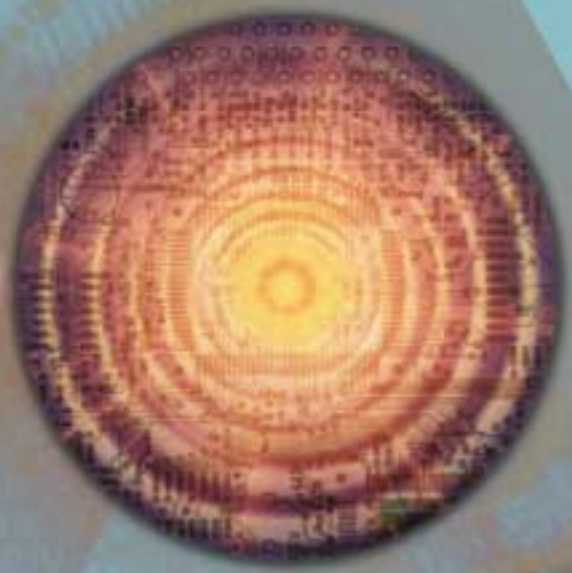
ENEA Report Energy and the Environment 2003



Executive Summary

of the Report Energy and the Environment 2003

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ENEA – Agency for Sustainable Development – Advisor

The Report Energy and the Environment 2003, prepared by the ENEA Agency for Sustainable Development – Advisor, is the outcome of an in-depth analysis of data on the energy situation in Italy.

It is a consultation tool, drawn with a view to the international energy scenario.

In line with the previous editions, the Report shows the development of the national energy framework as for energy supply and demand and energy-environment issues, in compliance with the commitments undertaken at Government level.

The Report also contains the energy and environmental policies at regional and local level, as well as an overview of the developments of research and technology innovation in the energy field.

The Report comprises three volumes:

- ***The Analysis**, outlining the energy and environmental trends in the global macroeconomic and energy framework;*
- ***The Figures**, providing energy, environmental and economic statistical data at international, national and regional level;*
- *a monograph on renewable energy sources.*

This compendium represents a concise summary of the major data contained in the Report.

The volumes of the Report Energy and the Environment 2003 can be requested to:
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International framework

Economy

In 2002, the world economy grew by 3%, slightly less than the average for the last twenty years, but higher than the 2.3% annual growth rate recorded in 2001. This was conditioned by the economic trend in the United States, where uncertainty on the development of the economic situation prompted the Federal Reserve to further reduce the official rate of discount. Short-term interest rates were negative or near to zero in real terms. At the same time, the Congress of the United States approved the adoption of a programme for tax cuts and increases in spending for the next decade. These measures contributed to bolstering the up trend that had begun in the last quarter of 2001. However, the Federal annual budget worsened in September 2002, resulting negative at an equivalent of 1.5% of the GDP. The Congress of the United States estimated that the budget could remain in deficit until 2007, resulting in a total debit of over 400 billion dollars for the decade 2002-2011. The average annual growth rate of the GDP was 2.4% against 0.3% in 2001, but gradually declined over the year due to the negative trend in the financial markets and renewed fears of terrorist acts.

Economic recovery was spurred on by the increase in consumption brought about by the trend in real wages, tax cuts and the reduction in interest rates that led to the renegotiation of mortgage loans.

The increased gap between the economic growth rate of the United States and its main trading partners, led to a further deterioration in its foreign accounts.

In particular, the balance of current accounts increased the deficit to 4.8% of the GDP in 2002. In the evaluation of the markets, the extent of the current accounts deficit and uncertainties on the economic recovery impacted on the depreciation of the dollar in comparison with the other major currencies.

After the recession in 2001, the Japanese economy made a slight recovery, triggered by strong growth in exports (+8.1% in 2002, –6.1% in 2001). However, the GDP only increased by 0.3% due to a decline in domestic demand. In fact, in 2002,

employment figures fell even further, especially in large-sized firms; despite reductions in consumer prices, there was a considerable contraction of real wages that further squeezed available family income, resulting in a slow down of the consumer dynamics.

In 2002 the gross domestic product in the euro area, increased by 0.8% (1.4% in 2001). The foreign component of the aggregate demand contributed to support growth, while investments fell and household consumption slackened, slowed down by a declining employment market. In 2002, consumer-price inflation dropped from 2.5% to 2%. In December 2002, the mitigated risk of inflation and the need to revive domestic demand prompted the European Central Bank to reduce by half a percent the rate on major re-financing operations that was set at 2.75%. A further reduction was made in March 2003, fixing the rate at 2.50%.

The tax policies were, on the other hand, far less accommodating. The high public deficit levels in the major countries of the euro area and the restrictions imposed by the Pact of Stability and Growth riduce the room for adopting expansive tax policies.

During the course of 2002 there was a slump in production, especially in Italy and Germany and by the fourth quarter France was also affected by the contraction of economic activities. Since 1995, the growth levels of Italy and Germany have been below the European average: the German economy has, for some years, been marked by poor domestic demand, and Italy has suffered from a gradual loss in competitiveness. Stagnation in the German domestic demand, especially of the component regarding household consumption, resulted from the financial efforts made after the unification process. The financial aid allocated to restructuring the production system in the eastern regions determined a considerable reduction in public finances, only partially compensated by increased fiscal pressure. In more recent years, expectations for welfare state reform have curbed household consumption. The transfer of many production activities to central-eastern European countries has, moreover, impeded growth in the eastern regions and led to a reduction in production investments.

Growth was driven by the positive trend in exports, three-quarters of which intended for other European countries. Imports, however, fell considerably, negatively influencing the exports of other countries in the Union: in 2002, Italy's exports to Germany dropped by 10%. Loss of competitiveness on the international markets is one of the crucial points of the Italian economy, whose share of world exports decreased by 20% between 1995 and 2002.

The trend in exports was affected by the international economic trend, but also by certain structural characteristics of the Italian production system, such as the delayed introduction of new technologies, sectorial specialization and the innovation difficulties of firms.

Uncertainties on the development of the geopolitical situation weighed especially heavily on the global economic trend of 2003. In the first quarter, the GDP

rose by 1.6% compared to the same quarter of the previous year. The state of uncertainty caused a slump in investments and a reduction in the purchase of durable goods. However, with regard to the previous quarter, investments in new computer and communication technologies increased considerably. The first elements on the second quarter show lower than expected growth rates for the GDP and employment. The greater confidence of households, continued low interest rates and the reduction in oil prices induce to forecast a recovery in employment and investments, such as to guarantee higher growth rates.

In April 2003, with oil prices around 25 dollars per barrel, IMF forecasts indicated a growth rate in world trade of 4.3% and a 3.2% growth rate of the GDP. The modest growth rates estimated were to be attributed above all to the economic trend of the first six months. An acceleration was expected in the second half of the year, thanks especially to the propelling force of the United States economy. A 2.2% average annual growth rate of the GDP was expected in the USA, acceleration in growth that, in the fourth quarter, could be 3.5% more than for the same period in 2002. The structural problems of the Japanese economy cause a pessimistic forecast to be made on the prospects of economic recovery. In fact, IMF forecasts estimate a 0.8% growth rate in GDP.

