



APAT
Agency for Environmental Protection and
Technical Services

Carbon Dioxide Intensity Indicators

May 2007

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1. Introduction

The aim of this report is to present key environmental indicators, related to carbon dioxide (CO₂) emissions, in order to report, on a regular and consistent basis, on the main driving forces and highlight the progress at national level in a number of sectoral areas.

Indicators can be used at international and national levels in state of the environment reporting, measurement of environmental performance and reporting on progress towards sustainable development. They can further be used at national level in planning, clarifying policy objectives and setting priorities.

Indicators provide an overview of environmental and economic developments and a source of statistics for various analysis.

According to Eurostat, indicators should satisfy the following conditions: full country and sectoral coverage, real time updating, availability of long time series, complete documentation; moreover, quality dimensions of indicators should regard timeliness, accuracy, comparability, relevance and coherence.

The data set of the indicators provides a manageable and stable basis for indicator-based reporting, it prioritizes improvements in the quality and geographical coverage of data flows, it streamlines the contributions to other European and global indicator initiatives.

The European Environment Agency (EEA) suggests that indicators should have the following features:

- policy relevance, namely the indicator should support policies' priority issues of increasing policy relevance;
- the capability to monitor progress toward the quantified targets;
- being based on ready available and routinely collected data for EEA countries within specified timescale (to be determined country by country) at reasonable cost-benefit ratio;
- consistence in space coverage and covering of all or most of EEA countries;
- time coverage – sufficient/insufficient time trends (exemptions of general nature to be verified – e.g. situation of candidate countries);
- national in scale and representative for countries (countries benchmarking);
- understandable and simple;
- conceptually and methodologically well founded and representative (to be used by at least one community or international organization) and based on well established consultation with countries;
- being of priority in EEA management plan;
- being timely (be produced in reasonable and “useful” time);
- being well documented and of known quality.

Other definitions of indicators exist (OECD, EPA), but there is the need to develop a common conceptual framework in order to increase and promote the exchange of interrelated experiences and assist in further development and use of environmental indicators both in Member countries of a specific organization and with non members and other international organisations.

At European level and Member States level, the indicators presented in the report are useful to answer to several main policy questions, including the progress made by European Union and Member States in reducing total and sectoral greenhouse gas emissions and progress in improving emission intensity and energy efficiency of the main sectors.

The Commission Decision N° 2005/166/EC of February 10th 2005 lays down rules implementing Decision N° 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

The Commission Decision establishes to monitor all anthropogenic emissions by sources and removals by sinks of greenhouse gases, evaluate progress towards meeting commitments, implement the UNFCCC and Kyoto Protocol, as regards national programmes, greenhouse gas inventories, national systems and registries as well as ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the Community and its Member States to the UNFCCC.

In addition, the Decision establishes that, by January 15th 2005 and each year thereafter, Member States shall report information on indicators referring on Article 3 (1)(j) of Decision N° 280/2004/EC. In particular, Member States shall submit figures on specified priority indicators and should submit information on additional priority and supplementary indicators.

The information on national policies and measures referring on Article 3(2)(a) of Decision N° 280/2004/EC shall include indicators to perform forecasts for the years 2005, 2010, 2015 and 2020.

The data provided for the compilation of these indicators are consistent with the data in the national greenhouse gas inventory submitted annually under Council Decision N° 280/2004/EC.

This document gives information about the construction of indicators and about the data used for compilation as well.

For all indicators, the entire time series from 1990 has been calculated, considering the base year 1990 equal to 100.

2. Priority indicators

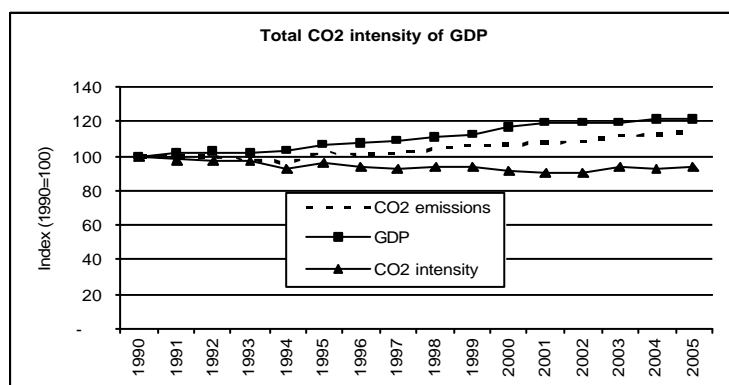
The first section consists of seven indicators, defined as follows.

2.1 MACRO

The first indicator represents the total CO₂ intensity of GDP (t/Mio Euro). It is calculated as the ratio between total CO₂ emissions (excluding LUCF), as reported in the Common Reporting Format (CRF, hereafter) and Gross Domestic Product (GDP, hereafter) at concatenated 2000 prices, as reported in the national statistics (“Conti Economici Nazionali”, ISTAT).

The mean value of the time series is 403.54 t CO₂ emissions/Mio Euro of GDP. In the period 2000-2002, the indicator attains a lower value with respect to the value attained in other years. This fact is due to the growth of GDP, which is faster than the increase of CO₂ emissions.

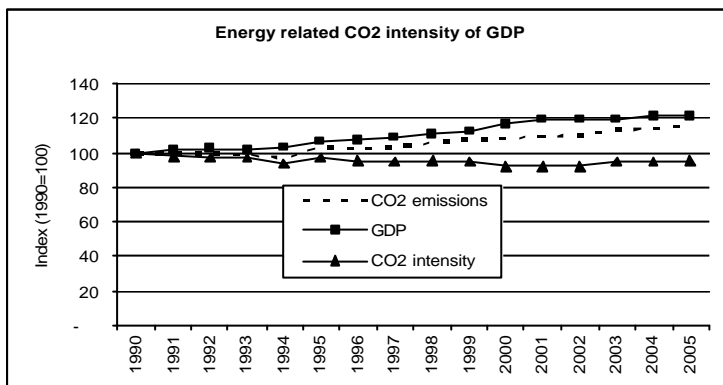
In 2005, the value is equal to 401.26 t/Mio Euro (due to the ratio between 493,372 Gg CO₂ emissions and 1,229.57 Bio euro of GDP). From 1990 to 2005, the value decreases of 6%.



2.2 MACRO B0

The second indicator is given by the energy related CO₂ intensity of GDP (t/Mio Euro). This indicator has been estimated by the ratio between CO₂ emissions from combustion of fossil fuels, as reported in the CRF (IPCC source category 1A, sectoral approach), and Gross Domestic Product at concatenated 2000 prices, as reported in the national statistics (“Conti Economici Nazionali”, ISTAT).

The trend of time series is analogous to the performance of the previous indicator. In 2005, the value is equal to 376.47 t/Mio Euro (due to the ratio between 462,894 Gg CO₂ emissions and 1,229.57 Bio euro of GDP). CO₂ emissions taken into account represent 94 % of total CO₂ emissions (excluding LULUCF). From 1990 to 2005, the decrease of “Energy related CO₂ intensity of GDP” indicator is 4.7%. In 1990, it assumes the maximum value, equal to 395.15 t CO₂ emissions/Mio Euro of GDP. The lowest value is 363.26 t CO₂ emissions/Mio Euro of GDP, in 2001.



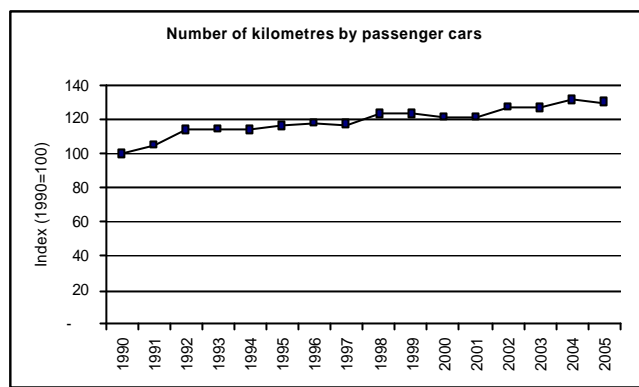
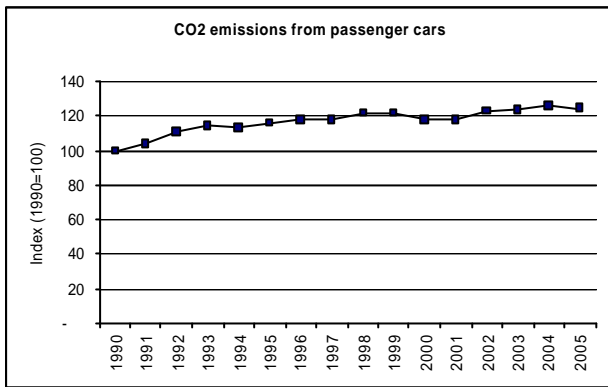
2.3 TRANSPORT C0

Concerning transport activity, two indicators have been calculated:

- “CO₂ emissions from the combustion of fossil fuels for all transport activity with passenger cars (kt)”;
- “Number of vehicle kilometres by passenger cars (Mkm)”.

