the iron and steel sector, which produces the higuest emission of CO2, SO_2 and heavy metals.

f) The emissions of NMVOCs from the industrial sector –a 23.17% of the total- are produced by the chemical organic industry, with nearly an 87%

g) CO_2 emissions produced by city traffic represent the 56.66%, without taking into account urban buses, which represent the 4.4% in the city and access roads to city districts.

h) Traffic in access roads represent the biggest contribution to NOx emissions (52.47%) with respect to the total of emissions of this pollutant.

i) Regarding pollutants other than nitrogen oxides, the highest emission values are produced in the urban agglomeration.

j) By kind of vehicle, CO_2 emissions are produced by private cars (66.7%), followed by vans and trucks (14% and 4%), buses (14.7%), and finally bikes and motorbykes (5%)

k) Emissions produced by traffic take place mainly in the urban area, with around a 60%, except the pollutant NOx (45%). Half of NOx emissions and more than a 30% of other pollutants are produced in access roads used to a large extent by vehicles going past the city, not driving into it.

5 GLOBAL BALANCE OF GREENHOUSE GAS EMISSIONS

In order to make the balance of greenhouse gas emissions (GHG) is necessary to value the Global Warming Potential (GWP) corresponding to other types of greenhouse gas and know the contribution of every pollutant to the equivalent emissions of CO_2.

GWP is a concept developed to compare greenhouse effect contribution of different gases, with CO_2 as referent. If we define Global Warming Potential as *the warming effect integrated along time which produces an immediate release of 1kg of greenhouse gas compared to the quantity caused by* CO_2, the equivalent emissions of CO_2 are calculated by multiplying the real emissions of every pollutant by its GWP.

Green-house gas	**Emissions 2005 (tons/year)**	**GWP**	**Equivalent emissions CO_2**	**%**
CO_2	1,860.157.38	1	1,860.157.38	78.9
Methane CH_4	17,600.91	23	404,820.87	17.2
Nitrous oxide N_2O	195.64	296	57,909.94	2.5
Hydrofluorocarbon HFC	21.73	1,300	28,243.80	1.2
Perfluorocarbon PFC	0.16	8,600	1,379.96	0.1
Sulphur hexafluoride SF_6	0.23	22,200	1,138.41	0.2

CLIMATE CHANGE AND AIR QUALITY STRATEGY

1 ECAZ: PREVIOUS DATA AND GOALS

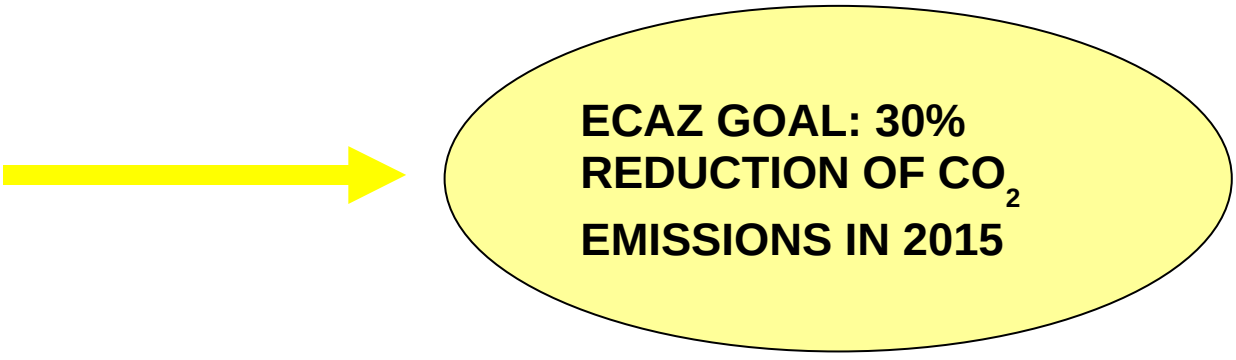
ZARAGOZA CLIMATE CHANGE AND AIR QUALITY STRATEGY comes from the evident need to implement measures in order to improve air quality and mitigate and adapt to climate change.

The evaluation of the starting situation was carried out from the Emission Register 2005 which provided the diagnosis of the situation, a necessary element to adopt the most adequate measures in every case.

The analysis of the conclusions of the ER 2005 is the framework for planning the strategy to be developed through setting up the fields where determined actions are necessary or indispensable, or are idoneous for the application of certain measures. Once the actions have been established and defined, a strategic map offering the global vision of the Estrategia de Cambio Climático y de Calidad del Aire de Zaragoza (Zaragoza Climate Change and Air Quality Strategy – ECAZ) is already available.

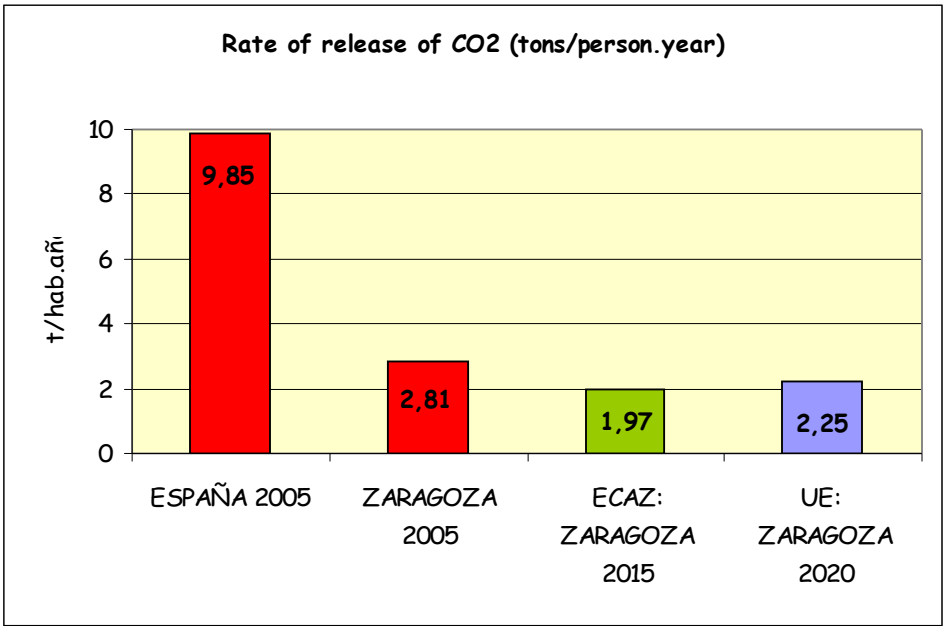
The following step is to make a first estimate of the expected evolution of the emissions -if the present tendency continues- taking into account factors such as the number of inhabitants and vehicles, city growth, etc. Finally, an estimate is made on the reduction of emissions sent to the atmosphere, according to the application of the ECAZ for the year 2015 and taking into account the emission reduction after the implementation of the foreseen measures.

With these premises, the general objective of ECAZ is established, setting out a global reduction of **30%** of CO_2 emissions per inhabitant for the year **2015**, which will mean an emission rate of 1.97 tons of CO_2 per inhabitant.



Therefore, the goal of Zaragoza Climate Change and Air Quality Strategy is to reduce the emission rate of CO_2 in Zaragoza to 1.97 tons of CO_2 per person for the year 2015.

This quantity is much more ambitious than that derived from the goal established by the European Union –a reduction of 20% of CO2 emissions for the year 2020, which will represent a rate of 2.25 tons of CO_2 per person in Zaragoza.