In the euro area, the GDP growth rate forecast for 2003 was 1.1%, slightly more than in 2002. Projections on price trends estimate consumer-price inflation at 1.8% in 2003 and 1.6% in 2004. These expectations prompted the European Central Bank to intervene in relation to the economic developments in the euro zone: the official rate of discount, already reduced by 0.5% in December, was further reduced by 0.25% on 6 March 2003 and 5 June 2003. The decision to set the cost of money at 2%, the lowest since 1948, was also determined by the need to counter the effects of the appreciation of the euro against the dollar (24% in 12 months).

Despite the negative effects of the SARS epidemic, which affected many countries in Asia, economic growth was expected to remain around 6% in the other Asian countries, China and India included.

Thanks to a moderate recovery in production activities in Brazil and Argentina, there could be a renewed up trend of the GDP also in Latin America, although at around 1.5%.

Energy

In 2002, world consumption of primary energy increased by 2.6% compared to the previous year: a rate significantly higher than the average for the previous decade and three and a half times more than in 2001 (Table 1).
This trend reflects essentially the economic recovery of the Asian region and, to a lesser extent, the increasing energy consumption in the United States after the slump in the previous year.

Table 1 - Primary energy consumption by geographical area. Years 2001-2002 (Mtoe)

	2001	2002	Variation 2002/2001 (%)	Share 2002 (%)
Northern America	2670.5	2715.4	1.7	28.9
Central and Southern America	448.7	448.2	–0.1	4.8
Western Europe*	1774.5	1757.8	–0.9	18.7
Former USSR, economies in transition**, Turkey	1070.8	1071.7	0.1	11.4
Middle East	396.5	403.1	1.6	4.3
Africa	284.7	291.0	2.2	3.1
Asia and the Pacific	2519.6	2717.8	7.9	28.9
World	9165.3	9405.0	2.6	100.0
of which: European Union (15)	1483.7	1468.9	–1.0	15.6
OECD	5314.0	5346.1	0.6	56.8
former USSR	944.6	946.1	0.2	10.1

Source: FEEM data processing of BP data

* Includes countries about to enter the EU
** Bulgaria, Rumania

An analysis of demand by source (Table 2), confirmed that oil is the energy source most used worldwide, accounting for an approximate 38% share of primary energy consumption. In 2002, global oil demand remained stable at the same level of the previous year, although an analysis of consumption indicated different trends in different geographical areas.

Global oil production dropped by 0.7% compared to 2001, from 74.3 million barrels/day (74.3 Mb/d) to 73.9 Mb/d. The reduction mainly concerned the OPEC countries that had reduced production by 1.9 Mb/d.

Coal meets approximately 26% of overall energy needs and is the second source of energy in the world. Scarcely used in the Middle East and in Central and South America, coal meets over 50% of the total energy requirements of some countries (South Africa, China, India and Poland). It is also widely used in the United States and in the former USSR countries. In 2002, the coal consumption recorded a sharp increase on the previous year (about 7%), at rate higher than total energy demand, in contrast with the downtrend in demand of the nineties. As a result of the increase in world demand, production also rose for the second year running at a rate of more than 5%.

The 6.2% increase, compared to 2001, was the result of a robust rise in production in Asia (+17.8%), particularly in China (+28.3%), and a drastic fall in production in Europe, the United States and Canada.

Natural gas meets little more than 24% of world energy requirements and is the third most important source, now close to the level of consumption of coal. In 2002, global consumption rose by 2.8%, a higher growth rate than that of the previous decade (2.1%) but lower than the GDP growth rate (3%).

Table 2 - Primary energy consumption by source and geographical area. Year 2002 (Mtoe)

	Oil	Natural gas	Coal	Nuclear	Hydro-electric	Total
Northern America	1064.9	711.2	591.5	205.0	142.4	**2715.4**
Central and Southern America	214.8	88.2	17.8	4.7	122.7	**448.2**
Europe and Eurasia	925.2	939.5	506.1	280.0	178.9	**2829.5**
Middle East	207.4	185.1	8.4	–	1.9	**403.1**
Africa	118.6	60.7	90.6	2.9	18.5	**291.0**
Asia and the Pacific	991.6	297.3	1183.5	118.0	127.7	**2717.8**
World	**3522.5**	**2282.0**	**2397.9**	**610.6**	**592.1**	**9405.0**
of which: EU (15)	634.4	347.2	216.8	201.7	69.2	**1468.9**
former USSR	168.3	511.9	160.5	53.4	52.0	**946.1**
			VARIATION 2002/2001 (%)			
Northern America	–0.3	3.4	1.5	1.2	10.4	**1.7**
Central and Southern America	–1.8	0.2	–8.7	–7.8	4.7	**–0.1**
Europe and Eurasia	–0.6	2.0	–3.3	1.4	–8.2	**–0.6**
Middle East	0.5	2.5	5.0	–	26.7	**1.7**
Africa	1.8	3.4	1.6	11.5	3.4	**2.2**
Asia and the Pacific	1.5	4.8	16.0	3.0	2.8	**7.9**
World	**0.2**	**2.8**	**6.9**	**1.6**	**1.3**	**2.6**
of which: EU (15)	–0.8	0.8	0.6	–0.1	–16.1	**–1.0**
former USSR	0.5	2.8	–7.8	4.3	–3.9	**0.2**

Source: FEEM data processing of BP data

The slowdown was particularly significant in the European Union, where the relative price trends brought about a return to coal in the electric power generation sector. In 2002, natural gas production increased by 1.4% compared to 2001: as a result of a substantial increase in production in the former Soviet Union, Asia (Indonesia and Malaysia in particular), Africa (particularly Algeria), the Middle East (Saudi Arabia and Qatar) and Norway, there was a reduction in supply of the European Union and the United States.

Primary energy demand in the countries of the European Union amounted to 15.6% of the world total. The fuel mix shows the great importance of oil (42%), natural gas (24%), nuclear energy (14%) and coal (14%). The remaining demand (6%) was covered by renewable energy sources. In 2002, the demand for primary energy in the countries of the European Union was 1% lower than in the previous year. Economic stagnation and the promotion of measures aimed at encouraging energy efficiency reduced the overall demand. In slight contrast to the trend in more recent years, there was a reversal in the demand for natural gas in favour of coal.

There was a general decline in energy intensity (the energy required per unit of gross domestic product) in all economic areas, except for Asia and Central and South America.
The problem of supply diversification appears particularly serious in the European Union where the degree of dependence on foreign supplies could rise from almost 50% in 2002 to 70% in 2030. The need to diversify supplies, regards, to a greater extent, the natural gas sector rather than the oil sector since its supply mix is made up of imports from the Middle East, North Africa and the countries of the former Soviet Union.
The penetration of natural gas, especially in the electric power generation sector, would determine a substantial increase in demand, only marginally met by gas imports from Africa and Norway.
Natural gas from Iran and Qatar is available, but there is the problem of new infrastructures being required; the market for liquefied natural gas faces the same problem. Although the construction of gas pipelines for northern China and the northern islands of Japan is planned, the European Union would remain the main importer of natural gas from Russia, which would become the most important energy supplier of the European Union.
A policy aimed at guaranteeing greater security of energy supplies should not only be aimed at reducing dependence on imports but, above all, reducing the associated risks.
The diversification of supply sources, the development of renewable energy sources and the promotion of energy efficiency and rational use of energy are the foundations of the European strategy for improving energy security in a sustainable context.