The first indicator has been computed on the basis of data used to calculate CRF emissions from road transportation (IPCC source category 1A3bi). This indicator represents on average 15% of CO₂ emissions from combustion of fossil fuels and 60% of CO₂ emissions from road transportation. From 1990 to 2005 the value increases of 24.5%, passing from 56,070 to 69,792 kt CO₂ emissions. The mean value is equal to 65,615.69 kt CO₂ emissions.

The second indicator has been compiled starting from the estimates made on the basis of national transport statistics (“Annuario Statistico”, ACI). The trend grows on average and the mean value is equal to 353,661.98 million vehicle kilometres by passenger cars. From 1990 to 2005 the value increases of 30%, passing from 298,007 to 386,004 Mkm.

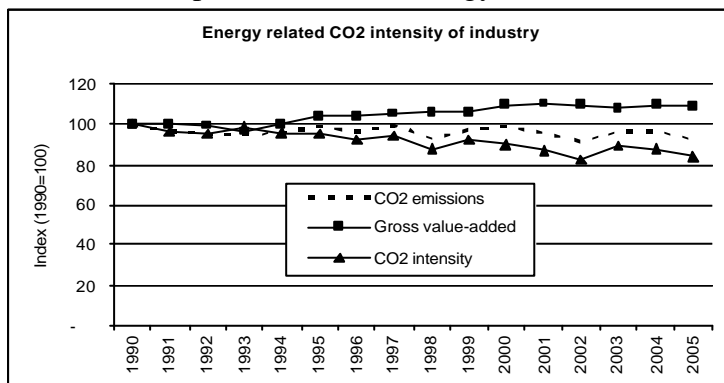


2.4 INDUSTRY A1

The “Energy related CO₂ intensity of industry (t/Mio Euro)” indicator is the ratio between:

- emissions from combustion of fossil fuels in manufacturing industries, construction, mining and quarrying (except coal mines and oil and gas extraction) including combustion for the generation of electricity and heat, data are obtained from the CRF (IPCC source category 1A2);
- economics data, like Gross value added at concatenated 2000 prices in manufacturing industries (NACE 15-22, 24-37), construction (NACE 45), mining and quarrying (except coal mines and oil and gas extraction), as reported in the national statistics (“Conti Economici Nazionali”, ISTAT).

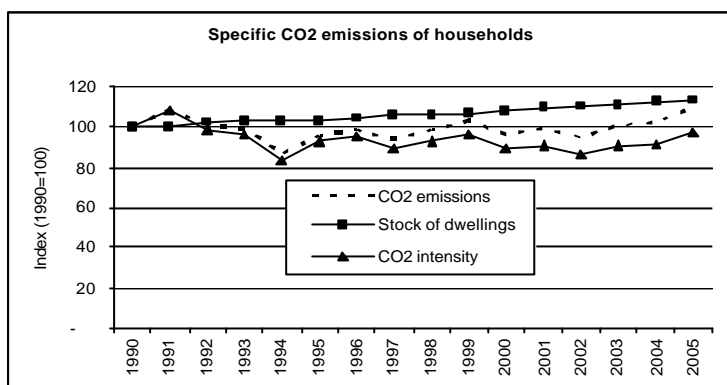
From 1990 to 2005, the value has decreased by 15.6% (it decreases from 342.33 to 288.98 t CO₂ emissions/Mio Euro), mainly due to the reduction of CO₂ emissions of sector activity taken into account, that represents 18% of energy sector emissions.



2.5 HOUSEHOLDS A.1

The fifth indicator, “Specific CO₂ emissions of households, (t/dwelling)”, has been determined by the ratio between CO₂ emissions from fossil fuel consumption households, as reported in the CRF (IPCC source category 1A4b), and the stock of permanently occupied dwellings. Data on dwellings are obtained from the national statistics (“Censimento della Popolazione e delle Abitazioni”, ISTAT), only for the years 1991 and 2001. Information for other years is estimated on the basis of other available information.

The mean value of the indicator is about 3 tons of CO₂ emissions on dwelling. In 2005, the value is equal to 2.56 tons, due to the ratio between 57,161.02 Gg CO₂ emissions and 22,320,400 dwellings. CO₂ emissions represent 12 % of energy sector emissions.

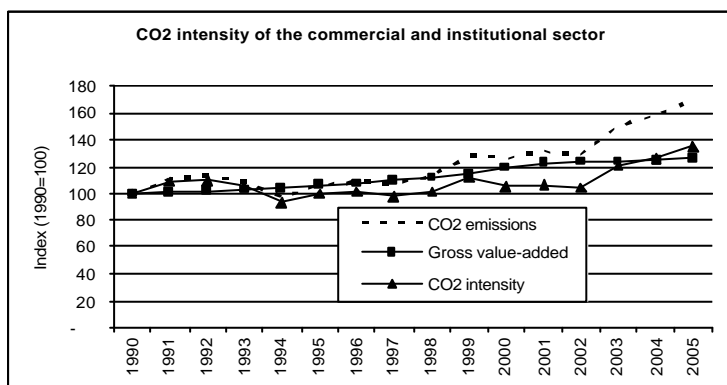


2.6 SERVICES A0

As regards service sector, the types of data used to calculate the “CO₂ intensity of the commercial and institutional sector (t/Mio Euro)” indicator are:

- CO₂ emissions from fossil fuel combustion in commercial and institutional buildings in the public and private sectors, as reported in the CRF (IPCC source category 1A4a);
- Gross value added at concatenated 2000 prices in services (NACE 41, 50, 51, 52, 55, 63, 64, 65, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93, 99), as reported in the national statistics (“Conti Economici Nazionali”, ISTAT).

From 1990 to 2005, the increase in indicator’s values (it raises from 28.31 to 38.18 t CO₂ emissions/Mio Euro) is due to the growth of CO₂ emissions for heating, that is about equal to 70%. CO₂ emissions of service sector represent 6 % of energy sector emissions.

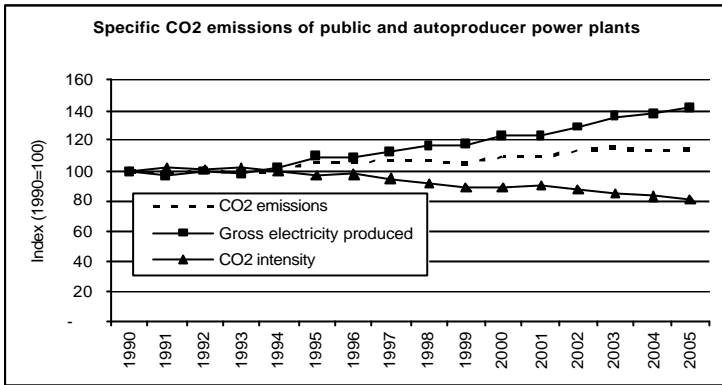


2.7 TRANSFORMATION B0

The seventh priority indicator is “Specific CO₂ emissions of public and autoproducer power plants, (t/TJ)”. It is the ratio between:

- CO₂ emissions from all fossil fuel combustion for gross electricity and heat production by public and autoproducer thermal power and combined heat and power plants, calculated on the basis of national electricity statistics elaborated by GRTN-TERNA;
- Gross electricity produced and any heat sold to third parties (combined heat and power plants) by public and autoproducer thermal power and combined heat and power plants (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA).

The decrease of the indicator from 1990 (200.16 t CO₂ emissions/TJ of the production of electricity) to 2005 (161.33 t/TJ, due to the ratio between 146,329.73 Gg CO₂ emissions and 907.04 PJ of the production of electricity) is about 19%, mainly due to the growth of the production of electricity, that has been faster than CO₂ emissions.

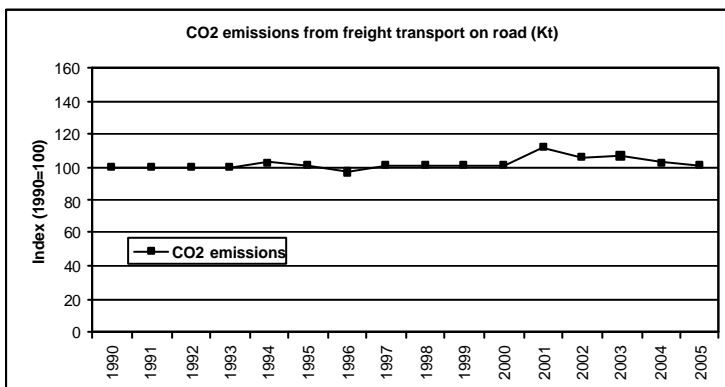


3. Additional priority indicators

This section focuses on the following six indicators.