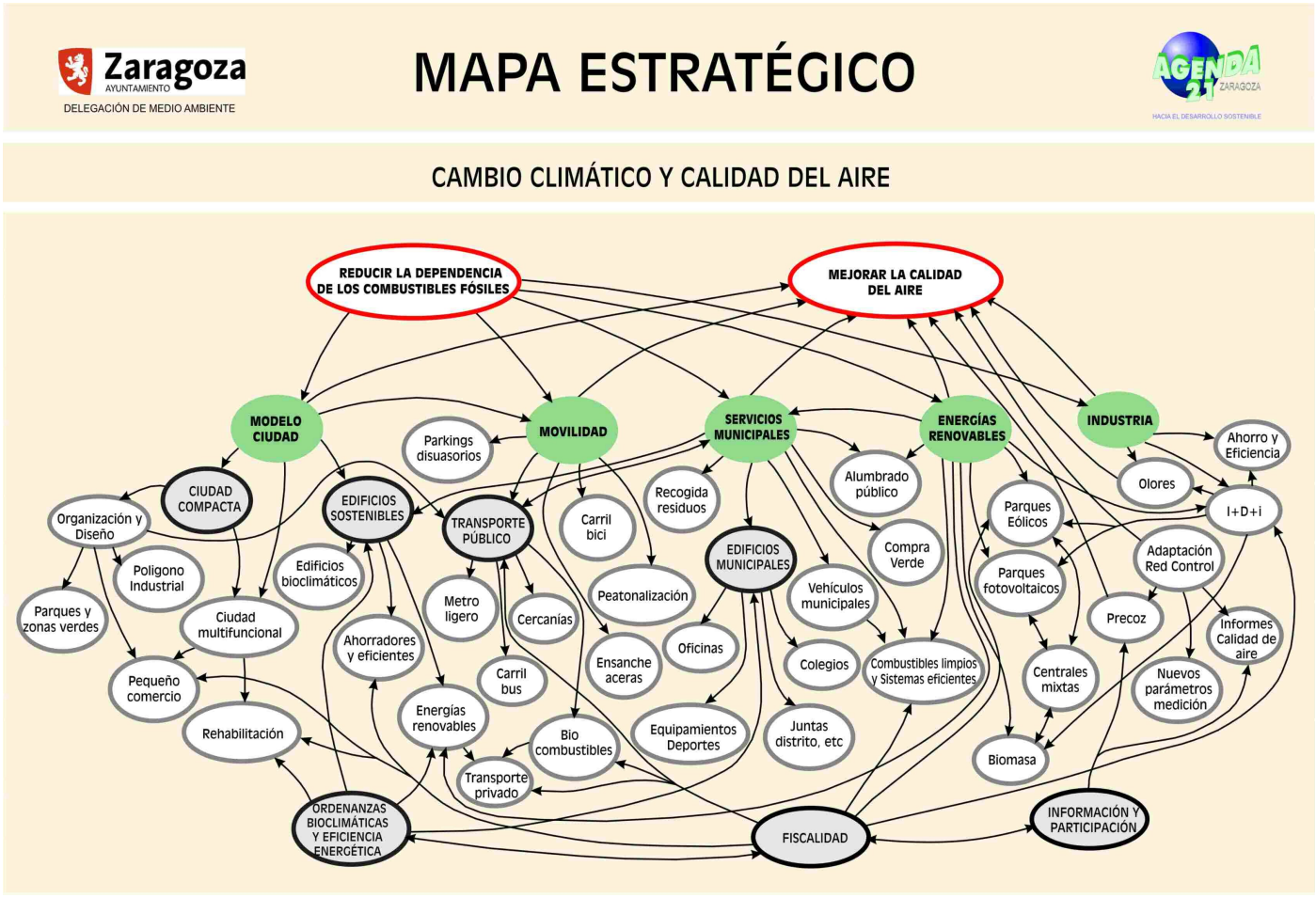
In order to achieve this goal -with the implicit reduction of all the pollutants in a bigger or lesser degree- the register must by analised from every point of view: origin and amount of the emissions, affected areas, natural characteristics of the areas… ,in order to get a strategic vision for obtaining the highest effectiveness in the actions.

After this analysis, it has been drawn up a strategic map that contains the approaches and goals for ECAZ development, with two global objectives: *reduce dependency on fossile fuels and improve air quality.*

In order to attain these two objectives, five fields of action have been established: city model, mobility, municipal services, renewable energies, and industry. At the same time, the actions to be implemented are defined and interrelated.

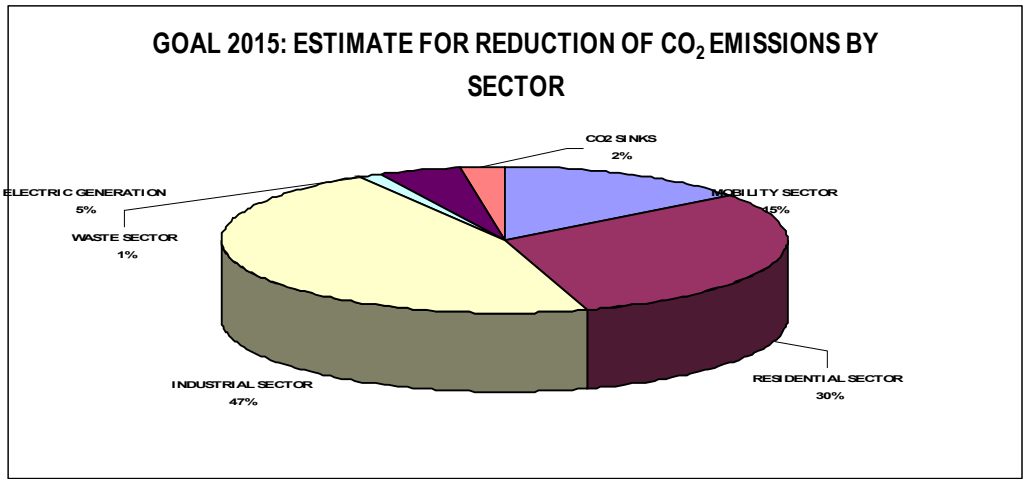
And all the above goals and its fields of actions are implemented with the corresponding legal, fiscal, and citizen participation and information actions.

STRATEGIC MAP. CLIMATE CHANGE AND AIR QUALITY



2 ECAZ: ACTION FIELDS AND ACTIONS

ECAZ is setting out two goals for its strategic map: to improve air quality and to reduce dependency on fossile fuels, and has established five action fields for the plan and implementation of the necessary actions to reach its goals. The following graphic shows an estimate in the reduction of emissions by sectors:

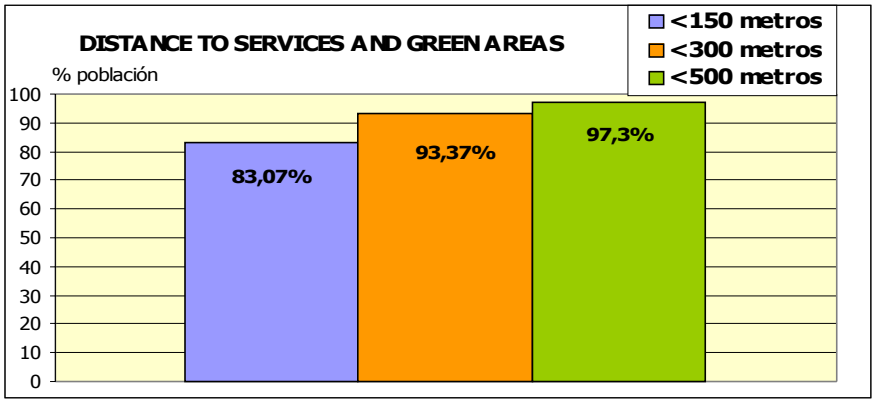


2.1 CITY MODEL

In general terms, the goal is to keep the compact and multifunctional city through the promotion of an efficient and adequate use of energy consumption systems.

It is about contributing to decentralize tertiary uses in a way that the citizens can have their needs covered without doing long trips, and reducing car dependency.

In order to value the city model, the European Common Indicator A4 was established. This indicator reflects the availability of open public areas and basic local services, and offers very appropriate results in its last updating: over 97% of the population lives less than 500 metres away from local public services and green areas. The updating of this indicator is still to be done, after the transformation suffered by the city in the last years



2.1.1 RESIDENTIAL, INSTITUTIONAL AND SERVICES SECTOR: SUSTAINABLE BUILDINGS

a) Analysis of the Emission Register

This sector stands out by the emission of particles (total of 72.63%), mainly due to coal consumption for heating, and contributes in an important way to SO_2 emissions (46.92%)

From the total of CO_2SO_2 emissions, a 23% comes from fuel consumption produced by households and small shops.

Among institutional buildings –municipal or not- the emission of schools and institutes, which have the biggest number of centres, can be highlighted.

Talking about other greenhouse gases, it can be emphasised the emission of N_2O (38.60%).

b) Priority fields of action

RESIDENTIAL, INSTITUTIONAL AND SERVICES SECTOR
• Replace coal boilers by less polluting boilers • Use of biodiesel and biomass in heating boilers • Centralised air-conditioning systems • Updating of inner lighting systems • RENOVE Plan for electrical appliances • Municipal public actions of Sociedad Zaragoza Vivienda • RENAISSANCE Project: energy saving in 616 new homes and 400 restored dwellings • Programme of sustainable renovation of small shops and hotel and catering businesses • Municipal law on saving, efficiency and use of renewable energies in buildings • Green and/or solar covers

PROYECTO RENAISSANCE started in Zaragoza on October 2005 and foreseeably will end in October 2010.

Its goal is to reach a good energy administration as well as to improve social housing policies and develop economic activities with innovative approaches.

In Zaragoza, RENAISSANCE is implemented in a total of 1,016 households –616 new and 400 restored (built in the 1960s).

The goal is to reach a saving of 5,008 tons of CO_2/year, after summing up saving from the 2.5 MW of wind energy.

This figures mean a 58% of fuel saving and a 32% of electricity saving in new households, and a 69% of fuel and 38% of electricity saving in restored buildings.

ZARAGOZA VIVIENDA has launched different projects such as, apart from those above mentioned, the restoration of 3,000 households, a good practice that will mean a saving of 1,334.000 tons of CO_2 in 10 years.

ECOCIUDAD VALDESPARTERA is a project for building 10,000 bioclimatic households, included in the partial plan for Valdespartera passed on 29 November

2002 for the development of the Plan General de Zaragoza 2001. The Plan General includes the development of 2,432.349 m² of land at the South of the city.

The plan and construction of the area must introduce “criteria for a better bioclimatic use”, setting out a saving of 29,167 tons of CO_2 by year.

The average consumption of heating and hot water will be 60% less than in an average high constructive quality building, without suffering from an excessive heat in summer thanks to the collector galleries, its bigger levels of thermal insulation and crossed airing.