Environment

The environmental policies on the use of energy sources pursue two main lines: the international agreements for the reduction of emissions and the promotion of renewable energy sources. Recently, the European Union has taken on an active role on both fronts. Waiting for the Kyoto Protocol to come into force, dependent on the Russian Parliament's ratification, the European Union has definitively adopted the directive on Emission Trading and submitted a proposal for a directive on credits derived from the flexible mechanisms. Both measures, that regard cutting the costs of reducing emissions, are an important part of the European strategy for reducing greenhouse gas emissions.
The development of renewables is largely connected to international policies on the reduction of emissions. Many plans approved by the Member States to carry into effect the Kyoto Protocol consider this option as one of the most important among those feasible. In Italy, an assessment is being made of the level of implementation of the policies referred to in the CIPE (the Italian Inter-ministerial Committee for Economic Planning) resolution N° 123/2002, which include, among other things, the further development of energy production from renewable energy sources.
The importance of the development of renewable energy sources is also related to both

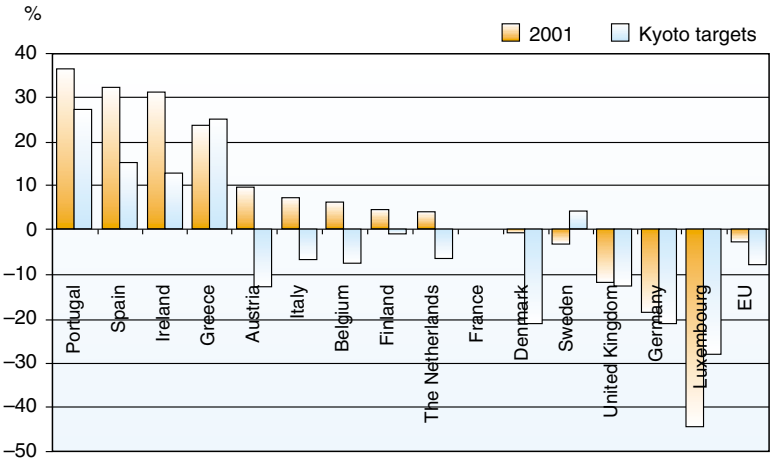
the diversification of the energy supply and the energy security. At the International Summit of Johannesburg (September 2002), the participating countries drew attention to the urgent need to increase the share of renewables in the total energy supply. On the initiative of the European Union and its Member States, the "Johannesburg Renewable Energy Coalition" (JREC) was established, a coalition of 80 countries committed to promoting renewable sources, by fixing specific objectives and implementation agendas.
In the European Union, between 1990 and 2001, overall greenhouse gas emissions decreased by about 2.3% (Figure 1). However, the emission trends of individual Member States were not consistent. Germany and the United Kingdom accounted for the bulk of overall emissions in the EU, yet they obtained the best results (thanks above all to the switch from coal to natural gas) whereas Italy, whose emissions have been increasing since 1990, was far from the reduction target formally undertaken.
At European level, with regard to the sectorial trends during the period 1990-2001, the trend in CO_2 emissions of the energy production sector was lower than the overall trend for 1990 (Figure 2). The electric power generation sector contributed the most to this trend, due to the switch from coal and lignite to natural gas. However, there was a clear increase in carbon dioxide emissions in the transportation sector.

Italy

Economy

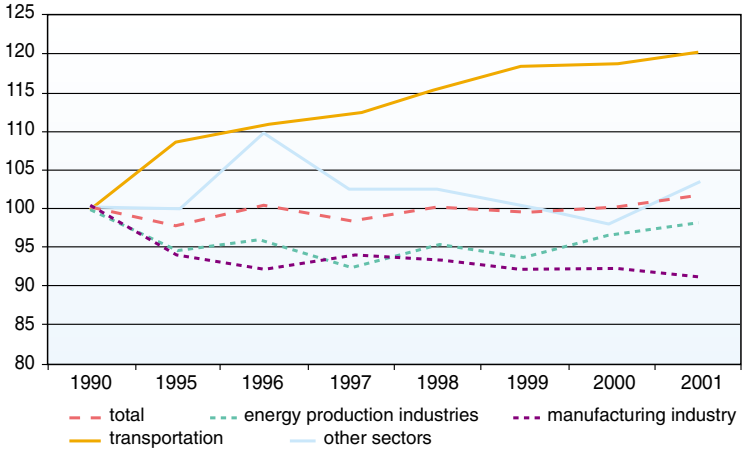
In 2002, the economic downtrend was more pronounced in Italy than in the rest of the euro zone, principally due to a series of structural factors. The GDP grew on average by 0.4%, compared to a 0.8% growth rate in the euro zone.
Preliminary GDP estimates for the first quarter of 2003 show a reduction of 0.1%, compared to the previous quarter, caused above all by a contraction of activities in the manufacturing industry. The figures on industrial production for the second quarter of the same year, showed a substantial stagnation of the index, at the same low levels of the first quarter of 2003, and estimates for the GDP confirm, for the second quarter, the same levels than for the first quarter.
The prospects for the second half of the year seemed better: expectations of a recovery in the building sector and the data provided by the leading indicator of the cycle indicate a recovery driven by the foreign sector and a rise in household spending. The accumulation process, however, seems to be negatively effected by the purchase of investment goods made in advance in the previous year, concurrent with the end of the period of tax incentives.
The decline in exports and the slowdown in domestic demand had already weakened the economic trend in the second half of 2001. Investments, consumption and exports continued to decline in the first six months of 2002; in the second half of the year, investments gradually picked up, helped by the end of the period for tax benefits; in the same period, there was also a modest growth in consumption and exports.

Figure 1 - Greenhouse gas emissions in the European Union countries. Kyoto targets and year 2001 (%)



Source: EEA

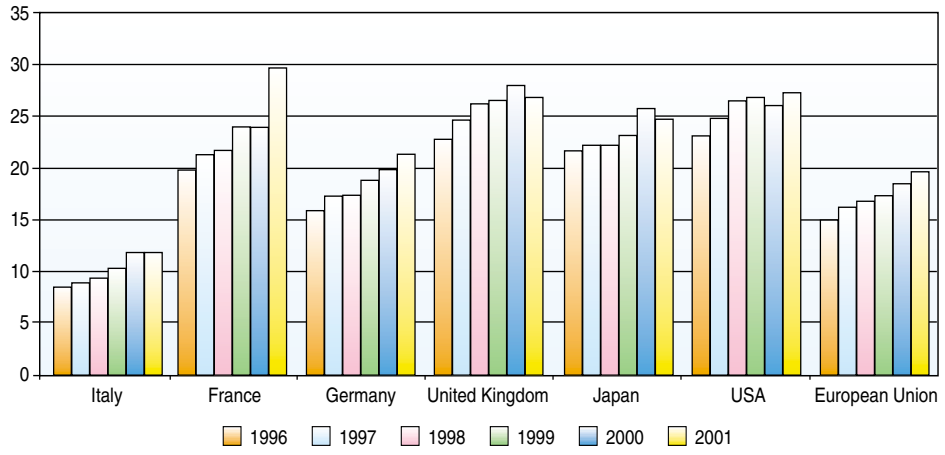
Figure 2 - Contribution to CO_2 emissions in Europe by sector of activity. Years 1990-2001 (index figures 1990=100)