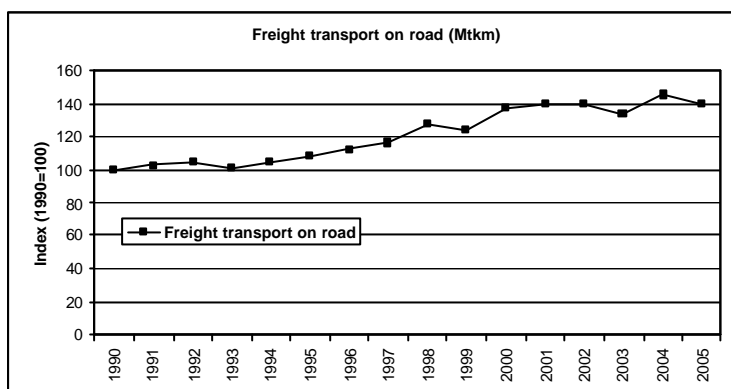
3.1 TRANSPORT D0

The first indicator of the second group considers CO₂ emissions from freight transport on road (kt), referring to heavy duty vehicles heavier than 3.5 t (highway driving, rural driving and urban driving). The emissions derive from the combustion of fossil fuel for all transport activity with light duty trucks (vehicles with a gross vehicle weight of 3900 kg or less designated primarily for transportation of light-weight cargo or which are equipped with special features such as four-wheel drive for off-road operation - IPCC source category 1A3bii) and heavy duty trucks (any vehicle rated at more than 3900 kg gross vehicle weight designated primarily for transportation of heavy-weight cargo - IPCC source category 1A3biii excluding buses). Emissions data are estimated on the basis of national activity and consumption data, used to calculate CRF emissions from road transportation.



From 1990 to 2005, the value has changed from 24,184.76 to 24,534.15 kt, registering a minimum in 1996, equal to 23,472.56 kt, and a maximum in 2001, equal to 27,080.61 kt. The trend of this indicator (the growth is about 1%) derives from two opposite trends: on the one hand the increase of the emissions from highway driving, on the other hand the decrease of the emissions both from urban and rural driving.

The second indicator represents the number of tonne-kilometres transported in light and heavy duty trucks on road (one tonne-kilometre is the transport of one tonne by road over one kilometre). The estimates are based on the national transport statistics (“CNIT”, Ministero delle Infrastrutture e dei Trasporti).



This indicator, from 1990 to 2004, shows a growth of about 39%, passing from 153,154.17 to 212,998.96 Mtkm. It registers a minimum in 1990 and a maximum in 2004, equal to 222,507.75 Mtkm.

3.2 INDUSTRY A1.1

This section presents an indicator expressing the total CO₂ intensity in iron and steel industry (t/Mio Euro).

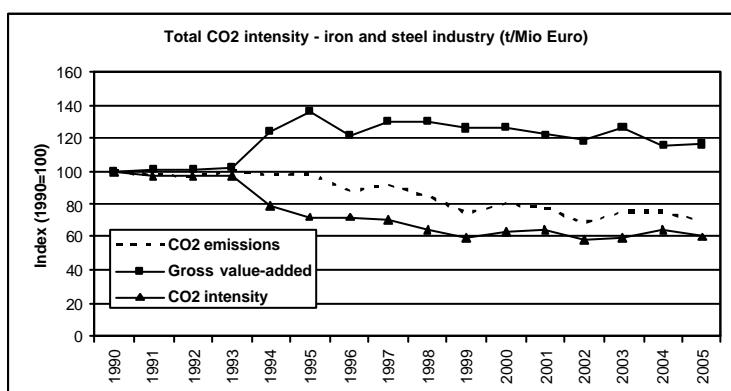
It is calculated as the ratio between:

- total CO₂ emissions from iron and steel industry (kt);
- gross value-added - iron and steel industry (Bio Euro).

The numerator expresses the CO₂ emissions (CRF) from combustion of fossil fuels in manufacture of iron and steel including combustion for the generation of electricity and heat (IPCC source category 1A2a), from the iron and steel production process (IPCC source category 2C1) and from ferroalloys production process (IPCC source category 2C2).

The denominator is the gross value added at concatenated 2000 prices in manufacture of basic iron and steel and of ferro-alloys (NACE 27.1), manufacture of tubes (NACE 27.2), other first processing of iron and steel (NACE (27.3), casting of iron (NACE 27.51) and casting of steel (NACE 27.52). Data concerning gross value are derived from “Conti Economici Nazionali”, ISTAT.

The following figure shows the trend from 1990 to 2005.



CO₂ emissions, passing from 24,352.75 to 16,957.04 kt, register a maximum in 1990 and a minimum in 2002, equal to 16,709.79 kt; the respective reduction is about 30%.

The gross value-added in 1990 is equal to 6.12 (it finds its minimum) and in 2005 it is equal to 7.11 billions of euros, having a growth of about 16%; it registers a maximum in 1995, equal to 8.35 billions of euros.

The decrease of the indicator from 1990 to 2005 is about 40%, mainly due to the reduction process of the emissions, faster than the growth of the gross value-added. It passes from 3,978.08 (the maximum) in 1990 to 2,386.21 t/Mio Euro in 2005, finding its minimum in 2002, equal to 2,303.13 t/Mio Euro.

3.3 INDUSTRY A1.2

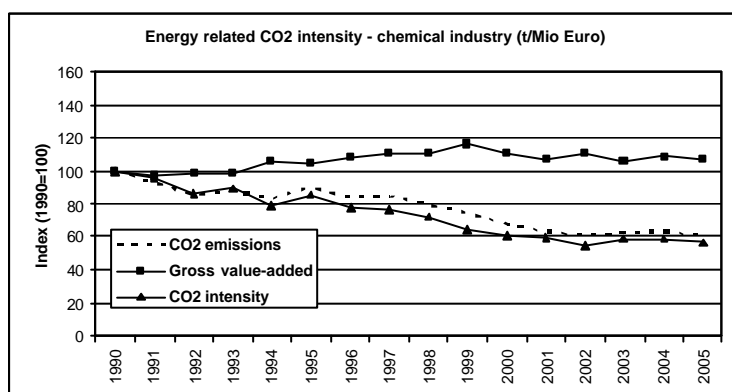
This indicator expresses the energy related CO₂ intensity in the chemical industry (t/Mio Euro). It is calculated as the ratio between:

- energy related CO₂ emissions in the chemical industries (kt);
- gross value-added in the chemical industry (Bio Euro).

CO₂ emissions (CRF) derive from the combustion of fossil fuels in manufacture of chemicals and chemical products including combustion for the generation of electricity and heat (IPCC source category 1A2c).

The denominator is the gross value added at concatenated 2000 prices in manufacture of chemicals and chemical products (NACE 24). Data concerning gross value are derived from “Conti Economici Nazionali”, ISTAT.

The trend is illustrated in the following figure.



In 1990, CO₂ emissions consist of 20,051.79 kt (the maximum), in 2005 the amount of emissions is equal to 12,175.35 kt (the minimum).

The gross value-added, passing from 15.26 billions of euros in 1990 to 16.39 billions of euros in 2005, has a minimum in 1991, equal to 14.80 billions of euros and a maximum in 1999, equal to 17.77 billions of euros.

In 1990 the indicator is equal to 1,313.66 t/Mio Euro (the maximum), in 2005 it is equal to 743.04 t/Mio Euro. It assumes the minimum value (723.16 t/Mio Euro) in the year 2002. The reduction of the CO₂ intensity of about 43% is due to the decreasing process of the emissions (39%), faster than the growth of the gross value-added (7%). The explanation can be found in the growth of the production, during last years, of the chemical products having higher value added and lower environmental impact, also due to the growth of the importation of intermediate products characterized by an higher value added. For instance the production of pharmaceutical products has increased, whereas the production of ammonia, nitric acid, sulphuric acid and fertilizers has decreased.

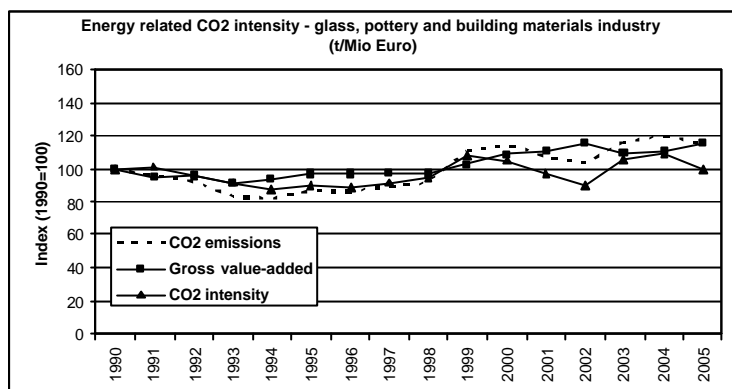
3.4 INDUSTRY A1.3

The energy related CO₂ intensity - glass, pottery and building materials industry expressed in t/Mio Euro, is calculated as the ratio between:

- energy related CO₂ emissions deriving from glass, pottery and building materials (kt);
- gross value-added in the glass, pottery and buildings materials industry, (Bio Euro).

CO₂ emissions derive from combustion of fuels in manufacture of non-metallic mineral products (NACE 26) including combustion for the generation of electricity and heat. Emissions data are estimated on the basis of national production and consumption data, used to calculate CRF emissions. The denominator is the gross value added at concatenated 2000 prices in manufacture of non-metallic mineral products (NACE 26). Data concerning gross value are derived from “Conti Economici Nazionali”, ISTAT.

The following figure shows the trend.



CO₂ emissions show a growth (15%), passing from 21,372.25 kt in 1990 to 24,602.74 kt in 2005. The year 1994 registers the minimum, equal to 17,539.63 kt; the maximum, equal to 25,639.38 kt, is registered in 2004.