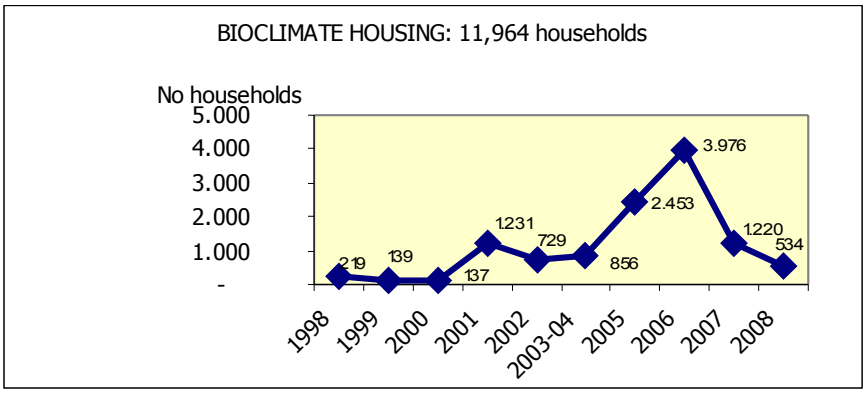
Regarding citizen awareness, environmental education programmes of the Agency for Environment and Sustainability “Desde mi aula para la ciudad”, “Stop al CO2”, and Hogares Verdes, the participation in the project CeroCO2, and others, are included.

In the services subsector, a programme for the sustainable renovation of small shops and restaurants has been implemented to favor good practices and energy saving.

This sector is an important alternative in relation to the installation of renewable energies and the empowering of the sink effect, emphasising the use of covers for photovoltaic panels and green points.

c) First results of ECAZ

The extent of these actions can be seen in the indicator En2: *Households built with bioclimate criteria*, with the evolution in the number of licenses given by the municipality from 1998.



d) Estimate of foreseeable results after the implementation of ECAZ

An estimate has been made on the foreseen reduction of pollutant emissions to the atmosphere through different actions, which shows the fall of CO_2 emissions, the most significant pollutant in climate change.

In this sector, the policy of creation and restoration of bioclimate housing and energy saving systems can be highlighted, adding a social and environmental nature through the important projects being implemented by it.

It is estimated that all the actions in the residential sector will contribute to reduce total emission in **342,659 tons of CO_2** during the period 2005-2015. The distribution is this:

REDUCTION OF DIRECT CO_2 EMISSIONS .	2005-2015
Application of new regulations CTE and Municipal by-law	-36,752
Restoration of buildings	-13,117
Replacement of coal heaters by biomass or natural gas	-2,439
Replacement of conventional gasoleum by biodiesel in gasoleum heaters	0 *
Citizen awareness: change citizen habits	-38,255
TOTAL tons/year	-90,563

REDUCTION OF INDIRECT EMISSION OF CO2	2005-2015
Saving in electrical consumption by restoration	-1,944.41
Replacement of conventional bulbs by low consumption lamps	-7,671,20
Plan RENOVE for electrical appliances	-32,012
Citizen awareness: change citizen habits	-210,467.71
TOTAL tons/year	-252,096

e) Uncertainty situations

These uncertainties are caused by the present economic situation that can provoque a reduction in the number of households built or restored, or make clean fuels and renewable energies not to be economically competitive.

2.1.2 PARKS AND GREEN AREAS

Between 1986 and 2001, the government of Zaragoza launched an intense creation of new parks in consolidated districts (parks of Oriente, Delicias, Oliver, Valdefierro, la Paz, la Aljafería, la Memoria at San José, a park at the river mouth of Huerva river, etc.). At present time, new green areas and a coherent urban structure has been consolidated by green corridors and the urban transport system, linking the different districts of the first periphery to the city, and even the city centre to the green and natural external areas and the big equipments of the city. Expo 2008 has been a deciding factor.

Carbon sinks to collect CO_2 are becoming an important alternative for climate change mitigation. The city of Zaragoza –with its extense green areas- has the adequate characteristics.

ECAZ proposal for increasing "sink effect" areas in Zaragoza and its outskirts is contributing to mitigate climate change, implementing the goal defined by the Agenda 21 Local on *Integration of nature in the city.*

Zaragoza has also agronomy conditions that make it easier to devote an important number of hectares to energy crops.

26,600 tons of CO2 is the estimated reduction of direct emissions of CO2 by sink collecting.

REDUCTION OF DIRECT EMISSIONS OF CO_2	2005-2015
Introduction of carbon sinks	- 26,600
TOTAL tons/year	-26,600

Zaragoza has 34,159.387 m2 of urban and periurban green areas, with 1,360.000 trees, a ratio of 2 trees and 50 m_2 of green surface by inhabitant.

The green ring linking the river banks to the city is 30 km long.

2.2 MUNICIPAL SERVICES

ECAZ actions in the municipal services, apart from being an implicit contribution to reduce CO_2 and improve air quality, are good examples of actions that can have an influence on the good practices of the citizens.

2.2.1 MUNICIPAL BUILDINGS

a) Analysis of the Emission Register

The emissions produced by the municipal services and buildings depending on the the City of Zaragoza represent around a 2% of the total of CO2 and several pollutants, reaching a top contribution of 8.1% of methane.

b) Priority fields of action

The City of Zaragoza aims at improving knowledge on the energy consumed by its facilities, and increase awareness on responsable consumption.

Therefore, it is being developed a *Survey for the energy analysis of the municipal buildings,* to revise energy consumption in municipal buildings, linking consumption to the constructive and maintenance system.

The results obtained in the survey will be the basis to establish the criteria to build new centres and carry out actions to reduce energy consumption without reducing the comfort and services for the users of those already existing.

After obtaining the results, it will be established the relation between the economic account of every buidling and the CO_2 emitted; in other words, its environmental acountancy that will be the base to implement measures for SAVING AND ENERGY EFFICIENCY.

2.2.2 SERVICE COMPANIES HIRED BY THE CITY

The goal is to boost a municipal corporate strategy to promote the use of ecological fuels in public service vehicles and service companies hired by the City, contributing to achieve th goal included in the Agenda 21 Local and the different institutional estrategies developed to fight against climate change and promote clean energy, by a decree which promotes the use of ecological fuel in municipal vehicles and services firms working for the municipality.

Municipal by-order of 12 April 2007 on the use of ecological fuel in municipal vehicles and service companies hired by the municipal government.

2.2.3 WASTE TREATMENT

a) Analysis of the Emisision Register

Waste treatment, mainly dumps, produces the 98% of CH_4 emissions.

After that, the most important emissions are VOCs, halogenated compounds (99.18%), and another GHGs: N_2O

b) Priority fields of action

The goal of the actions in this field is to influence for the reduction of the pollutant emission tax per inhabitant.

The role of the new Centro de Reciclaje de Zaragoza (Zaragoza Recycling Centre), placed within the Parque Tecnológico del Reciclado, and in which waste from Zaragoza and 61 surrounding municipalities are recycled, is essential.

On the one hand, electric and thermic energy will be obtained from from the biogas resulting from the process of biomethanization of organic materia, getting an important reduction of methane and CO_2 emission, with the corresponding saving of energy.

Apart from that, a high quality composting will be obtained and the recycling and separation of light containers will be made there.

c) First results of ECAZ

Zaragoza has a new plant for the selective treatment and production of compost, foreseen for giving service to 61 municipalities more. The complex has a capacity for 450,000 tons of waste per year, and 15,000 tons of containers.

There is 21,000 containers of different size in which approximately 250,000 tons of waste per year are collected.

d) Estimate of possible results with the application of ECAZ

REDUCTION OF CO_2 EMISSIONS	2005-2015
Global actions to reduce emissions rate by inhabitant	-15,502.03
TOTAL tons/year	-15,502.03

2.3 SUSTAINABLE MOBILITY

a) Analysis of the Emission Register

This sector is responsible of the 80% of CO emissions and contributes in an important way to NOx emissions (32.93%), (N_2O 32.64%) and CO_2 (29.9%).

Vehicles make about 1,020 million km per year in the urban centre of Zaragoza, from which a 20% are vehicles over 10 years old and a 58% vehicles with less than 5 years.

76% of kilometres are made by cars, 4% by public transport, 15% by goods traffic and a 4.4% by motorcycles and autocycles.

CO_2 emissions are produced by private vehicles in a 66.7%, vans and trucks (14% and 4%), buses (14.7%) and finally, motorcycles and autocycles (5%). The emissions produced by traffic in the city represent the 56.66%, without taking into account urban buses with the 4.4% in the city and road accesses to the different districts.

The biggest production of Nox emissions (52.47%) is produced by road traffic. Regarding pollutants -except nitrogen oxides- the highest emission values are produced by the city.

b) European regulations

The Directive of the European Parliament of 24 October 2007 on the Community strategy to reduce CO_2 emissions of private vehicles and light industrial vehicles, insists on the application of the complementary measures proposed to reach the above mentioned agreed objective of 120g of CO_2/km before 2012.

Therefore, it proposes quantifiable regulations and the establishment of annual binding emission goals, which will come into effect from 2011, as well as the promotion of technological improvements for the average emissions of all the comercialized vehicles in the EU market in 2015, not exceeding 125 g of CO_2/km.

c) Priority fields of action

THE SUSTAINABLE MOBILITY PLAN collects a very complete group of actions for improving air quality in the city. It was passed in September 2006 and will be fully introduced for the year 2015.