Source: EEA

Between 1996 and 1999 the Italian share of the global exports fell by 4.8% to 4.3%. In the same period, the export shares of France, Germany and Spain substantially remained stable at 5.5%, 10% and 2%, respectively.
Over the last three years, the Italian share further decreased to 3.7%. As a whole, between 1996 and 2002, Italy suffered a heavy loss in competitiveness. In fact, Italy's share of exports fell by 23%, whereas the export shares of Spain and Germany fell by about 7% and France by 13%. Italy's gradual loss in competitiveness was influenced by numerous elements. Firstly, the lack of Italian goods in the technologically advanced sectors also exposes Italy's export goods to competition from recently industrialized countries.
In this context, the recovery of the countries of the European Union, that had already started at the beginning of the decade, was very significant with regard to the strong progress made by the United States, with trading in high-tech products impacting on the total of manufactured goods by around 20%, against the figures just slightly over 25% of the U.S. economy. Italy still remained at around 10%, with a growing gap in competitiveness, in an international context where advanced technology acquires relatively greater importance (Figure 3).
The reduced possibility of carrying out competitive devaluations makes Italian exports vulnerable to trends in supply prices, necessarily linked to production costs. The limited introduction of digital technologies in the production and organizatio-

Figure 3 - Trend in high-tech share of the total manufacturing exports in several OECD countries. Years 1996-2001 (%)



Source: ENEA Observatory on Italy in international technological competitiveness

nal processes and the lack of technologically advanced productions, are also due to the limited amount of resources allocated to innovation and research in Italy by both the public sector and private firms. For instance, Japanese and American companies invest over 2% of their gross domestic product in research, four times more than Italy.
The figures for Germany, France and the United Kingdom are slightly lower. A specialization model that privileges production with low technology content influences the lack of propensity for innovation of Italian firms.

Energy demand

In 2002, both the economic stagnation and the mild climatic conditions determined a reduction in overall primary energy demand: domestic energy consumption fell in fact to 186.7 Mtoe, a drop of 0.6% compared to 2001 (Table 3).
The fall in energy consumption determined a reduction in energy intensity, from 181.6 to 179.8 Mtoe per million euro1995.
The first provisional data on total energy demand for 2003 indicated a 2.4% increase on the previous year. Total consumption of oil products in 2002 was 90.9 Mtoe, a fall of 0.3% on the previous year. In the first months of 2003, the total demand for oil products increased by 2.4%.
Domestic demand for natural gas in 2002 fell by 0.7%, bringing it to 58.1 Mtoe. However, in 2003, natural gas consumption increased on the previous year, especially in the residential and thermoelectric generation sectors.
With regard to 2001, coal consumption increased by 3.5% in 2002, totalling 14.2 Mtoe. In 2003 there was a particularly marked increase in solid fuel consumption during the summer months, in relation to the increase in thermoelectric production in proximity of the summer peak demand.

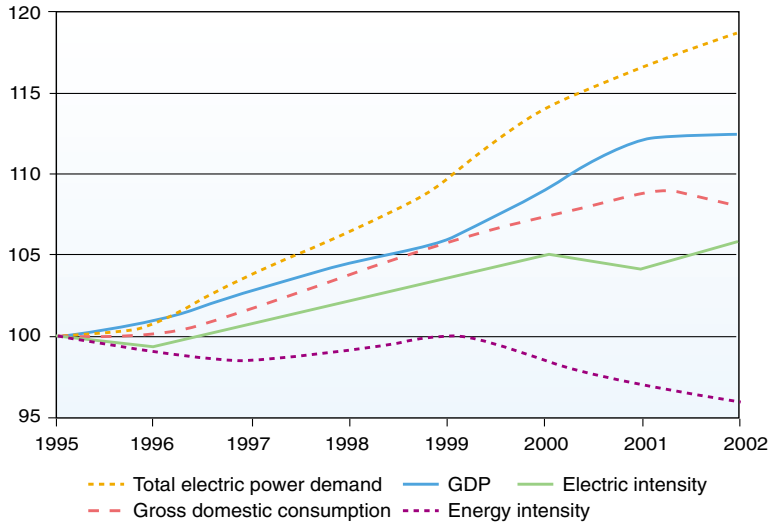
Table 3 - Gross domestic consumption of energy by source. Years 1995-2002

	Primary energy (Mtoe)								Variation (%)	
Source	1995	1996	1997	1998	1999	2000	2001	2002*	02/95	02/01
Solid fuels	12.5	11.3	11.7	12.1	12.2	12.8	13.7	14.2	13.6	3.5
Natural gas	44.8	46.4	47.8	51.5	56.0	58.4	58.5	58.1	29.7	–0.7
Oil products	95.7	94.3	94.9	94.9	92.4	91.3	91.2	90.9	–5.0	–0.3
Renewable sources	10.2	11.2	11.2	11.3	12.9	12.9	13.8	12.4	21.6	–10.1
Net electric power imports	8.4	8.4	8.9	9.4	9.2	9.8	10.6	11.1	32.1	4.3
Total	**171.6**	**171.6**	**174.5**	**179.2**	**182.7**	**185.2**	**187.8**	**186.7**	**8.8**	**–0.6**

Source: ENEA data processing of Ministry of Productive Activities (MAP) data

* Provisional data

Figure 4 - Energy intensity and electric intensity (index figures 1995 = 100)



Source: ENEA data processing of MAP data

In 2002, total electric power demand reached 310.7 TWh, an increase of 1.9% compared to 2001. Although the increase was less than in 2001 (2.3%), the figure for 2002 is significant in relation to Italy's economic stagnation phase.

Electric intensity reached 299 kWh per million $euro_{1995}$, a higher growth rate than in 2001, in line with that of the three-year period, 1997-2000.

The energy and electric intensity trends for the 1995-2002 periods are given in Figure 4.

Two other significant factors characterized 2002: the demand peak on the national electric power network (52,590 MW) recorded on 12 December, which was 1.2% more than in the previous year, and the new demand peak of 50,974 MW in the summer period, that occurred on 21 June, which was 4.8% higher than in 2001[1].

In 2003, the peak demand increased again in the same periods, with a new summer record, on 17 July, amounting to 53,105 MW and a new all-time high on 10 December, amounting to 53,400 MW (+1.5% on the previous year).

The final uses of energy fell by 1.1%, from 137.1 Mtoe in 2001 to 135.6 Mtoe in 2002 (Table 4). During the course of the year, consumption declined in the industrial sector, from 39.8 to 39.5 Mtoe, whereas the share referring to the same sector remained stable at 29.1%.

Consumption in the transportation sector, a little over 31% of the national total, remai-

[1] Italian National Grid Operator (GRTN), Report on Activities for 2002.

Table 4 - Synopsis of national energy balance. Year 2002 (Mtoe)

	Solid fuel	Natural gas	Oil products	Rene-wables	Electric power	Total
Production	0.4	12.0	5.5	11.9		29.8
Imports	13.6	48.9	107.4	0.5	11.3	181.7
Exports	0.1		21.0		0.2	21.3
Stock variations	–0.3	2.8	1.0			3.5
Gross Domestic Consumption	14.2	58.1	90.9	12.4	11.1	186.7
Consumption and losses in the energy sector	–1.0	–0.6	–5.7	–0.1	–43.7	–51.1
Transformation into electric power	–9.2	–18.5	–18.3	–10.9	56.9	
Total end uses	4.0	39.0	66.9	1.4	24.3	135.6
Industry	3.8	16.6	7.0	0.2	11.9	39.5
Transportation		0.4	41.4		0.7	42.5
Residential and services	0.1	21.0	7.2	1.0	11.2	40.5
Agriculture		0.1	2.6	0.2	0.5	3.4
Non-energy uses	0.1	0.9	5.7			6.7
Bunkering			3.0			3.0

Source: MAP * Provisional data

ned virtually stable around 42.5 Mtoe. The residential and services sector accounted for almost 30% of consumption.
In absolute terms, consumption decreased by 1.8%, from 41.2 to 40.5 Mtoe. In 2002, the primary sector used 2.5% of the end uses, consuming 3.4 Mtoe, the same as in the previous year. Non-energy uses decreased by 9.3%, from 7.4 to 6.7 Mtoe.