Analogously, a growth (16%) is registered by the gross value-added; in 1990 it assumes the value of 11.28 Bio Euro, in 2005 it is equal to 13.05 Bio Euro (the maximum value). In 1993 it assumes the minimum value, equal to 10.32 Bio Euro.

The intensity varies from 1,893.92 t/Mio Euro in 1990 to 1,884.64 t/Mio Euro in 2005, registering a minimum in 1994 (1,664.03 t/Mio Euro) and a maximum in 2004 (2,057.89 t/Mio Euro). The steadiness of the trend (the variation is about of 0.49%) is due to the similar increase of both emissions and gross value-added.

3.5 INDUSTRY C0.1

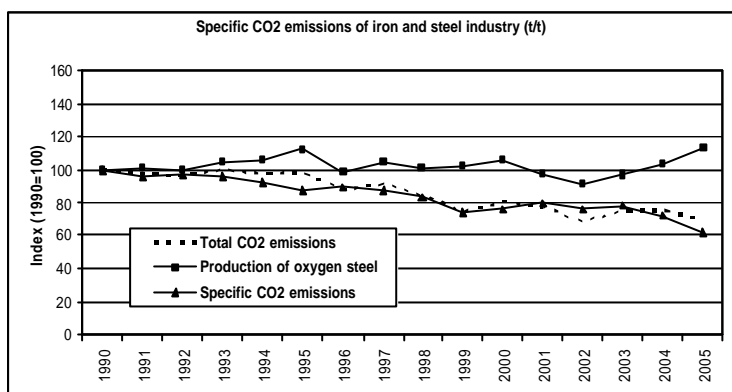
This indicator expresses the specific CO₂ emissions of iron and steel industry. It is calculated as the ratio between:

- total CO₂ emissions from iron and steel (kt);
- production of oxygen steel (kt).

The numerator includes the CO₂ emissions (CRF) from combustion of fossil fuels in manufacture of iron and steel including combustion for the generation of electricity and heat (IPCC source category 1A2a), from the iron and steel production process (IPCC source category 2C1) and from ferroalloys production process (IPCC source category 2C2).

The production of oxygen steel (NACE 27) derives from national production statistics.

The indicator is illustrated in the following figure.



CO₂ emissions, passing from 24,352.75 kt to 16,957.04 kt, register a maximum in 1990 and a minimum in 2002, equal to 16,709.79 kt; the respective reduction is about 30%.

The production of oxygen steel in 1990 is equal to 10,365.04 kt and in 2005 it is equal to 11,688.27 kt (the maximum value), having a growth of about 13%; it registers a minimum equal to 9,376.09 kt in 2002.

The decrease of the indicator from 1990 to 2005 is about 38%, mainly due to the reduction process of the emissions, faster than the growth of the production. It passes from 2.35 (the maximum) in 1990 to 1.45 (its minimum) in 2005.

3.6 INDUSTRY C0.2

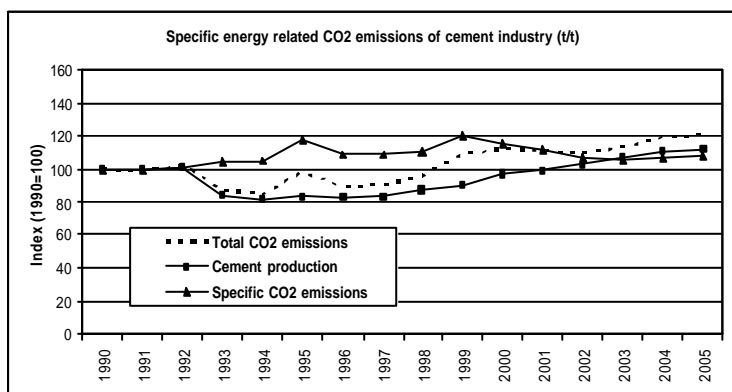
The specific energy related CO₂ emissions of cement industry is calculated as the ratio between:

- energy related CO₂ emissions from cement production (kt).
- cement production (kt).

Emissions data are estimated on the basis of national production and consumption data, used to calculate CRF emissions.

The production of cement (NACE 26) derives from national production statistics.

The indicator is illustrated in the following figure.



CO₂ emissions show a growth (21%), passing from 10,866.35 kt in 1990 to 13,113.59 kt in 2005 (the maximum value). The year 1994 registers the minimum, equal to 9,248.33 kt.

The cement production shows a growth of about 12%; in 1990 it assumes the value of 42,413.59 kt, in 2005 it is equal to 47,306.07 kt (the maximum value). In 1994 it assumes the minimum value, equal to 34,498.04 kt.

The indicator varies from 0.26 in 1990 to 0.28 in 2005, registering a minimum equal to 0.25 in 1991 and a maximum equal to 0.31 in 1999, showing a growth of about 8%.

4. Supplementary indicators

This section consists of 15 indicators.

4.1 TRANSPORT B0 - diesel

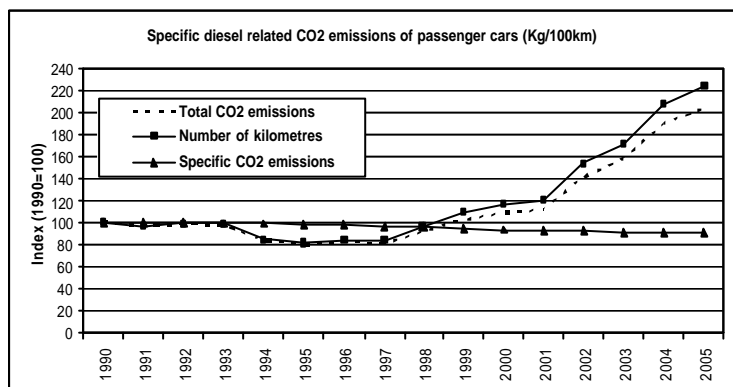
This indicator expresses the specific diesel related CO₂ emissions of passenger cars (kg/100 km). It is calculated as the ratio between:

- CO₂ emissions of diesel-driven passenger cars (kt);
- number of kilometres of diesel-driven passenger cars (Mio km).

The numerator is calculated using the CO₂ emissions from the combustion of diesel for all transport activity with passenger cars (automobiles designated primarily for transport of persons and having capacity of 12 persons or fewer; gross vehicle weight rating of 3900 kg or less - IPCC source category 1A3bi only diesel). Emissions data are based on national activity and consumption data, used to calculate CRF emissions from road transportation.

The denominator is based on the number of vehicle kilometres of total diesel-driven passenger cars licensed to use roads open to public traffic, deriving from the national transport statistics ("CNIT", Ministero delle Infrastrutture e dei Trasporti).

The following figure shows the trend.



From 1990 to 2005, the emissions value passes from 14,934.49 kt to 30,517.57 kt (the maximum value) registering a minimum in 1995, equal to 12,002.13 kt, showing a growth of about 104%.

The number of kilometres passes from the value of 78,254.94 Mio km in 1990 to the value of 175,565.83 (the maximum value) Mio km in 2005 registering a growth of about 124%.

The value of the indicator passes from the value of 19.08 kg/100 km in 1990 to 17.38 kg/100 km in 2005 (the minimum value), showing a decrease of about 9%. The maximum, equal to 19.10 kg/100 km, is reached in 1992.

4.2 TRANSPORT B0 – petrol

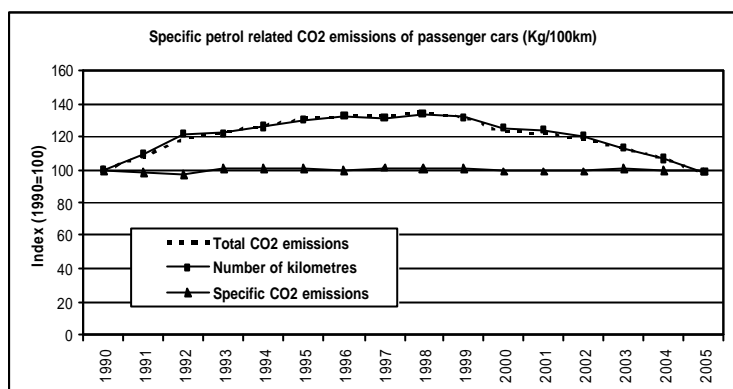
The specific petrol related CO₂ emissions of passenger cars (kg/100km) are calculated as the ratio between:

- CO₂ emissions of petrol-driven passenger cars (kt);
- number of kilometres of petrol-driven passenger cars (Mio km).

CO₂ emissions derive from the combustion of petrol for all transport activity with passenger cars (automobiles designated primarily for transport of persons and having capacity of 12 persons or fewer; gross vehicle weight rating of 3900 kg or less – IPCC source category 1A3bi only petrol). Emissions data are estimated on the basis of national activity and consumption data, used to calculate CRF emissions from road transportation.

The number of vehicle kilometres of total petrol-driven passenger cars licensed to use roads open to public traffic is derived from the national transport statistics (“CNIT”, Ministero delle Infrastrutture e dei Trasporti).

The indicator is illustrated in the following figure.