The plan pretends to fix the mobility strategies of Zaragoza and its nearby municipalities, and will need a very important economic investment. Among the actions to be implemented are included these:

SUSTAINABLE MOBILITY PLAN

- Road traffic restricted in the city centre: a total area of 40,522 m_2 with preference for pedestrians and 6 zones 30
- Reinforcement of cycle tracks in the city centre (144 km.) and 152 new kilometres of cycle tracks to link Zaragoza to the municipalities of its metropolitan area

- High capacity transport: commuting trains networks, light rail transit, and tram
- 15 new car parks, 44,000 posts for residents and 15 passangers exchangers
- Reorganization of the bus network to be linked to high capacity axes, and creation of 40 km of urban bus lanes and 36.5 km for access to exchangers.
- Municipal bylaw No 6 for mechanically drawn vehicles: bonus for hybrid vehicles and vehicles classified by energy source
- Reorganization of the bus network: high capacity axes and reinforcement of the bus lane

ECAZ has implemented the actions foreseen in the plan with others such as the use of biofuels and hybrid vehicles, organization of courses for efficient driving, plans of transport for firms, etc.

For example, the Bylaw of the City of Zaragoza of 12 April 2007on the use of ecological fuel in the municipal vehicles and municipal outsourcing commented on the above paragraph.

Even though the use of biofuel does not have an effect in CO_2 emissions, it means a decrease in concentration in the atmosphere, since the crops produced by those biofuels will contribute to fix a similar quantity of CO_2.

Apart from that, the use of biofuels has the important role of diminishing dependency on fossil fules, contributes to improve air quality, and cut the emission to the atmosphere of other pollutants such as CO, SO_2 and particles.

d) First results of ECAZ

At the east–west axis, the first commuting line linking Casetas district to Miraflores area has been opened. At the same time, the possibility to reinforce these systems with an undergroung network is being studied.

The tram is in the awarding stage and the city has 13 km of bus lanes in the expansion phase.

In December 2008, there were 78 kms of cycle tracks operative and a total of 111 after summing up cycle roads.

In June 2008, Bizi, a public system for renting bicycles, was launched. On the first stage it has 300 bicycles and 30 park areas. In two years, 1,000 bikes are foreseen.

e) Foreseable results after the application of ECAZ

ECAZ has estimated emission saving derived from the application of the actions proposed, with these results:

REDUCTION OF DIRECT CO_2 EMISSIONS	2005-2015
Implementation of the sustainable mobility plan	-153,020.28
Use of biofuels	0 *
Increase in the number of hybrid vehicles/hydrogen	- 6,861.28
Training techniques for efficient driving	-7,277.57
Transport plans in companies	-7,000
TOTAL tons/year	-174,159.13

REDUCTION OF INDIRECT CO2 EMISSIONS	2005-2015
Implementation of the sustainable mobility plan	+7,032.69
TOTAL tons/year	+7,032.69

f) Uncertainty situations

The delay on the sustainable mobility plan and the development of hydrogen technology. Crisis can also produce a reduction on the rate of renovation of vehicles, and, therefore, the incorporation of new elements able to reach the limits proposed by the European Union for the emission of private and light vehicles.

2.3.1 EMISSIONS TO BE PRODUCED BY THE FUTURE TRAM LINE

The North-South tram route will start at calle Majas de Goya, going along G. Gómez de Avellaneda, María Zambrano, César Augusto, Coso, Independencia, Gran Vía, Fernando el Católico, Isabel la Católica, Vía Ibérica, Los olvidados and La ventana indiscreta, ending at calle Los pájaros in Valdespartera.

In this section the emissions to the atmosphere produced by the tram are estimated. For the analysis, only the suppresion of the buses that are now using the streets of the future tramline has been taken into account. The estimation is that the tram will replace 15,000 vehicles by kilometre every day. This quantity will be increased by the foreseen traffic restrictions.

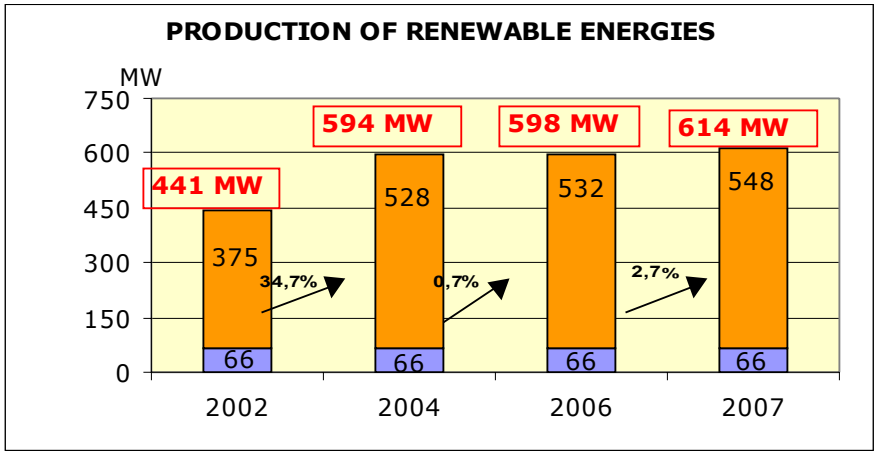
The source of information is the evaluation project on the environmental impact of the tramline between Parque Goya and Valdespartera in Zaragoza.

Calculations have been made using CORINAIR methodology and from the IMD-Intensidades Medias de Tráfico (Average Traffic Intensities) supplied by the Mobility Service of the City of Zaragoza.

POLLUTANTS	TOTAL BUS EMISSIONS kg/year	REDUCTION OF BUS EMISSIONS kg/year	REDUCTION OF BUS EMISSIONS %
CO_2	22,090.860.00	274,878.93	1.24 %
CO	49,050.00	524.86	1.07 %
Partícles	6,730.00	78.16	1.16 %
SO_2	710.00	8.83	1.24 %
NOx	180,530.00	1,706.23	0.95 %
COV	22,420.00	307.57	1.37 %
CH4	2,230.00	19.33	0.87 %
N_2O	600.00	7.42	1.24 %
NH_3	60.00	0.74	1.24 %
HAPs	4.81	0.06	1.24 %
Heavy metals	20.00	0.69	3.46 %

2.4. RENEWABLE ENERGIES

Zaragoza is trying to reduce its dependency on fossile fuels through encouraging the use of renewable energies such as solar and wind, and making good use of the many hours of sun and the frequent presence of wind in the city.



Zaragoza and its surrounding area with **32** wind parks working- produces **614** MW of energy, a figure that eaily exceeds the 400 foreseen as a goal of the Agenda 21 for the year 2010.

These good results and the encouraging forecasts for the progressive establishment of another form of renawable energy the photovoltaic one- has forced us to establish new goals for the year 2015, fixing them in 850 MW of wind and photovoltaic energy, from which 140 MW would belong to the own municipality of Zaragoza.

Today, overcoming the most optimistic forecasts, the production of renewable energies in the city of Zaragoza represents around a 20% of the necessary for home consumption of all its citizens. Take into account its influence area, the production of renewable energy represents between a 40%/50% of the total electric consumption of the city and its surrounding area. In other words, it could guarantee the whole domestic consumption and lighting of Zaragoza.

The goal for the year 2015 is to go beyond that and get a zero emission of CO_2 in public lighting, home and commercial consumption, and tram use.

a) Top priority fields of action and foreseeable results

ECAZ foresees actions for promoting different types of alternative energies (photovoltaic, thermic, wind) apart from those commented on when talking about the residential sector and the new regulations.

REDUCTION OF INDIRECT CO_2 EMISSIONS	2005-2015
Promotion of renewable energies	-53,364.67
TOTAL tons/year	-53,364.67

b) Firsts results of ECAZ

From the year 2000, the Sociedad Municipal de Rehabilitación Urbana (Municipal Society for Urban Restoration) is including the installation of solar collectors for hot water consumption in several promotions of Zaragoza Vivienda.

Nowadays, the installation of more than 3 MW is being done, and the power for the year 2010 is foreseen to be 5 MW.

Similar experiences have been implemented. We can highlight the installation of 10 MW of photovoltaic solar energy on the covers of General Motors, 9 MW in Zuera, 3,700 kW in Pedrola, and 1 MW at Eprinet premises in PLAZA. The City has installed photovoltaic panels with 19 kW at the school Cándido Domingo, forming part of the actions included in Renaissance project. The covering of the tanks of the Casablance sewage treatment plan includes the installation of 2 MW of photovoltaic solar energy, and the new Seminary building has 45kW.

Zaragoza has also a hydrogen station to reinforce the progressive installation of more ecological fuels in the urban transport. The first adapted vehicles of the city -presented for the firts time at the Expo site- are supplied from this new production and supply hydrogen station.

It is being proposed to extend the areas of sink effect , since the agricultural conditions of Zaragoza can make easier the development of an important number of hectares for energy crops.

c) Uncertain situations

Today, the photovoltaic solar energy is being developed slowly and is not competitive enough, except through the existing grants.

Hydrogen technology is an important possibility in order to get sustainability and a climate change decrease, even though its high cost makes its introduction difficult.

The reduction in the price of the fossile fuels can make it difficult the setting up of renewable energies.

2.5. INDUSTRIAL SECTOR

a) Analysis of the Emission Register

This has been during the last years the most controlled sector by the City of Zaragoza, especially in what we can considered as big industries from the point of view of emissions to the atmosphere.

This monitoring, supported by voluntary agreements implemented by companies, has given a result as positive as the reduction of a 14% of emissions from the year 1996, date in which the previous register was carried out.

The industrial sector stands up by its highest levels in the emission of pollutants in general, producing the biggest proportion of CO_2, NOx, heavy metals and SH_2.

The highest emissions of CO_2 correspond to the paper sector (59.62%) and food sector (15.18). The steel sector presents the highest emissions of CO, SO_2 and heavy metals.