Energy supply

In 2002, the national production of energy sources fell by 4.6% with regard to the previous year.
This led to increased dependence on imports, despite the fall in Italy's energy requirements compared to the previous year.
Nevertheless, thanks to the fall in crude oil and natural gas prices, the total energy bill for 2002 amounted to 26,449 million euro, 4.7% less than in 2001 (from 2.3% to 2.1% of the GDP).
In particular, the oil bill[2] reduced by 2.7%, from 15,985 million euro to 15,554 million euro; the overall gain for the energy bill, however, was above all due to a reduction in natural gas expenditure, from 8,782 million euro in 2001 to 7,905 million euro in 2002.

[2] Oil Union: Annual Report 2003.

With regard to the average for 2002, even though the price of oil in dollars rose by 2.2% on 2001, the rise of the euro against the dollar more than compensated for this increase, determining a 3.4% drop in the price in euro. In the period 1993-2002, there was an increase in the amount of crude oil and natural gas (that make up about 95% of energy-producing minerals) that came from Russia, Algeria and Norway, to the detriment of supplies from Libya, Iran and Saudi Arabia.

With regard to the national crude oil production in 2002 as a whole, there was a very positive trend, with a total production of 5,498 million tons (around 110 thousand barrels a day), a 35% increase on 2001. This level of production was achieved thanks above all to supplies from the Val d'Agri area. It should be noted that onshore plants currently account for over 81% of production, whereas offshore crude oil production supplies about 19%.

The International Energy Agency of Paris, in the monthly analysis for September 2003, drew attention to crude oil stocks, raising the point that industrial stocks had never been so low in the last 5 years.

The Agency pointed out that especially the importing countries should consider the energy security and prices aspects. Keeping stocks to a minimum (commercial, mandatory and strategic) has to do with the aspiration of reducing financial charges, and often this aspiration results in a last minute decision to purchase the bare minimum to guarantee that refineries operate under safe conditions.

There could also be a series of positive structural factors that contribute towards low stock levels, such as the logistic capabilities of companies, supported by information technologies. The tendency not to keep large stockpiles was reinforced when it was found that, in practical and institutional terms, they could not be used to contain prices. Recent experience, at the basis of the latest initiatives of the European Union and the United States, tends to reinforce the view that the present management and control of stockpiles should be maintained rather than increased.

The natural gas market was opened up to competition on 1st January 2003, since the obligations of the national provision had been met in order to carry into effect the 98/30/EC European Directive. The actual opening of the market on the demand-side (since 1st January 2003 any user, including residential users, can choose their gas supplier on the current distribution network) is not, on its own, a sufficient condition to really liberalize the market. It is essential, as confirmed by the experience of importing countries in market liberalization, that competitors put themselves as much as possible on the supply-side.

In 2002 the national production of natural gas was 14,940 million standard m^3 (-4% compared to 2001).

The decline in production since 1994 is to be attributed to the gradual decline in production of mature fields, both on and offshore and new sources being put into production, such as the ones in the northern Adriatic Sea. In 2002, natural gas imports amounted to 58,100 million standard m^3 (83% of the national energy requirements of 69,900 million standard m^3), of which 54,300 million m^3 via gas pipeline and 3,600 million m^3 of liquefied natural gas.

Since the issue of competitiveness of the national system as a whole has been raised, mention should be made of the natural gas transport technologies, sectors where the leading companies at world level are Italian. Examples of underwater gas pipelines either in the installation or design phase are the Libya to Sicily pipeline, which began construction in 2003, the Algeria-Spain line project, that is in its final phase and, lastly, the Galsi gas pipeline connecting Algeria to Sardinia.

The Algeria-Italy gas pipeline project, via Sardinia, is very similar to Blue Stream[3], especially with regard to its technological aspects.

The plan is to make two lines, over 300 km long (in steel x70 and 24 inches - 624.3 mm - in external diameter), one from Hannaba, the other from Skidda in Algeria to Cagliari in Sardinia, and long stretches will be at depths of 2,500 and 2,750 metres, respectively. The pipelines are expected to come into operation in 2008, and the pipeline run will be 8,000 million standard m^3 of natural gas per year.

At the same time, new transport modalities in alternative to pipelines are being developed: for instance, LNG (liquefied natural gas) technology, GTL (gas to liquids), LPG (liquefied petroleum gas), CNG (compressed natural gas). These, currently applied to the different ranges of transport (taking into account volumetric flow and distance), make it possible to access enormous gas reservoirs in remote areas that are difficult to access and, in general, they provide a range of technical-economic solutions to run connections to markets at an average or long distance.

The only Italian coal resource is concentrated in the Sulcis Iglesiente basin, in southwest Sardinia. It is a sub-bituminous coal deposit of the Eocene period, made up of numerous coal strata ranging from a few centimetres to a few metres in width, intercalated with limestone, marl, carbonaceous clay and sandstone. The actual mining area, concerning only a small part of the basin (about 20 km^2) contains, on the basis of the most recent estimates on the reserves that can be mined under present conditions, over 57 million tons of usable coal with a calorific value of over 5,000 kcal/kg and a high content of ash and sulphur.

The Protocol of Agreement signed in February 2003 between the Ministry of Production Activities and the Provincial Administration of Sardinia, indicates, among other things, the opportunity of preparing a feasibility study to verify the conditions for the possible installation of a new thermoelectric power station that would serve industrial users.

Besides reviving mining activities, the power station could also have positive repercussions on the price of electric power for basic industry in the area, if the cost of energy is comparable to the one currently guaranteed by the special systems in operation.

Italy imports about 99% of its total coal requirements via sea, half of which is transported on bulk carriers of the Italian fleet, comprised of about 60 ships with a total

[3] The 390 km long gas pipeline between the Russian and Turkish coasts of the Black Sea was completed in 2002; the operators were Gazprom and Eni, through SNAM (Saipem and SNAM Projects as the main contractors of offshore activities and engineering services, respectively).

load capacity of over 4.6 million tons. The main importing countries are the USA, South Africa, Australia, Indonesia and Colombia. Canada and Venezuela also provide significant shares.

Total solid fossil fuel imports decreased by about 1%, from 20.1 million tons in 2001 to 19.8 in 2002: the main contribution being derived from steam-generating coal (+11%) and metallurgical coke (+12%), whereas coking coal fell by 24%.

Between 2001 and 2002, the demand for electric power increased a further 1.9%, reaching 310.7 billion kWh (Table 5). The increase in 2002 was in line with that of 2001 (2.3%) and with the average increase for the 1990-2000 period (2.4%). The increase in demand was, again in 2002, higher than the rate of growth of the GDP.