From 1990 to 2005, the emissions value passes from 37,115.17 kt to 36,193.41 kt (the minimum value) registering a maximum in 1998, equal to 50,032.39 kt, showing a decrease of about 2%.

The number of kilometres passes from the value of 196,465.63 Mio km in 1990 to the value of 193,008.13 (the minimum value) Mio km in 2005 registering, analogously to the emissions, a maximum in 1998 (equal to 262,749.74 Mio km) and a decrease of about 2%.

In consequence of these similar trends, the value of the indicator is relatively steady, passing from the value of 18.89 kg/100 km in 1990 to 18.75 kg/100 km in 2005 and showing a decrease of about 1% (it reaches the minimum, equal to 18.35 kg/100 km, in 1992 and the maximum, equal to 19.16 kg/100 km, in 1997).

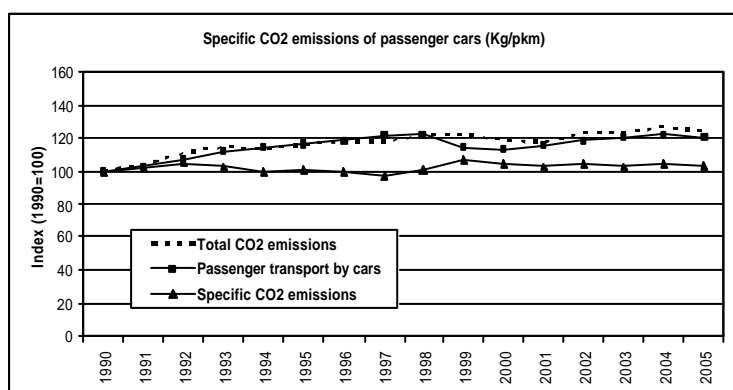
4.3 TRANSPORT CO

The specific CO₂ emissions of passenger cars, kg/pkm, are calculated as the ratio between:

- CO₂ emissions from passenger cars (kt);
- passenger transport by cars (Mpkm).

CO₂ emissions derive from the combustion of fossil fuels for all transport activity with passenger cars (automobiles designated primarily for transport of persons and having capacity of 12 persons or fewer; gross vehicle weight rating of 3900 kg or less - IPCC source category 1A3bi). Emissions are based on national activity and consumption data, used to calculate CRF emissions from road transportation.

The denominator is the number of passenger-kilometres travelled in passenger cars; one passenger-kilometre is the transport of one passenger over one kilometre. The estimates are based on the national transport statistics (“CNIT”, Ministero delle Infrastrutture e dei Trasporti).



CO₂ emissions show a growth (24%), passing from 56,070.10 kt (the minimum value) in 1990 to 69,792.09 kt in 2005. The year 2004 registers the maximum, equal to 70,997.22 kt.

The passenger transport by cars shows a growth of about 20%; in 1990 it assumes the minimum value equal to 521,989.00 Mpkm, in 2005 it is equal to 626,046.01 Mpkm. In 1998 it assumes the maximum value, equal to 636,603.09 Mpkm.

The indicator is equal to 0.11 kg/pkm both in 1990 and in 2005, registering a minimum equal to 0.10 kg/pkm in 1997 and a maximum equal to 0.12 kg/pkm in 1999.

4.4 TRANSPORT E1

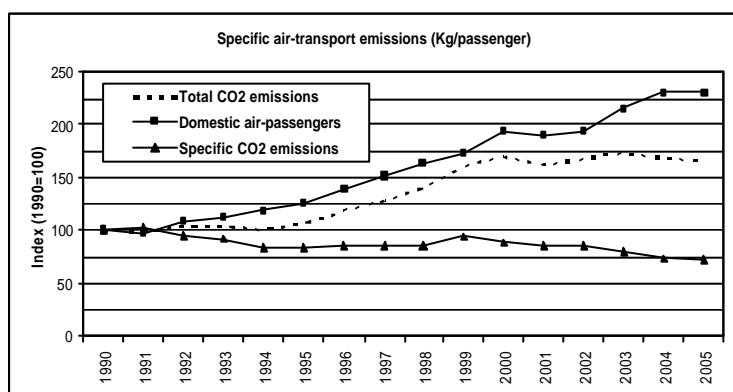
Specific air-transport emissions (kg/passenger) are calculated as the ratio between:

- CO₂ emissions from domestic air transport (kt);
- domestic air-passengers (Mio).

CO₂ emissions (CRF) derive from domestic air transport (commercial, private, agricultural, etc.), including take-offs and landings (IPCC source category 1A3aii). The use of fuel at airports for ground transport and fuel for stationary combustion at airports are excluded.

The number of persons, excluding on-duty members of the flight and cabin crews, making a journey by air (domestic aviation only) is derived from the national transport statistics (“CNIT”, Ministero delle Infrastrutture e dei Trasporti).

The following figure shows the trends.



From 1990 to 2005, the emissions value passes from 1,596.70 kt to 2,651.67 kt, registering a minimum in 1991, equal to 1,576.36 kt, and a maximum in 2003, equal to 2,771.78 kt. It shows a growth of about 66%.

The number of domestic air-passengers passes from the value of 46.58 Mio in 1990 to the value of 106.99 (the maximum value) Mio in 2005 registering a growth of about 130%.

The growth of the number of passengers is faster than the growth of the emissions. This is mainly due, during last years, to the coming in the market of the low cost companies and so to the growth of the competition and therefore to the decrease of prices.

The value of the indicator passes from the value of 34.28 kg/passenger in 1990 to 24.78 kg/passenger in 2005 (the minimum value), showing a decrease of about 28%. The maximum, equal to 35.21 kg/passenger, is reached in 1991.

4.5 INDUSTRY A1.4

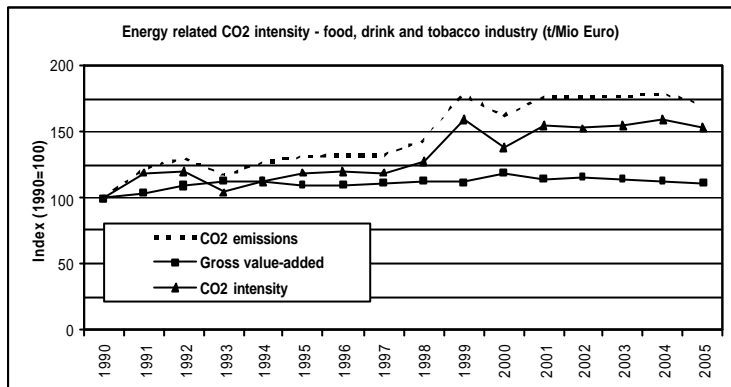
The indicator “energy related CO₂ intensity, food, drink and tobacco industry (t/Mio Euro)” is calculated as the ratio between:

- energy related CO₂ emissions from food industries (kt);
- gross value-added in the food, drink and tobacco industry (Mio Euro).

CO₂ emissions (CRF) derive from combustion of fossil fuels in manufacture of food products and beverages and tobacco products including combustion for the generation of electricity and heat (IPCC source category 1A2e).

The denominator is calculated using the gross value added at concatenated 2000 prices in manufacture of food products and beverages (NACE 15) and tobacco products (NACE 16) (“Conti Economici Nazionali”, ISTAT).

The indicator is illustrated in the following figure.



CO₂ emissions shows a growth of about 70%, passing from the minimum value, equal to 3,853.15 kt in 1990, to 6,549.58 kt in 2005. The maximum value, reached in 2004, is equal to 6,897.86 kt.

The gross value-added passes from the minimum value 25,379.88 Mio Euro to 28,179.48 Mio Euro, reaching the maximum (29,921.45 Mio Euro) in 2000 and showing a growth of about 11%.

The value of the indicator passes from the minimum value of 151.82 t/Mio Euro in 1990 to 232.42 t/Mio Euro in 2005, increasing of about 53%. The maximum, equal to 241.55 t/Mio Euro, is reached in 1999.

4.6 INDUSTRY A1.5

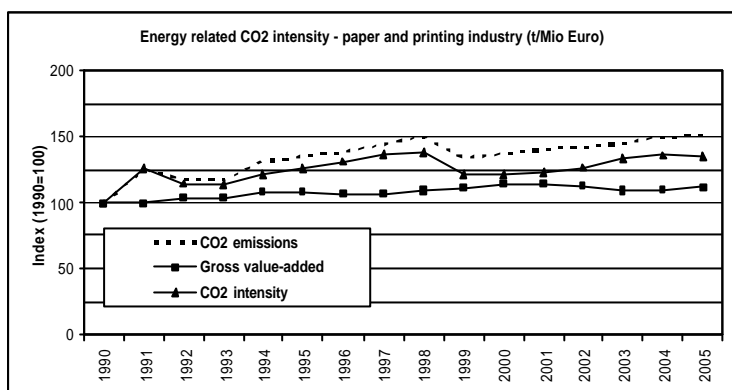
The energy related CO₂ intensity in the paper and printing industry (t/Mio Euro) is calculated as the ratio between:

- energy related CO₂ emissions from paper and printing (kt);
- gross value-added in paper and printing industry (Mio Euro).