The emission of NMCOV from the industrial sector -representing the 23.17% of the total- has its origin in the organic chemical industry, nearly an 87%.Together with the residential sector, it produces the 83.7% of SO_2 emissions.

b) Priority action fields

Today and after the actions developed during the last years for the big industries of the city, the new actions are set in industrial areas and other small and medium size industries which pay special attention to combustion systems and also to the control established by the own productive process.

c) First ECAZ actions

The actions of the industrial sector were launched in 2002, year in which the Environment Audit for el Picarral district was carried out in order to value its environmental quality, subsequently expanded to include the most significant industries of the city.

The actions implemented are related fundamentally to the productive process of those industries and have included actions in the fields of dumping and noise, and also others for reducing emissions sent to the atmosphere.

It is important to highlight the relevance of the cogeneration systems of these big industries. With its more than 7,000 MW, Zaragoza has 339 MW from the 578 MW available in Aragon, being one of the cities with a bigger input power of this system of energy production.

The club Encuentros con la Agenda 21 Local is formed by a group of firms awarded with the environmental certificate and that, as far they can, work with the City of Zaragoza for the improvement of the sustainability of the city. Today, the efforts are contributing to the mitigation of climate change through the implementation of a group of efficiency and energy saving measures.

More concretely, Encuentros con la Agenda 21 Local works to establish a system of environmental accountancy in companies for establishing measures for energy saving promotion.

d) Foreseable results with the application of ECAZ

The implementation of new actions gives the following reduction of CO2 emissions, stressing on energy saving and improvements in the productive process:

REDUCTION OF DIRECT EMISSIONS OF CO_2	2005-2015
Control on Group I companies	-385,979
Control on Group II companies	-51,693
TOTAL tons/year	-437,672

REDUCTION OF INDIRECT CO_2 EMISSIONS	2005-2015
Control and raising awareness in electric consumption saving	-82,199.97
TOTAL tons/year	-82,199.97

3. ECAZ: LEGAL AND FISCAL MEASURES

3.1.1. LEGAL MEASURES

After Kyoto Protocol came into effect in Spain on 16 February 2005, our country has an international commitment to limit Greenhouse Gases GHGs. The average of emissions for the period 2008-2012 should not exceed a 15% more than the base year 1990.

The City of Zaragoza, which already was including in its action plans from the Agenda 21 Local actions to fight against climate change, launched on 4 February 2005 legal measures, and passed on plenary session different agreements for the *support and boost of all those initiatives to develop tools and mechanisms to reduce the emission of greenhouse gases produced by diffuse sources.*

Subsequently and in order to reduce the contribution of municipal vehicles to climate change, a municipal by-law was passed on 12 April 2007 on the use of ecological fuels in municipal vehicles and municipal outsourcing.

The goal is to boost a municipal strategy for promoting the use of ecological fuels in the vehicles owned bypublic services and municipal contracted companiers, in order to contribute to fulfill the goals included in the Agenda 21 Local and in the different institutional strategies developed to fight against climate change, boosting the use of clean energies and ecological fuels.

Finally, it has been planned and is in the answer to pleas stage a *Municipal bylaw on energy eco-efficiency and use of renewable energies in buildings and facilities,* that, besides the application of the Technical Code on Building, will improve energy consumption, and, therefore, air quality in the city.

3.1.2. TAX SYSTEM

The tax measures set up by the City of Zaragoza have a positive character. Bonuses are awarded for adequate behaviours from an environmental point of view, both in the Municipal Bylaw 6 (on vehicles and mechanical drawn) and the Municipal By-law 10 on constructions, facilities, and works.

In the case of vehicles, a tax discount for motor vehicles have been established which ranges between 50 and 75%, depending on the motor, type of fuel, and the effect of combustion in the environment:

- Hybrid vehicles which reduced emissions
- New vehicles with energy qualification A and B
- Electric and/or zero emission vehicles
- Private vehicles with emission under 120 or 130 gr/km of CO_2

The Municipal By-law 10 on constructions, facilities and works, foresees environmental actions with discounts up to a 30% on taxes for construction, facilities and works in which biomass boilers for heating and domestic hot water are used.

4. ENVIRONMENTAL EDUCATION

Environmental education is an important way to get sustainability and to improve the environmental parameters.

The City of Zaragoza has been developing for the last 25 years programmes of environmental education intensified from the introduction of the Agenda 21 Local. The municipal programme of environmental education Desde mi aula para mi ciudad, un compromiso educativo con el medio ambiente (From my classroom to my city, an education committment to the environment) includes three main working lines: biodiversity, climate change, and water.

The activities related to CLIMATE CHANGE are four: Stop al CO_2, Hogares verdes , an exposition on glaciers, and visits to the pollution control network.

The activity *Stop al CO_2* tries to pass on in an amusing and dynamic way the importance of climate change and the way we are making it worse, but also our solutions to stop the increase of CO_2 emissions to the atmosphere.

Different lighting systems and electrical appliances that can be found in an education centre are analysed from the point of view of energy consumption, offering ideas to save electricity both in existing appliances and systems, and also in case of replacement for more efficient ones. The main types of heating are also showed -its working, regulation and consumption- and insulation, orientation, glazing, etc of the centres are analyzed. During the course 2006-2007 an education guide for energy saving was published.

Hogares Verdes pretends to boost a responsible consumption of energy and water at home, proposing to the participating families concrete goals for its reduction:

- Reduce CO_2 emissions in a 5.2% (goal of Kyoto Protocol)

- Reduce between 6% and 10% home water consumption.

At present, approximately 250 households of Zaragoza and families from other Spanish cities, small villages and regions take part in this joint challenge, since the programme is promoted in the whole country by the Centro Nacional de Educación Ambiental, depending on the Ministry for Environment, and is being implemented at the same time in other Spanish places.

Visits to the *pollution control network* show the control, track and vigilance of atmospheric pollution in the city.

The Specific Local Indicador P1 analyzes the number of students that take part in the municipal programmes of environmental education aiming at their awareness, education, and training.

The activities are made during the school year and adressed at every kind of educational, public, private, or subsidized school, and students of every education level.

5. ECAZ: EFFECTS ON AIR QUALITY

In order to value ECAZ effects on air quality, it is necessary to refer to all the pollutants registered. Considering the emission rate per person and year, we can say that the hypothesis developed make feasable the reduction of emissions per person specified in the following table:

POLLUTANT	2005	2015	
	Ratio (kg/person .year)	Ratio (kg/person year)	Goal %
CO_2	2,814.60	1,982.56	**-30%**
CO	15.02	11.82	**-21%**
Particles	9.04	3.01	**-67%**
SO_2	2.17	1.19	**-45%**
NO_X	12.34	8.88	**-21%**
VOC	49.13	40.50	**-18%**
NMCOV	22.50	17.77	**-21%**
CH_4	26.63	22.88	**-14%**
N_2O	0.30	0.23	**-24%**
CO_2 equivalent	***3,514.76***	***2,575.53***	***-27%***

These values are very ambitious and, sometimes, difficult to put into practice, so it is essential the active participation of all the agents of Zaragoza under the leadership of the government of the city, and all the citizens, the industrial sector, the primary sector, the Government of Aragon, and, in general, the rest of public and private entities.

6 INDICATORS SYSTEMS

The preparation and boosting of the sustainability indicators of Zaragoza were launched in 1999 with the signature by the Government of the city of the Chart of European Cities towards Sustainability -Chart of Aalborg- with the implicit commitment to launch the ten European Common Indicators.

Those ten indicators were not enough to implement the diagnosis and analysis of the evolution of sustainability in the city, since some relevant aspects were not treated in their definition. Therefore, 24 local indicators were introduced, rounded with four more, making a total number of 38.

The first group of indicators included data from 2000, being updated every year by the City of Zaragoza.

Even though all the indicators can be related to the Climate Change and Air Quality Strategy, there are two of them which are directly related to it: the European Common Indicator A2-Local Contribution to the global climate change, and the A5-Air Quality. Both indicators belong to the so-called target indicators -basic indicators, which have a concrete goal.