The increase in net electric power production was 1.8%, slightly lower than the increase in demand. The domestic production of 284.4 billion kWh was obtained thanks to an increase in production from traditional thermal sources (+5.3%). Production from hydroelectric sources decreased by 12.4% compared to 2001, due to the lack of rainfall, and amounted to just over 47 TWh, lower than for 2000 (51 TWh). Energy production from wind and photovoltaic sources increased by 19% compared to 2001. Electric power generated from fuel from recycled material from refineries, steelworks and public waste, accounted for 10% of thermoelectric production.

The increase in electric power from thermoelectric generation in 2002 was mainly due to an increase in coal production (+12%). Growth in natural gas consumption was further consolidated, still further outstripping the consumption of petroleum products, even though this had increased, but to a lesser extent.

Of the 230 TWh of thermal power produced in Italy, almost 100 TWh were derived from natural gas, 77 TWh from petroleum products, 35 TWh from coal and 18 TWh from other

Table 5 - Electric power balance in Italy. Years 2001-2002 (GWh)

	2001	2002	Variations 2002/01 (%)
Gross water production	53,926	47,262	–12.4
Gross thermal production	219,379	231,069	5.3
Gross geothermal production	4,507	4,662	3.5
Gross wind and photovoltaic production	1183.4	1408.3	19.0
Total gross production	**278,995**	**284,401**	**1.9**
Energy for services	13,029	13,619	4.5
Total net production	**265,965**	**270,783**	**1.8**
Received from foreign suppliers	48,927	51,519	5.3
Provided for foreign customers	549.3	922.3	67.9
Allocated to pumping	9,511	10,654	12.0
Total Italian demand	**304,832**	**310,726**	**1.9**

Source: GRTN

sources (including, in order of importance, orimulsion, blast-furnace gas, waste gases from refineries, coke-oven gas and others).
In 2002, petroleum products covered 33.4% of conventional thermoelectric production, a slight fall on the previous year (33.5%). Natural gas contributed 43.2% to electric power generation (42.8% in 2001).
The most dynamic trend was in coal use, which covered 14.2% -15.4% of the thermoelectric production demand: from 31.7 TWh in 2001 to 35.5 TWh in 2002.
Energy demand hit an all-time high on Tuesday, 12 December 2002, according to GRTN data; the demand peak totalled around 52,600 MW on that day (Table 6).
In recent years, the increase in energy demand in Italy has not been met by an adequate development in electric power generation, making imports vital for covering demand. In the 2001-2002 biennium, as in the previous biennium, there was a reduction in the energy margin available, meant to handle the possible unavailability of production capacity or unexpected increases in demand.
Very narrow reserve margins moreover make it crucial to have the interruptible service that permits the GRTN to cut off a portion of the load to users on the free market, according to apposite contractual procedures.
The national generation pool is characterized by considerable differences between the power officially recorded for statistical purposes and the power actually available.
In particular, the obsolescence of the electric power grid and the frequent maintenance activities necessary and environmental adjustments on the one hand, and the sensitivity of a large part of the grid to weather conditions on the other, are critical elements in order to reduce the amount of power officially recorded.
In 2002, imported electric power amounted to 50.6 TWh, a 4.6% increase on 2001. Almost half of which came via Switzerland, 36.8% via France, 10.2% via Slovenia and the remaining 3.5% from Austria.
With regard to the price of electric power, the Italian price system is characterized by low prices, compared to the European average, for low-consumption residential use and, on the contrary, by high prices for the use of high-consumption levels. However, the elec-

Table 6 - Power balance at the peak in 2002, on 12/12/2002 (MW)

Nominal power recorded	76,950
Power available in Italy*	48,950
Maximum import capacity	6,300
Total power available (*)	55,250
Demand peak	52,590
Available margin	2,660
% reserve of power in relation to peak	5.1

Source: GRTN

(*) Includes the operative reserve

Table 7 - Energy by renewable energy sources in Italy, in equivalent substituted fossil fuel. Years 1995-2002 (ktoe)*

	1995	1999	2000	2001	2002[4]
Hydroelectric[1]	8312	9979	9725	10298	8694
Wind	2	89	124	259	309
Photovoltaic	3	4	4	4	4
Thermal solar	7	10	11	11	14
Geothermal for electric power	756	969	1035	992	1026
Geothermal for direct use	213	213	213	213	213
Public solid waste	97	374	461	721	818
Wood and similar[2]	4635	4824	4807	4833	5008
Biofuel	65	38	66	87	94
Biogas	29	167	162	196	270
Total	**14119**	**16667**	**16608**	**17613**	**16450**
Of which non-traditional[3]	1265	1893	2022	2516	2933

[1] Only electric power from natural supplies. [2] The series includes the results from the ENEA investigation on wood burning consumption in homes. [3] Wind, solar, public solid waste, wood district heating, wood and similar for the production of electric power and heat in industrial plants (the use of firewood in the residential sector, estimated at 3.6 Mtoe, is excluded since it is of traditional use), biofuels, biogas. [4] Provisional data and estimates.

* In addition, 9.8 TWh produced from industrial waste is to be considered, corresponding to 2.1 Mtoe substituted (GRTN data)

Source: ENEA data processing of data from various sources

tric power prices for industrial use are among the highest in Europe, with variances increasing according to the reference level of consumption.

The contribution of renewable energy sources to the national energy balance rose from approximately 14 Mtoe in 1995 to almost 16.5 Mtoe in 2002, an increase of about 16.5% over the period, that is, an average increase of 2.4% a year. In the same period, the energy produced by non-traditional renewable energy sources more than doubled (Table 7).

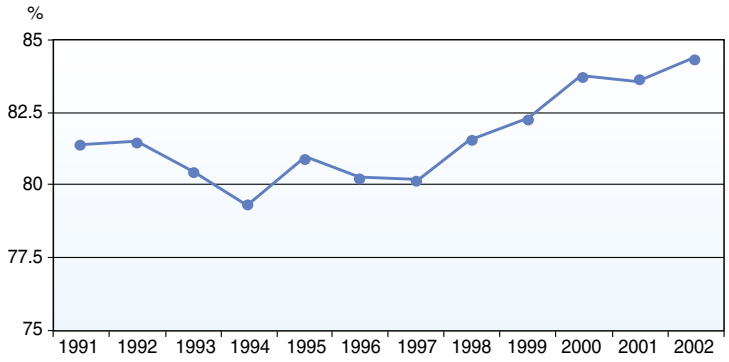
Energy dependence

Italy's energy dependence figures went from just under 81% in 1995 to 83.6% in 2001, rising to 84.3% in 2002 (Figure 5). The European average was around 54% and, in the European Union, only Ireland, Luxemburg and Portugal are more energy dependent than Italy (Table 8).

An analysis of dependence by primary energy source shows a scenario that had slowly evolved over the years (Table 9).

In 2002, 94% of the domestic demand for oil was met by imports. The demand for solid fuel was almost entirely covered by imported products, whereas energy dependence on natural gas rose steadily, exceeding 80% in 2002.