CO₂ emissions (CRF) derive from combustion of fossil fuels in manufacture of pulp, paper and paper products and publishing, printing and reproduction of recorded media including emissions from combustion for the generation of electricity and heat (IPCC source category 1A2d).

The denominator is the gross value added at concatenated 2000 in manufacture of pulp, paper and paper products (NACE 21) and publishing, printing and reproduction of recorded media (NACE 22) (“Conti Economici Nazionali”, ISTAT).

The following figure shows the trends.



CO₂ emissions show a growth (51%), passing from the minimum value 3,076.40 kt in 1990 to the maximum value, equal to 4,636.07 kt, in 2005.

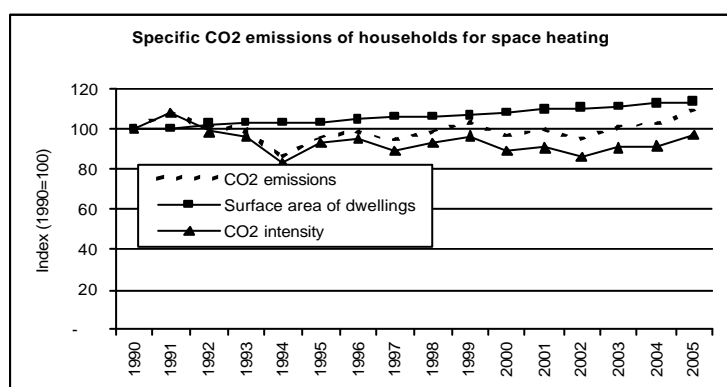
The gross value-added shows a growth of about 12%; in 1990 it is equal to 11,978.84 Mio Euro and in 2005 it is equal to 13,411.44 Mio Euro. In 1991 it assumes the minimum value equal to 11,961.46 Mio Euro and in 2001 it assumes the maximum value, equal to 13,693.72 Mio Euro.

In 1990, the indicator assumes the minimum value (256.82 t/Mio Euro); in 2005 it is equal to 345.68 t/Mio Euro and in 1998 it assumes the maximum value, 352.54 t/Mio Euro, showing a growth of about 35%.

4.7 HOUSEHOLDS A0

The seventh indicator in the list of the supplementary indicators is “Specific CO₂ emissions of households for space heating (kg/m²)”. It has been determined by the ratio between CO₂ emissions for space heating in households, as reported in the CRF (IPCC source category 1A4b), and the surface area of permanently occupied dwellings. Data on dwellings are obtained from the national statistics (“Censimento della Popolazione e delle Abitazioni”, ISTAT), just for the years 1991 and 2001. Information for other years is estimated on the basis of available information and data.

The decrease of the indicator from 1990 to 2005 is about 3%, mainly due to the growth of the total surface area of permanently occupied dwellings, that has been faster than CO₂ emissions. The indicator’s mean value is equal to 25.72 kg CO₂ emissions/m².

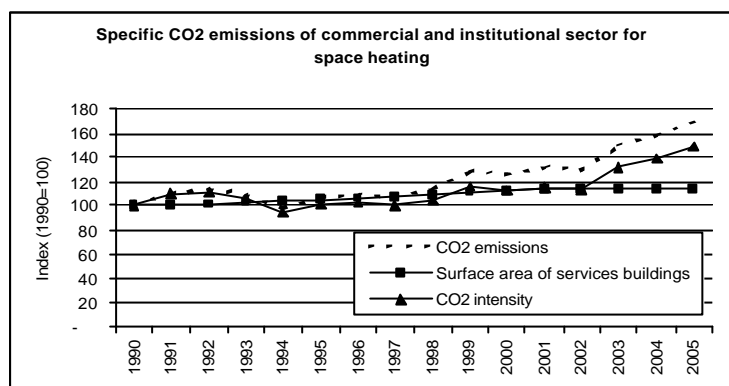


4.8 SERVICES B0

As regards service sector, the types of data used to calculate the “Specific CO₂ emissions of commercial and institutional sector for space heating, (kg/m²)” indicator are:

- CO₂ emissions from fossil fuel combustion for space heating in commercial and institutional buildings in the public and private sectors, as reported in the CRF (IPCC source category 1A4a);
- Total surface area of services buildings (NACE 41, 50, 51, 52, 55, 63, 64, 65, 66, 67, 70, 71, 72, 73, 74, 75, 80, 85, 90, 91, 92, 93, 99). Data on buildings are obtained from the national statistics (“Censimento Industria e Servizi”, ISTAT), only for the years 1991 and 2001. Information for other years is estimated on the basis of other available information and data.

From 1990 to 2005, the increase in indicator’s value (+49%) is due to the growth of CO₂ emissions for heating, that is about equal to 70%. The indicator’s mean value is equal to 32.97 kg CO₂ emissions/m².



The next two indicators show the trend of specific CO₂ emissions from production of electricity, by public power plants and autoproducer plants separately.

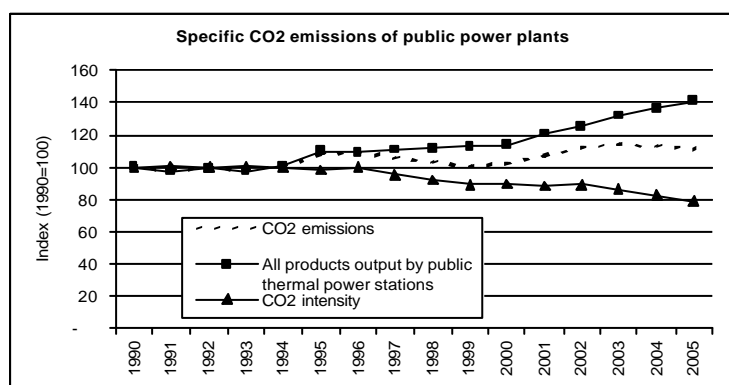
4.9 TRANSFORMATION D0

The eighth supplementary indicator is “Specific CO₂ emissions of public power plants, (t/TJ)”. It is the ratio between:

- CO₂ emissions from all fossil fuel combustion for gross electricity and heat production by public thermal power and combined heat and power plants, calculated on the basis of national statistics (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA);
- Gross electricity produced and any heat sold to third parties (combined heat and power plants) by public thermal power and combined heat and power plants (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA).

The decrease of the indicator from 1990 to 2005 is about 21%, mainly due to the growth of the production of electricity, that has been faster than the CO₂ emissions increase.

In 1991, the indicator’s value is equal to 195.80 t/TJ and it is the maximum value of the time series. The minimum value, estimated in 2005, is equal to 153.98 t/TJ.



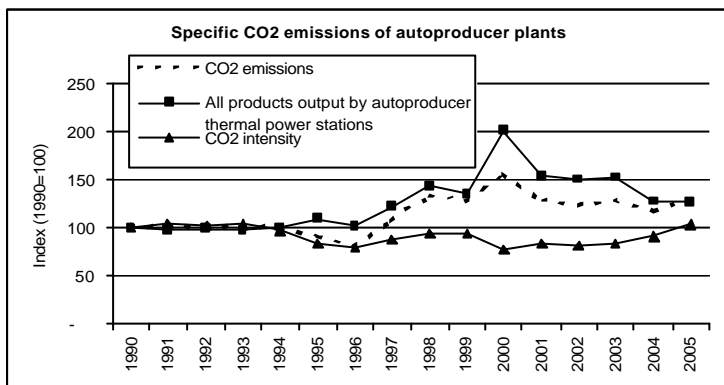
4.10 TRANSFORMATION E0

The “Specific CO₂ emissions of autoproducer plants, (t/TJ)” indicator has been determined by the ratio between:

- CO₂ emissions from all fossil fuel combustion for gross electricity and heat production by autoproducer thermal power and combined heat and power plants, calculated on the basis of national statistics (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA);
- Gross electricity produced and any heat sold to third parties (combined heat and power) by autoproducer thermal power and combined heat and power plants (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA).

From 1990 to 2005, the increase in indicator’s value is relatively low (+3%).

The indicator’s minimum value is 194.53 t/TJ and the maximum value is 262.35 t/TJ, estimated for 2000 and 1991 respectively.

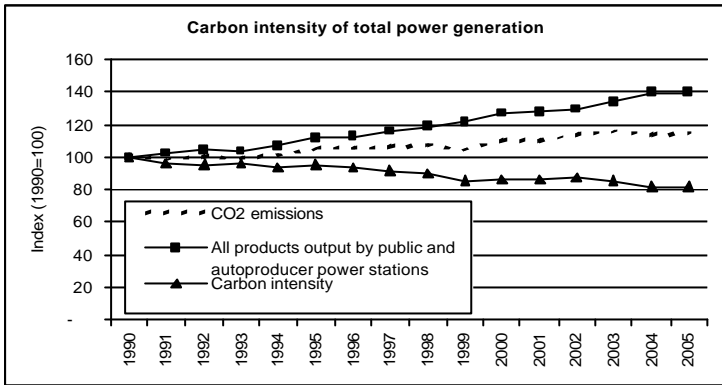


4.11 TRANSFORMATION

In the transformation sector, the “Carbon intensity of total power generation, (t/TJ)” indicator has been determined too. It is the ratio between:

- CO₂ emissions from all fossil fuel combustion for gross electricity and heat production by public thermal power and combined heat and power plants and by autoproducer thermal power and combined heat and power plants calculated on the basis of national statistics (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA);
- Gross electricity produced and any heat sold to third parties (combined heat and power) by public and autoproducer power and combined heat and power plants. It includes electricity production from renewable sources and nuclear power (“Dati statistici sull’energia elettrica in Italia”, GRTN-TERNA).