Several of the Specific Local Indicators, which form part of the diagnosis of the situation, belong to the same group: En1-*Final Consumption of Energy,* A3-*Ways of Transport,* or At1-*Emissions of SO2.*

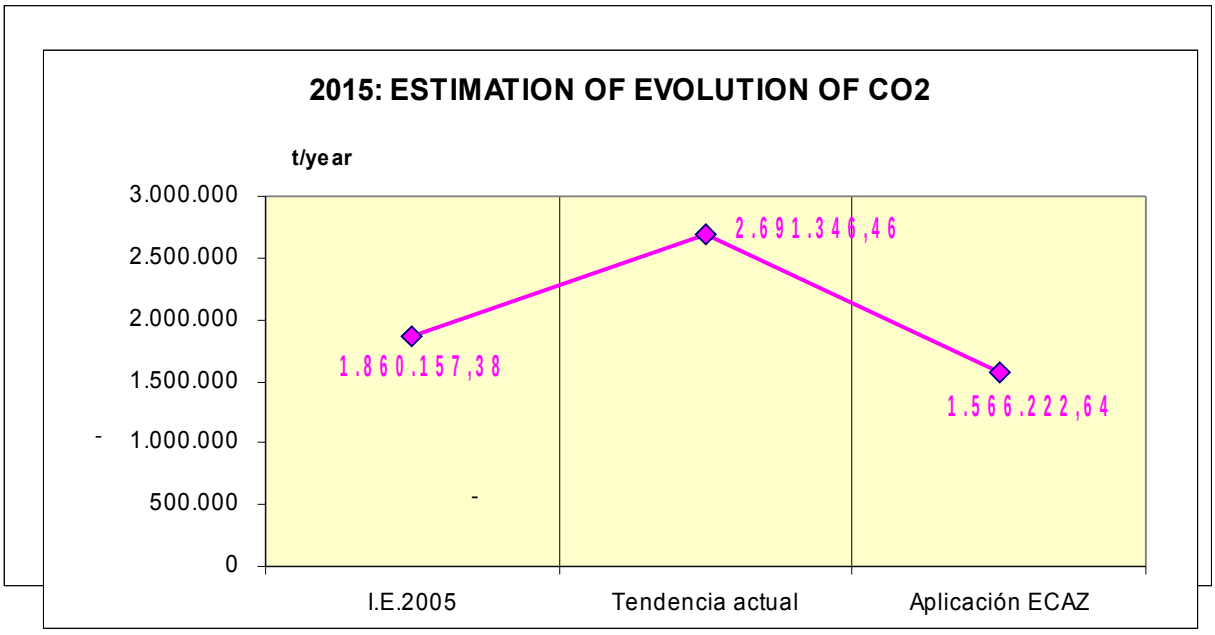
Other group of indicators is the tracking indicators, related to the actions implemented to improve air quality and mitigate climate change, such as A3.1-*Use of public transport* and M1-*Special areas for circulation,* or those already commented on when talking about actions in the residential sector, En3-*Production of renewable energies*, and environmental education, P1-*Students that take part in programmes of environmental education,* or resources devoted to these actions: G3-*Energy and sustainable development.*

6. 1. ECAZ TARGET INDICATORS:

ICE A2: Local contribution to global climate change

The European Common Indicator A2 tries to gauge the contribution of the city of Zaragoza to climate change through measuring CO2 emissions and other greenhouse effect gases.

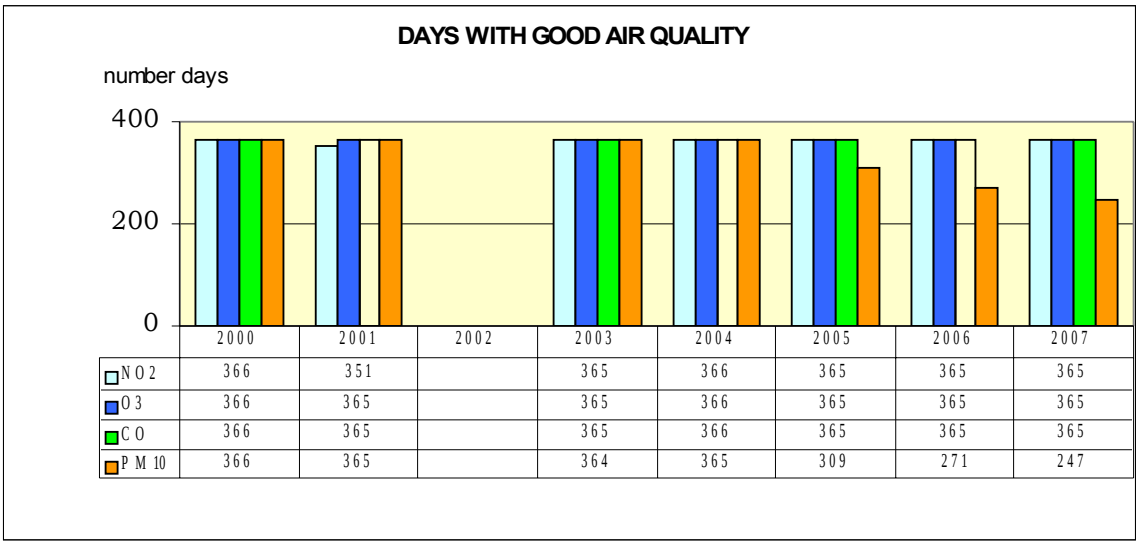
Through the actions proposed by Zaragoza Climate Change and Air Quality Strategy it is hoped to stop CO_2 emissions and to reach a 16% of global reduction, which will represent a drop of 30% in emissions per inhabitant. In other words, the above commented ratio of 1.97 tons/person in the year 2015 will be reached.



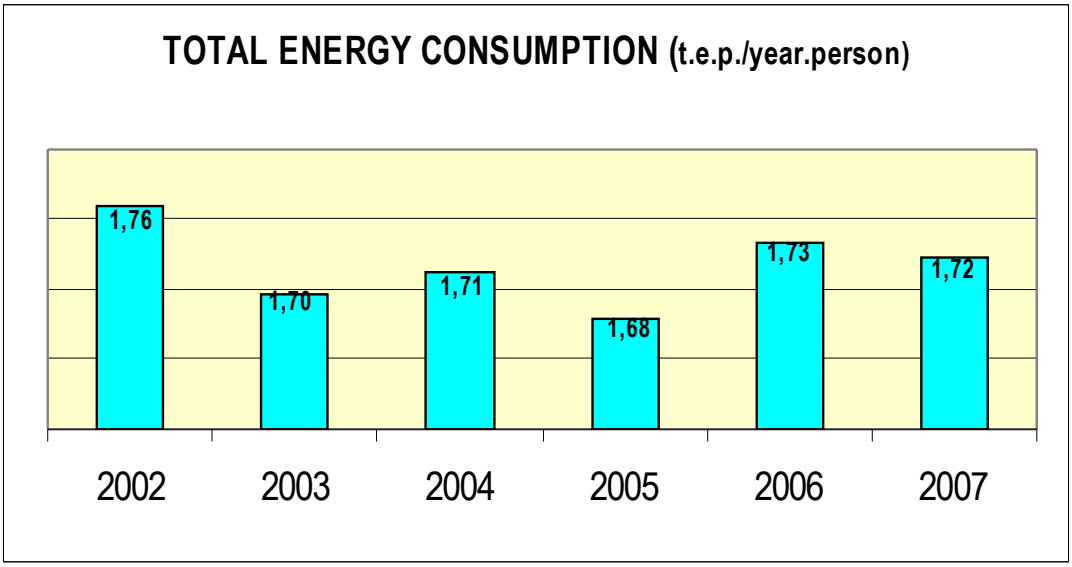
ICE A5: air quality

Another basic goal indicator is the European Common Indicator A5 which measures the number of days with good or high air quality in order to improve and gauge the quality of local air.

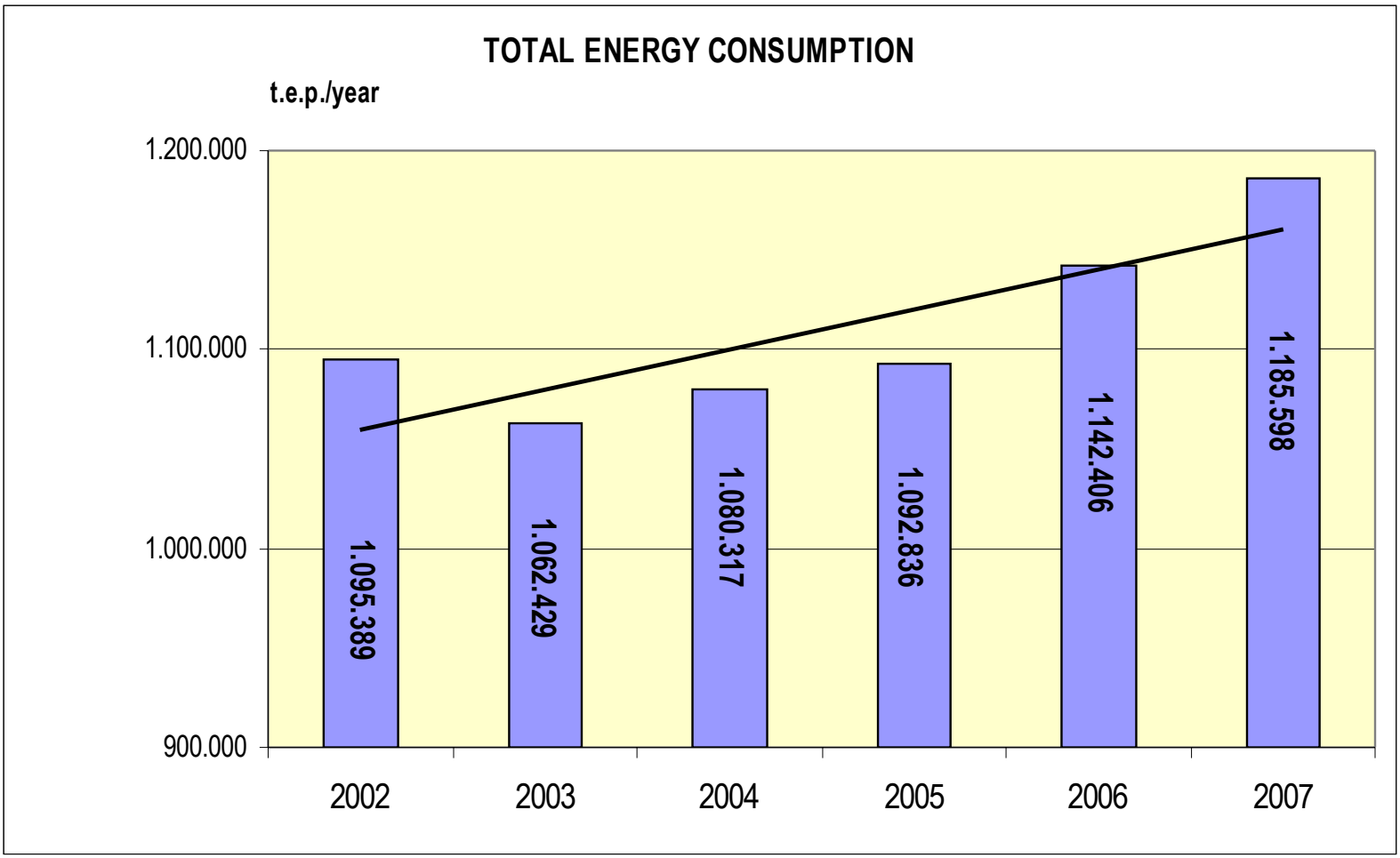
There are several target indicators among the Specific Local Indicators, among them energy consumption that presents the following evolution:



	2000	2001	2002	2003	2004	2005	2006	2007
NO2	366	351		365	366	365	365	365
O3	366	365		365	366	365	365	365
CO	366	365		365	366	365	365	365
PM 10	366	365		364	365	309	271	247



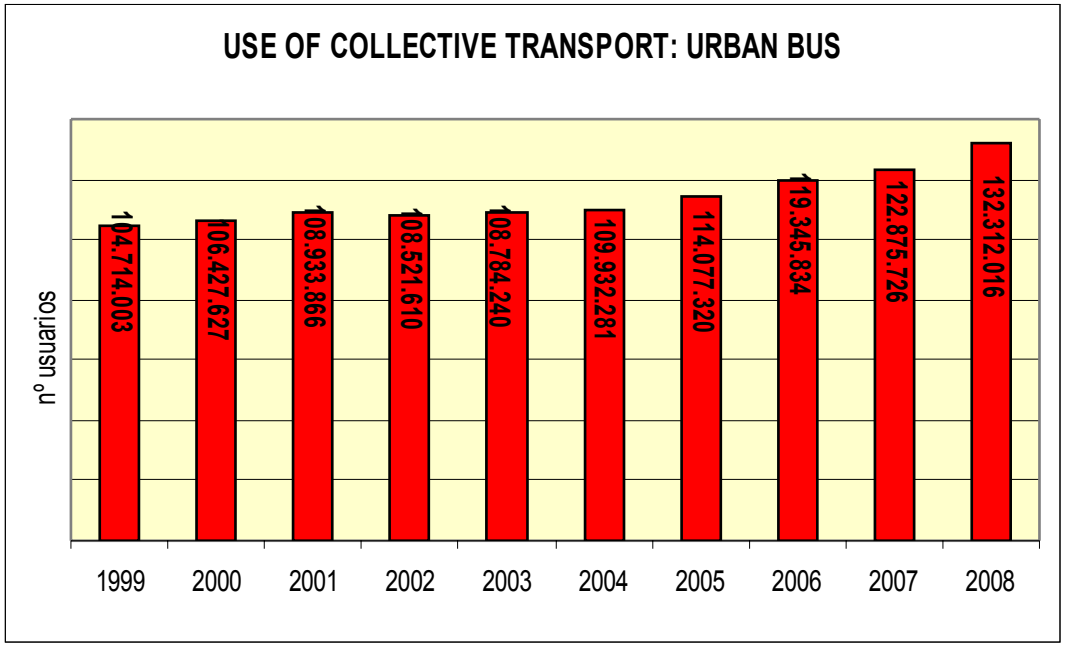
ILEn1: Total energy consumption



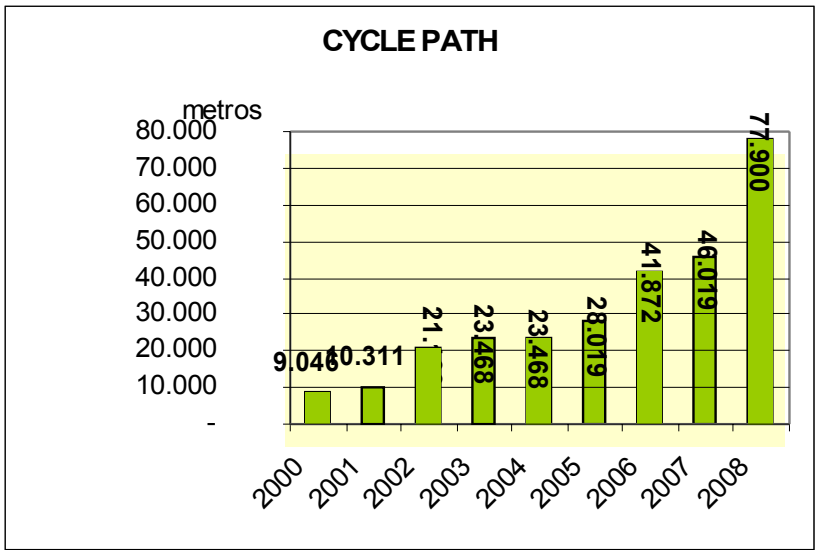
6. 2 ECAZ TRACK INDICATORS:

Among the different track indicators we highlight those related to the actions affecting to mobility: A3.1-*Use of public transport,* M1-*Special Circulation Areas,* or renewable energies, En3-*Production of renewable energies*

ICE A3.1: Modes of transport

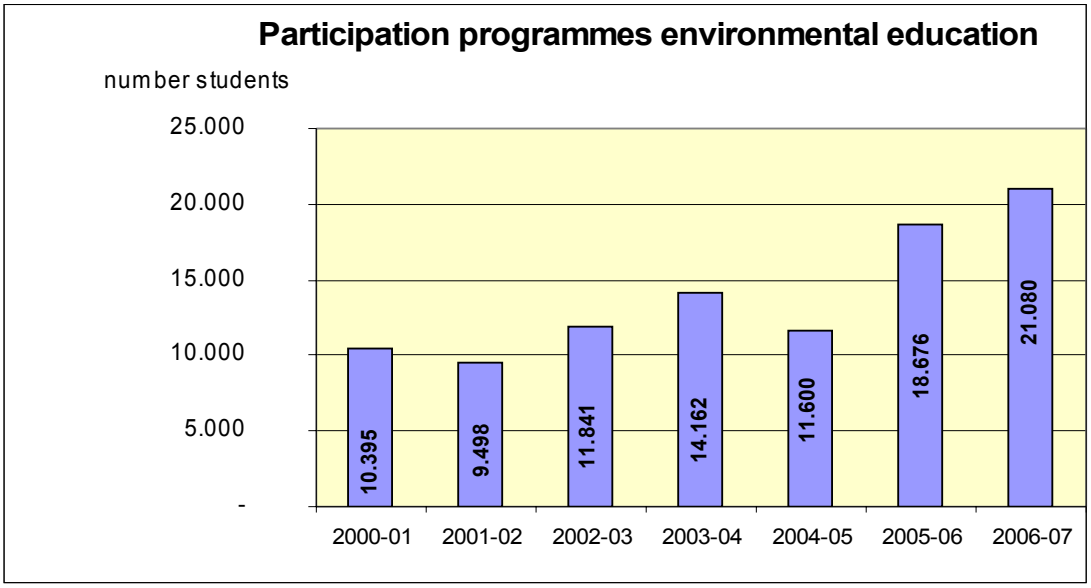


ILE M1: Special circulation areas



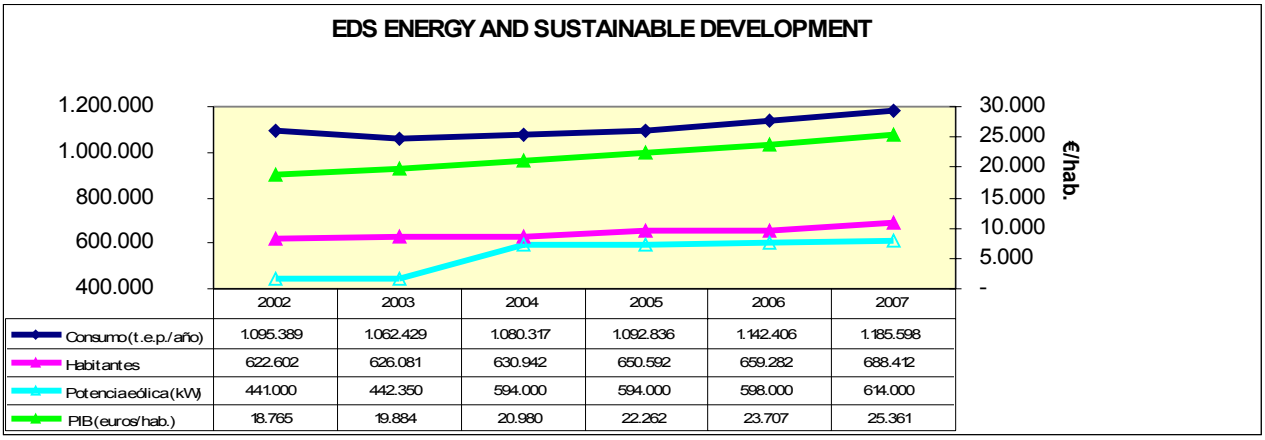
The environmental education indicator reflects the different transversal actions implemented by the City of Zaragoza, many of them for air quality improvement.