Figure 5 - Energy dependence of Italy. Years 1991-2002 (%)



Source: ENEA data processing of MAP data

Table 8 - Energy dependence[1] of EU countries (%)

	1995	1996	1997	1998	1999	2000	2001	2002
Austria	66.0	68.4	68.5	68.2	65.9	65.7	66.6	67.7
Belgium	77.6	78.3	76.9	77.9	76.5	77.3	77.9	76.8
Finland	56.6	58.7	55.1	59.4	54.2	54.7	55.7	57.3
France	46.9	48.5	48.0	50.5	49.9	48.9	49.2	48.4
Germany	58.0	59.9	59.6	61.8	59.9	60.4	60.7	59.9
Ireland	60.7	68.6	76.6	80.7	80.8	83.9	88.2	87.3
Italy	80.9	80.2	80.2	81.6	82.2	83.7	83.6	84.3
Luxembourg	98.6	98.9	98.7	98.6	98.7	98.5	98.4	98.4
The Netherlands	11.6	5.1	14.4	18.5	22.4	26.8	24.2	24.8
Portugal	86.9	84.1	85.3	86.6	89.0	87.2	86.3	89.1
Spain	69.7	67.9	70.6	71.6	74.2	74.1	73.5	75.5
Denmark	23.9	23.8	6.5	4.,2	–16.4	–39.4	–33.1	–43.0
Greece	61.3	60.7	62.0	63.2	64.1	63.9	64.0	63.4
United Kingdom	–15.5	–15.7	–18.1	–18.0	–21.4	–16.7	–10.4	–11.3
Sweden	36.2	37.4	34.7	32.8	33.2	35.6	32.9	38.3

[1] Energy dependence = (Net Imports / (Production + Net Imports)*100

Source: ENEA data processing of MAP data

Table 9 - Italy: energy dependence by source (%)

	Solid fuels	Natural gas	Oil	Total
2000	97.8	77.6	95.1	83.7
2001	96.5	78.2	95.4	83.6
2002	97.1	80.3	94.0	84.3

Source: ENEA data processing of MAP data

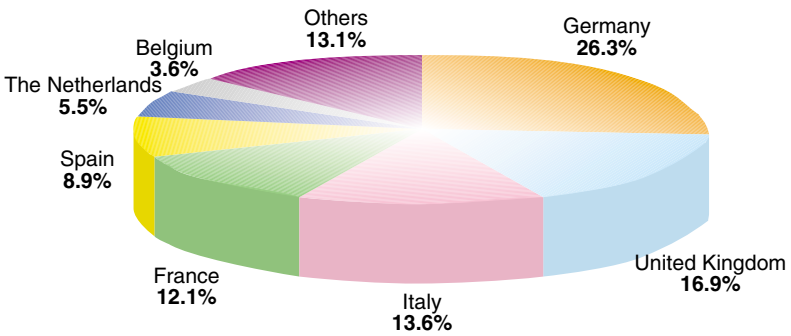
Importing energy from foreign operators involves considerable monetary disbursement, which is not adequately counterbalanced by exports in energy products.
The figures on Italian exports of energy products are negligible, except for the export of refined petroleum products that secure revenues of between 4,000 and 5,000 million euro.
In the last decade, Libya has been Italy's main crude oil supplier. Supplies from Russia, Algeria and, to a lesser extent,
The Netherlands, meet the demand for natural gas in Italy. Since 2001, with the liberalization of the sector in Europe, Norway came to the fore as a new supplier of natural gas and its role is bound to grow.
The majority of coal imports come from Western Europe, whereas China has been Italy's main supplier of coke products since the second half of the 90's.
The "geography" of Italy's energy supply sources is therefore slowly changing compared to the past decade with regard to those products that seem to weigh more on national energy demand.

Environment

In the European Union, the energy transformation sector accounted for about 27% of CO_2 emissions in 1990 and about 35% in 2000.
In the same period, the CO_2 emissions of the manufacturing industry sector decreased from 21% to 19% and the residential and services sector remained unchanged at 20%, whereas the transportation sector showed the greatest increase, rising from 22% to 26% of the total. Italy is accountable for about 14% of the CO_2 emissions in the European energy system (Figure 6).
The trend in total CO_2 emissions of the Italian energy system showed that it had risen by over 6% in 2000 compared to 1990 (Figure 7).
The most important sector, in percentage terms, was the energy transformation sector, which accounted for 35% of total emissions in both 1990 and 2001 (Figure 8). The transportation sector accounted for 25% of total emissions in 1990 and for around 29% in 2001.
In line with the trends found in the Union, the transportation sector showed the highest increases: from 1990 to 2001 its contribution increased by 22.7% (Figure 9). The contribution of the energy production sector increased by 11.7%, whereas in the manufacturing industry sector it fell by 8.3%.
Italy ratified the Kyoto Protocol with Law N° 120 of 1st June 2002. This law provides for the definition of a plan of action for the reduction of greenhouse gas emissions.
Resolution N° 123/2002 of the Italian Interministerial Committee for Economic Planning (CIPE) updated the guidelines for the national policies and measures on greenhouse gas reductions. The measure, that acknowledges the differences in performance with regard to reduction targets, halves and in some cases revokes the sectorial targets, compensa-

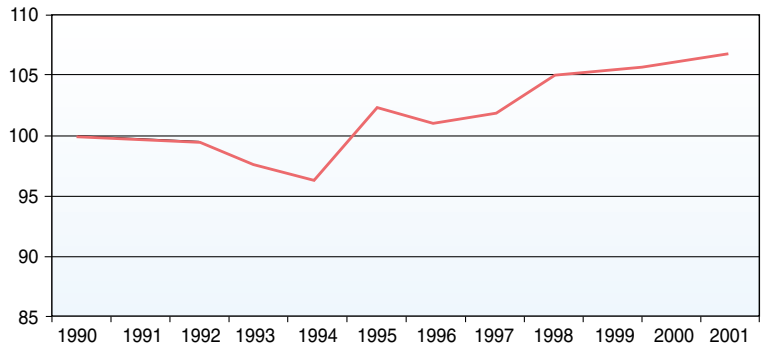
ting the difference with the overall national objectives by using the so-called "flexibility mechanisms". Unlimited recourse to these mechanisms was in fact acknowledged at the seventh conference by the signatories of the Kyoto Protocol.
However, not all the aspects of the flexibility mechanisms have been completely defined to date. The implications of their various application modalities are complex and have repercussions at national, European and international levels.

Figure 6 - Contribution to CO_2 emissions of the energy sector in the European Union countries. Year 2001 (%)



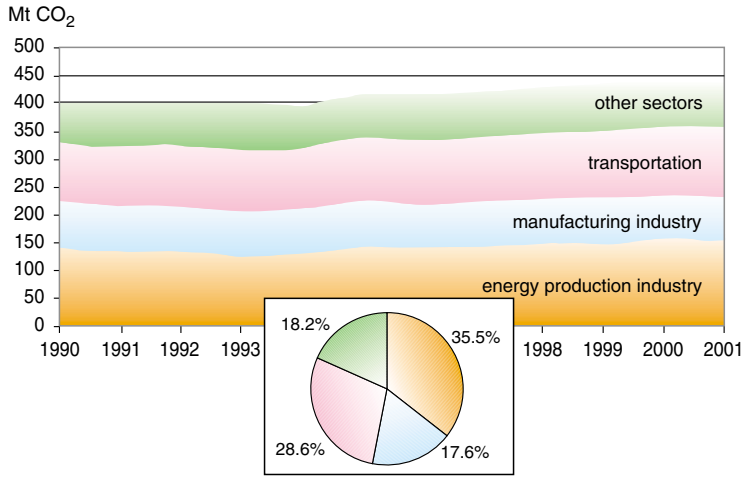
Fonte: EEA

Figure 7 - CO_2 emissions in Italy. Years 1990-2001 (index figures 1990=100)