The decrease of the indicator from 1990 to 2005 is about 18%, mainly due to the growth of the production of electricity, that has been faster than CO₂ emissions. The mean value of the indicator is 151.24 t CO₂ emissions /TJ.

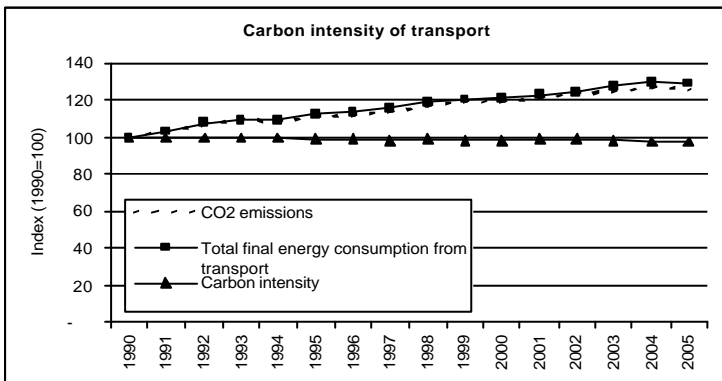


4.12 TRANSPORT

As regards transport sector, the types of data used to calculate the “Carbon intensity of transport, (t/TJ)” indicator are:

- CO₂ emissions from fossil fuels for all transport activity, as reported in the CRF (IPCC source category 1A3);
- total final energy consumption of transport from all energy sources (including biomass and electricity consumption); data are obtained from national statistics (CNIT, Ministero delle Infrastrutture e dei Trasporti).

From 1990 to 2005, the decrease in the indicator’s value is relatively low (-3%) and the indicator is equal to 68.62 t/TJ on average.



4.13 INDUSTRY C0.3

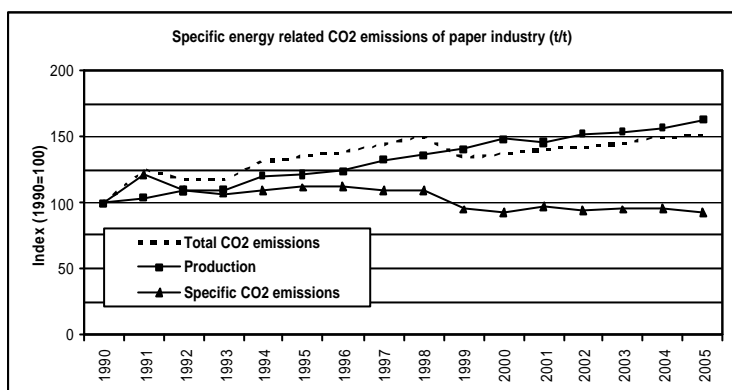
The specific energy related CO₂ emissions of paper industry (t/t) is calculated as the ratio between:

- energy related CO₂ emissions of the paper and printing industries (kt);
- physical output of paper (kt).

CO₂ emissions (CRF) derive from combustion of fossil fuels in manufacture of pulp, paper and paper products and publishing, printing and reproduction of recorded media including emissions from combustion for the generation of electricity and heat (IPCC source category 1A2d, CRF).

The production of paper (NACE 21) is derived from the national production statistics (Assocarta).

The indicator is illustrated in the following figure.



CO₂ emissions show a growth (51%), passing from the minimum value 3,076.40 kt in 1990 to the maximum value, equal to 4,636.07 kt, in 2005.

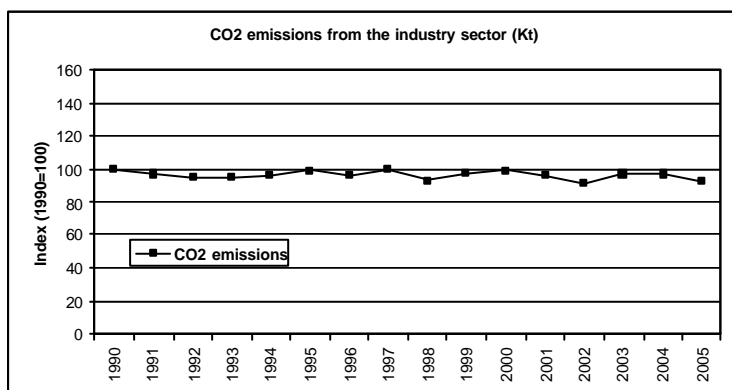
The production assumes the minimum value in 1990 (6,180.20 kt) and the maximum value in 2005 (9,999.40 kt), registering a growth of about 62%.

The indicator passes from 0.50 t/t to 0.46 t/t (the minimum value); in 1991 it reaches the maximum value, equal to 0.60 t/t. The decrease of about 7% is mainly due to the growth of the production, faster than CO₂ emissions.

4.14 INDUSTRY

4.14.1 CO₂ emissions from the industry sector

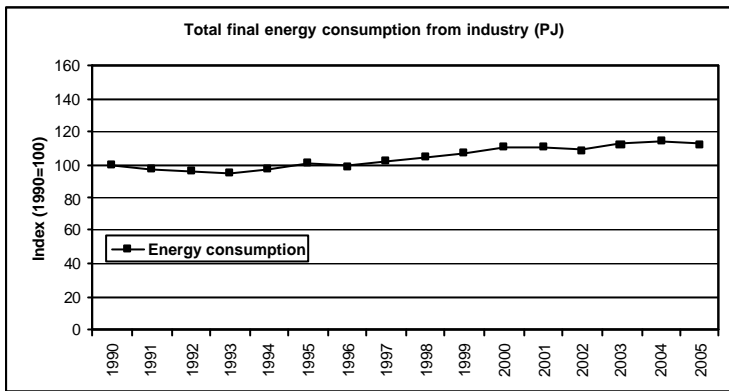
The emissions from combustion of fossil fuels in manufacturing industries, construction and mining and quarrying (except coal mines and oil and gas extraction) including combustion for the generation of electricity and heat (IPCC source category 1A2) are considered (CRF).



CO₂ emissions show a decrease (8 %), passing from the maximum value 88,936.88 kt in 1990 to 81,960.31 kt in 2005, reaching the minimum value in 2002, equal to 81,108.59 kt.

4.14.2 Total final energy consumption from industry

The indicator, expressed in PJ, includes total final energy consumption of industry from all energy sources (including biomass and electricity consumption) and is based on the national energy balance (BEN) of Ministero dello Sviluppo Economico.



The total final energy consumption of industry shows a growth of about 13%, passing from the value of 1,525.21 PJ in 1990 to the value of 1,717.95 PJ in 2005. In 1993 it reaches the minimum, equal to 1,441.70 PJ and in 1994 the maximum value, equal to 1,731.93 PJ.

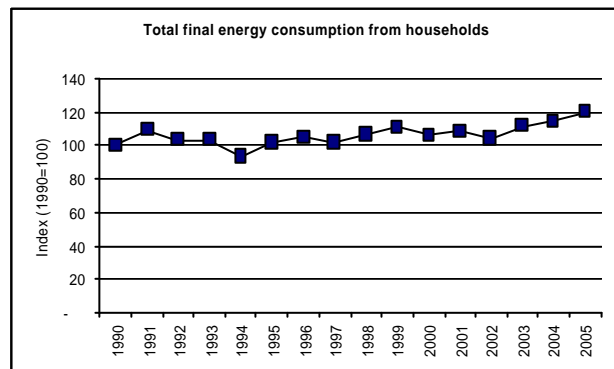
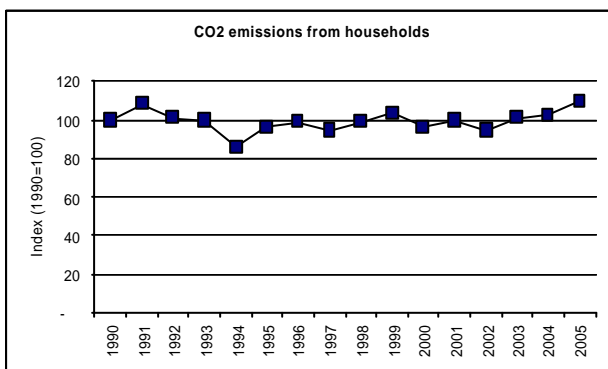
4.15 HOUSEHOLDS

Concerning households activity, two indicators have been calculated:

- “CO₂ emissions from households (kt)”;
- “Total final energy consumption from households, (PJ)”.

The first indicator has been computed on the basis of data used to calculate CRF emissions from fossil fuel combustion in households (IPCC source category 1A4b). This indicator represents on average 12% of CO₂ emissions from combustion of fossil fuels and from 1990 to 2005 the value increases of 10%. The minimum value is 44,804.18 kt CO₂ emissions, calculated for 1994, and the biggest one is 57,161.02 kt CO₂ emissions, estimated for the last year of the time series.