ILE P1: Students taking part in municipal programmes of environmental education



Finally, it is included the implementation indicator G3 *Energy and Development* for orienting on resources for air quality actions.

ILE G3: energy and sustainable development



	2002	2003	2004	2005	2006	2007
Consumo (t.e.p./año)	1.095.389	1.062.429	1.080.317	1.092.836	1.142.406	1.185.598
Habitantes	622.602	626.081	630.942	650.592	659.282	688.412
Potencia eólica (kW)	441.000	442.350	594.000	594.000	598.000	614.000
PIB (euros/hab.)	18.765	19.884	20.980	22.262	23.707	25.361

7. PARTICIPATION IN NATIONAL AND INTERNATIONAL NETWORKS

The city of Zaragoza participates in different national and international networks, collaborating in several forums and actions for environment improvement

CIDEU-Centro Iberoamericano de Desarrollo Estratégico Urbano- (Latin-American Centre for Urban Strategic Development).

It is an association of 68 cities focusing on urban strategic plannings (USP). It was launched in Barcelona in 1993 to share in network the benefits from USP processess tracking. Headquarters are in Barcelona, Spain.

Zaragoza forms part of the executive vicepresidency of this network, and headed the executive presidency in 2004.

ICLEI, Association of Local Governments for Sustainability.

Over 474 cities belong to this association. Its goal is the creation of a network of active municipalities commited to a sustainable environmental development.
Headquarters are in Freiburg, Germany.

On 1 July 2005, Zaragoza joined ICLEI for reaching tangible sustainable improvements..

EUROCITIES

Eurocities is the main network of European cities. It was launched in 1986 and includes 120 metropolitan area, with 105 cities of the European Union and 15 from other European countries. Eurocities is opened to every municipal government democratically elected as well as to economic and scientific partners (chambers of commerce and universitites) of cities with at least 250,000 inhabitants. Headquarters are in Brussels, Belgium. Eurocities unifies urban environment interests in European politics.

Zaragoza joined the network in 2001, and participates actively in different working groups.

ENERGIE-CITÉS

Energie-Cities is the Association of European Local Authorities for promoting local policies for sustainable energy and the development of renewable energies in the urban environment. It was launched in 1990 and has 110 members from 21 European countries. Headquarters are in the French city of Besançon and in Brussels, Belgium.

AMBIENTE ITALIA

Zaragoza launched the European common indicators in the year 2000, and, to draw them, has been taking part in the commission of experts of the European Union and AMBIENTE ITALIA.

It is an organization of the European Union in charge of coordinating the establishment of the European Common Indicators in every municipality or local entity.

NETWORK OF CITIES FOR CLIMATE AND ADHESION TO THE CHART OF THE EARTH - AGREEMENT FEMP-MMA (Spanish Federation of Municipalities and Regions Ministry for Environment)

It was created on 1 June 2005 in Getafe, Madrid, and is linked to the FEMP. Zaragoza is member of the permanent commission.

The network focuses on the promotion of policies for sustainable develoment, boosting of local policies for mitigation and adaptation to climate change, and the achievement of Kyoto Protocol, the Agenda 21 Local, and Aalborg Chart 10.

8. INTERNATIONAL COMMITMENTS

The City of Zaragoza, after signing the Chart of Aalborg (Danemark, 1964) has kept an international solid presence, drawing up analysis documents and elaborating proposals within city networks and/or international organizations.

Following this action line, the mayor of Zaragoza signed on 11 Septembre 2008 the Campaign of Cities for Climate Protection, a Reinforced Strategy for Europe with two goals: improve awareness on climate change among local governments, and understand its role in contribution to climate change as well as the environmental and economic benefits of local actions. It is offered a framework allowing local governments to integrate climate protection and recovery policies with actions targeting on municipal worries such as costs reduction, improvement of urban infrastructures, control of pollution, and improvement of habitability and biodiversity.

Later, on 23 October 2008, the mayor of Zaragoza ratified the Declaration of EUROCITIES on Climate Change with a commitment to adopt a strategy for fighting against climate change, mobilising all the agents of the territory and defining the most convenient public policies through urban planning and quality of our cities, transports and urban movility, renewable energies, and the divesification of energy production.

CONCLUSIONS

The final goal of the Convention on Climate Change of the United Nations is to get a balance between the concentration of greenhouse gases in the atmosphere in a level which can allow us to prevent any dangerous antropogenic interference with the climate system.

The European Union has stressed that, in order to reach this objective, the increase of the annual average temperature should not be 2ºC over temperature in the preindustrial era. Therefore, a minimum reduction of a 50% of world emissions of greenhouse gases in relation to the levels of 1990 is compulsory from now to the year 2050. The European Union has committed itself firmly to get in 2020 a reduction of a 20% of greehouse emissions with respect to the initial levels of 1990.

During the 14th Conference of Parties of the Framework Convention of the United Nations on Climate Change held in Poznan, Poland, it was admitted the urgent need to face climate change and to have a share vision on long-term cooperation for guiding the global effort in adaptation and mitigation, as well as the means to its implementation.

In the meeting held on 17 July 2008, the Delegate Commission of the Government of Spain for Climate Change (Comisión Delegada del Gobierno de España para el Cambio Climático CDGCC), at the start of its term of office identified six top priority strategic lines which include clear measures of the Spanish Strategy of Climate Change and Clean Energy (Estrategia Española de Cambio Climático y Energía Limpia) with a big impact for the reduction of greenhouse gases (GHGs):

- Waste and dung management
- Sustainable movility
- Sustainable construction
- Energy sustainability
- Forest policy and sinks
- Innovation

Headed by the Delegate Commission, the set and implementation of every strategic line needs the implication of all the ministerial departments with competences in that field:

Zaragoza Climate Change and Air Quality Strategy, adressed to an estimated population of 750,000 inhabitants in the year 2015, raises two main goals: to improve air quality and reduce dependence on fossil fuels, and to establish the design and application of the necessary actions to reach its goals.

With this strategy, Zaragoza pretends to get a reduction of a 30% per capita on CO_2 emissions for the end of 2015, and also, as this document explains, to act on polluting gases (CO, SO_2, NO_X, VOC, NMVOC, NO_2& ..) and suspended particles, in

order to improve air quality, getting lower levels than those established by the EC directive on air quality.

Zaragoza Climate Change and Air Quality Strategy has been prepared taking into account international committments and Aalborg Chart critera. Therefore, after establishing in the diagnosis the critical points of our city (emission register), several plans have been drawn up with action fields and transversal actions with its basic principles.

ACTION FIELDS: Model of City and Sustainable Construction, Mobility, Municipal Services, Renewable Energies, and Industrial Sector.

TRANSVERSAL LINES: Sustainable Taxation, Legislation and Information, General Awarding, and Citizen Participation.

PRINCIPLES: Saving Criteria, Efficiency, Optimization of resources, use of renewable energies, and innovation

The Strategy refuses deliverately the lists of specific actions and sets out some goals with concrete plans that, through a system of indicators, will enable a precise tracking.

These are generic and opened plans allowing a progressive introduction of its actions according to the results offered by the indicators. They include always the appropriate programmes, and, in any case keep the premise of the strategy: *adaptation to the circumstances without losing contact with the foreseen goals.*

In this sense, different plans are being implemented, among them the Sustainable Mobility Plan, the Programme of Environmental Education with the actions Stop al CO_2 y Hogares verdes, the Plan for Urban Restoration of Zaragoza Vivienda, the Plan for the Establishment of Renewable Energies, the Municipal Bylaw on Energy Ecoeficiency and Use of Renewable Energies in Buildings and Facilities, the Reforestation Plan with 600 new hectares reforested for 2015- or the actions developed in the club Meetings with the Agenda 21 Local for fighting against climate change (the last action implemented has been a programme on energy accounting and emission in companies.

In general terms, a reduction of, at least, 342,659 tons of CO_2 by actions in the residential sector has been estimated, 15,500 tons in municipal services, 167,126 tons by applying the Sustainability Plan, 53,364 tons by boosting of renewable energies, 519,871 tons in the industrial sector and in collection in sinks equal to to the emission of 26,000 tons of CO_2

On the other hand and being a global strategy, some actions are planned and affect sometimes more than one of the foreseen plans. As an example, the Plan for Renewable Energies sets out goals for renewable power in 2015 of 140 MW in Zaragoza, and a total of 850 MW in Zaragoza and its influence area.

Adding upp to these new facilities working on wind and photovoltaic energy the development of the tram and the extension of the commuting network planned by the Sustainable Mobility Plan, together with the programmes for environmental education (with an estimated reduction of a 4% of CO_2 by citizens awareness) as well as the different actions described in the residential and commercial sector and in the municipal services, is how the strategy can set up as an objective for 2015 to reach a zero emission of CO_2 in consumption derived from public lighting, home and commercial consumption, and the use of the tram and the commuting network.

Later on and as the present programmes and plans are consolidated, its own dynamic will demand the design and implementation of other new ones.

These efforts to reduce greehouse emissions must be planned under the principle of solidarity among citizens, economic agents and the administration, and with the premise of the need for a sustainable economic model to make possible a better future for the next generations.

Zaragoza, 6 April 2009.

THE HEAD OF THE SECCIÓN DE CONTROL

THE HEAD OF THE AGENCIA DE
MEDIO AMBIENTE Y SOSTENIBILIDAD

Carmen Cebrián Fernández.

Javier Celma Celma.