The second indicator has been compiled starting from the estimates made on the basis of national balance energy (“BEN”, Ministero dello Sviluppo Economico). The trend grows on average (+21%, from 1990 to 2005) and the mean value is 1,048.18 PJ energy consumption.



Annex I

Table 1: list of priority indicators

No	Nomenclature in Eurostat energy efficiency indicators	Indicator	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	MACRO	Total CO2 intensity of GDP, t/Mio Euro	427.33	420.34	416.80	414.54	399.16	411.26	402.37	398.72	402.77	399.51	389.24	387.07	387.27	399.84	399.13	401.26
2	MACRO B0	Energy related CO2 intensity of GDP, t/Mio Euro	395.15	389.13	385.36	385.54	371.81	383.07	376.74	373.28	377.81	375.63	365.55	363.26	363.76	375.07	374.39	376.47
3	TRANSPORT C0	CO2 emissions from passenger cars, kt	56,070.10	58,368.08	62,249.17	64,235.02	63,577.27	65,113.28	65,913.27	65,925.65	68,532.20	68,406.74	66,251.26	66,089.88	69,052.42	69,277.43	70,997.22	69,792.09
		Number of kilometres by passenger cars, Mkm	298,006.66	313,683.07	337,256.18	340,420.39	337,300.54	345,902.51	351,775.87	348,666.05	365,369.61	366,943.59	360,657.54	360,582.81	378,065.24	377,418.87	390,538.42	386,004.34
4	INDUSTRY A1	Energy related CO2 intensity of industry, t/Mio Euro	342.33	331.19	325.18	338.30	328.88	324.68	316.62	323.97	301.32	314.62	308.47	297.17	283.94	304.71	301.29	288.98
5	HOUSEHOLDS A.1	Specific CO2 emissions of households, t/dwelling	2.63	2.86	2.60	2.55	2.20	2.46	2.50	2.36	2.45	2.55	2.34	2.39	2.27	2.38	2.40	2.56
6	SERVICES A0	CO2 intensity of the commercial and institutional sector, t/Mio Euro	28.31	30.81	31.20	29.89	26.55	28.35	28.46	27.68	28.70	31.64	29.87	30.28	29.50	34.15	35.75	38.18
7	TRANSFORMATION B0	Specific CO2 emissions of public and autoproducer power plants, t/TJ	200.16	202.82	200.98	202.17	199.23	192.56	194.62	189.10	183.90	178.09	177.62	179.18	175.37	170.01	165.24	161.33

Table 2: list of additional priority indicators

No	Nomenclature in Eurostat energy efficiency indicators	Indicator	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	TRANSPORT D0	CO2 emissions from freight transport on road, kt	24,184.76	24,177.77	24,149.13	24,035.27	24,812.51	24,499.95	23,472.56	24,224.80	24,252.22	24,264.52	24,489.79	27,080.61	25,507.67	25,689.84	24,868.61	24,534.15
		Freight transport on road, Mtkm	153,154	157,244	159,821	153,825	161,170	165,291	172,633	177,536	194,727	189,802	209,627	213,569	214,641	204,503	222,508	212,999
2	INDUSTRY A1.1	Total CO2 intensity - iron and steel industry, t/Mio Euro	3,978.08	3,841.30	3,843.47	3,876.78	3,143.78	2,872.82	2,884.54	2,808.17	2,589.66	2,358.63	2,522.74	2,532.58	2,303.13	2,369.97	2,586.82	2,386.21
3	INDUSTRY A1.2	Energy related CO2 intensity - chemical industry, t/Mio Euro	1,313.66	1,260.16	1,138.85	1,170.44	1,036.07	1,125.03	1,021.39	1,004.94	945.43	842.75	799.48	779.52	723.16	774.33	768.51	743.04
4	INDUSTRY A1.3	Energy related CO2 intensity - glass, pottery and building materials industry, t/Mio Euro	1,893.92	1,916.61	1,822.94	1,730.46	1,664.03	1,706.02	1,679.93	1,737.36	1,788.12	2,045.30	1,993.10	1,830.58	1,703.36	1,999.46	2,057.89	1,884.64
5	INDUSTRY C0.1	Specific CO2 emissions of iron and steel industry, t/t	2.35	2.26	2.29	2.25	2.17	2.06	2.09	2.05	1.96	1.73	1.78	1.87	1.78	1.83	1.70	1.45
6	INDUSTRY C0.2	Specific energy related CO2 emissions of cement industry, t/t	0.26	0.25	0.26	0.27	0.27	0.30	0.28	0.28	0.28	0.31	0.30	0.29	0.27	0.27	0.27	0.28

Table 3: list of supplementary indicators

No	Nomenclature in Eurostat energy efficiency indicators	Indicator	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	TRANSPORT B0	Specific diesel related CO2 emissions of passenger cars, kg/100km	19.08	19.09	19.10	19.00	18.99	18.78	18.65	18.53	18.24	18.04	17.82	17.72	17.60	17.52	17.42	17.38
2	TRANSPORT B0	Specific petrol related CO2 emissions of passenger cars, kg/100km	18.89	18.58	18.35	18.97	18.95	18.98	18.90	19.16	19.04	18.95	18.66	18.64	18.67	18.93	18.82	18.75
3	TRANSPORT C0	Specific CO2 emissions of passenger cars, kg/pkm	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.12	0.11	0.11	0.11	0.11	0.11	0.11
4	TRANSPORT E1	Specific air-transport emissions, kg/passenger	34.28	35.21	32.75	31.66	28.70	28.79	29.46	29.05	29.42	32.15	30.19	29.18	29.55	27.69	24.94	24.78
5	INDUSTRY A1.4	Energy related CO2 intensity - food, drink and tobacco industry, t/Mio Euro	151.82	180.13	181.61	158.11	170.53	181.03	182.05	180.73	193.72	241.55	208.67	234.26	232.01	234.42	241.35	232.42
6	INDUSTRY A1.5	Energy related CO2 intensity - paper and printing industry, t/Mio Euro	256.82	321.75	293.43	291.40	312.72	323.12	337.01	351.61	352.54	310.92	309.38	314.89	324.99	342.16	349.79	345.68
7	HOUSEHOLDS A0	Specific CO2 emissions of households for space heating, kg/m²	27.43	29.79	27.10	26.59	22.93	25.57	26.01	24.57	25.56	26.59	24.42	24.87	23.60	24.82	25.02	26.67
8	SERVICES B0	Specific CO2 emissions of commercial and institutional sector for space heating, kg/m²	29.21	32.27	32.62	31.06	27.52	29.72	29.86	29.21	30.32	33.79	32.77	33.63	33.03	38.43	40.50	43.49
9	TRANSFORMATION D0	Specific CO2 emissions of public power plants, t/TJ	194.51	195.80	194.91	195.48	194.06	190.86	193.80	185.80	177.95	172.95	175.08	171.73	173.24	167.16	160.98	153.98
10	TRANSFORMATION E0	Specific CO2 emissions of autoproducer plants, t/TJ	247.89	262.35	252.36	258.81	242.83	206.37	198.10	218.37	232.93	233.75	194.53	206.19	203.09	207.45	227.93	255.24
11	TRANSFORMATION	Carbon intensity of	167.45	160.64	159.48	160.35	157.07	158.81	157.08	153.57	150.27	143.18	144.54	144.04	145.99	143.66	136.79	136.95

		total power generation, t/TJ																
12	TRANSPORT	Carbon intensity of transport, t/TJ	69.53	69.34	69.42	69.20	69.07	68.51	68.76	68.37	68.79	68.28	68.15	68.56	68.77	67.95	67.62	67.59
13	INDUSTRY C0.3	Specific energy related CO2 emissions of paper industry, t/t	0.50	0.60	0.54	0.53	0.55	0.56	0.56	0.54	0.55	0.47	0.46	0.48	0.47	0.47	0.48	0.46
14	INDUSTRY	CO2 emissions from the industry sector, kt	88,936.88	85,985.17	84,303.00	84,765.91	85,540.83	87,823.05	85,608.36	88,673.34	82,777.77	86,492.66	87,888.78	85,138.29	81,108.59	86,005.03	86,115.95	81,960.31
		Total final energy consumption from industry, PJ	1,525.21	1,487.26	1,469.87	1,441.70	1,490.39	1,540.79	1,513.20	1,556.43	1,586.46	1,637.18	1,680.99	1,695.82	1,654.94	1,713.95	1,731.93	1,717.95
15	HOUSEHOLDS	CO2 emissions from households, kt	51,989.68	56,465.44	52,450.84	51,910.01	44,804.18	49,970.16	51,516.69	49,236.30	51,316.93	53,699.58	50,063.38	51,706.11	49,342.53	52,408.18	53,362.01	57,161.02
		Total final energy consumption from households, PJ	982.53	1,074.93	1,021.47	1,021.07	920.37	1,003.05	1,036.75	1,005.81	1,052.46	1,096.76	1,040.02	1,072.51	1,028.18	1,103.55	1,124.87	1,186.62