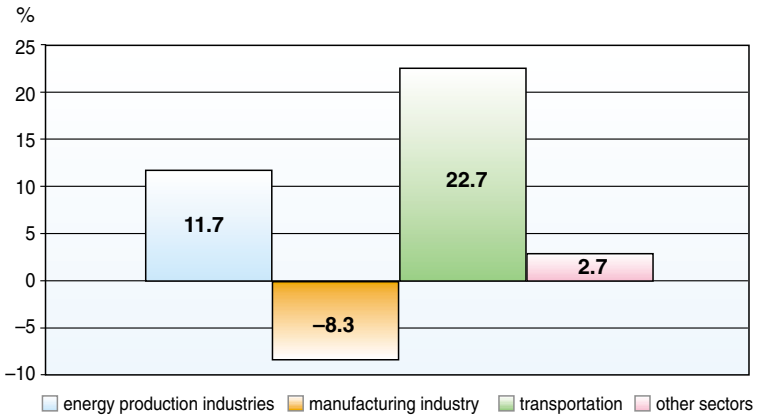
Fonte: EEA

Figure 8 - Contribution to CO_2 emissions of the different sectors in Italy. Year 2001



Fonte: Italian Agency for the Protection of the Environment and for Technical Services (APAT)

Figure 9 - CO_2 emissions by sub-sector. Years 1990-2001 (index figures 1990=0)



Fonte: Italian Agency for the Protection of the Environment and for Technical Services (APAT)

Regions and Local Administrations

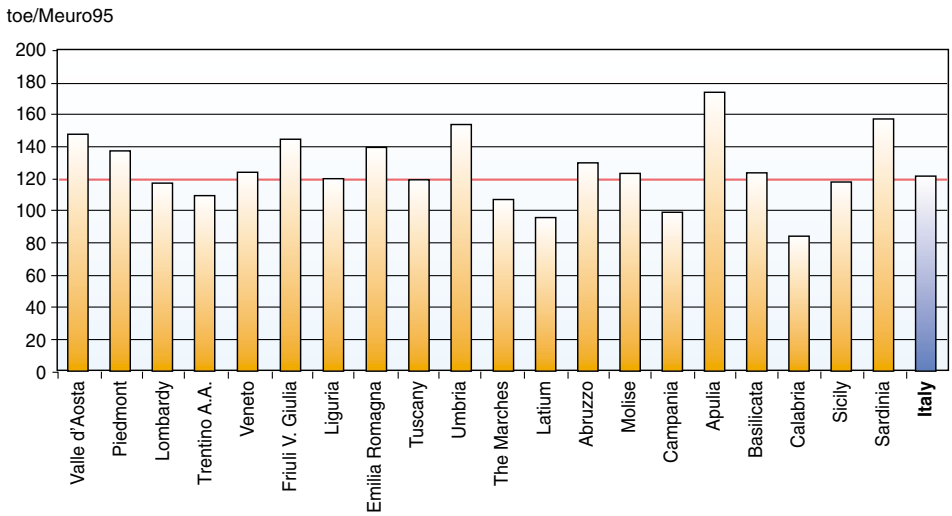
The decentralisation and liberalisation processes of the energy market are the two events that characterize the new set-up of the national energy system and its natural correlations and ties with the environmental and economic systems.
In the last year, the efforts of the Regional and local Administrations were aimed at finding a new balance as a result of the new demands on the energy system and radical institutional restructuring, dictated by the amendments to Section V of the Constitution (Constitutional Law N° 3/2001).
During this period a question arose, that is certainly central to the functioning of the sector's system of government: the importance of the forms of involvement of the Regional and local Administrations in a shared framework of policies and guidelines for medium-long term programmes, in order to ensure that the problems regarding the unit functioning of the energy markets and the impacts on the territory are approached jointly and in cooperation.

Figure 10 - The state of the energy-environmental plans in the different Regions

Source: ENEA

The critical events of the last year, caused by the increase in electric power demand, the problems regarding the fragility of the network, the authorization requests for new power stations which have increased with the liberalization of the system, the start-up of energy-saving activities and efficiency instruments, the support given to renewable sources have, as a whole, confirmed the need for a coherent framework of agreements between Regional Administrations. The regional energy-environmental plans, at various stages of implementation in all the Regional Administrations (Figure 10), show an appreciation of the critical situation and the new requirements dictated by national and European legislation and represent the substantial commitment of the Regional Administrations to the development of the energy system and the territorial environment, undertaking full responsibility with regard to national and community policies.

Figure 11 - Final energy intensity of the Italian Regions. Year 2000 (toe/Meuro$_{95}$)



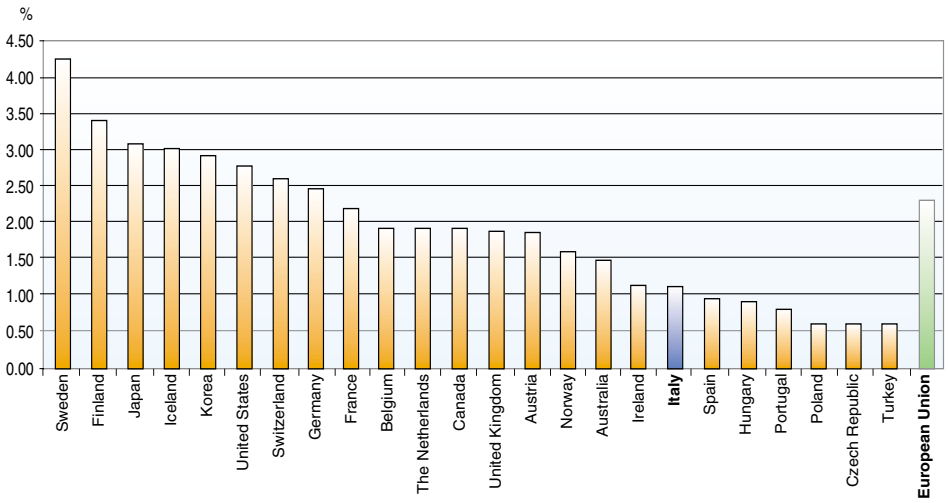
Fonte: ENEA

Research in Technology

Technological development is an important opportunity for Italy with regard to sustainable development and economic competitiveness, as well as energy security. The policies, measures and negotiations for the reduction of emissions should be supported by a concerted effort in the research and development of new energy technologies, which are the focal point in order to be able to provide sustainable solutions to the issues at hand in the medium-long term.

Italy, however, still ranks far behind the other OECD countries in respect of the investments allocated to research, with regard to the GDP (Figure 12) whereas, in terms of absolute value of expenditure (at the same buying power), Italy is well below the position it should have, considering the size of its economic-industrial system (Table 10).
Italy's lack of commitment to research is also evident from its share of the total expenditure in R&D of the major western countries, barely 2.8%, which places Italy behind Canada, a country appreciably smaller in economic size (Table 10).
With regard to research commitments specific to the energy sector, Figure 13 gives the aggregate government spending on R&D of the IEA member countries from 1974 to 1998: the figures are expressed in millions of US dollar at the prices and exchange rates of 2002.
From the first oil shock in 1974 and until 1980, public spending on R&D in the field of energy more than doubled, only to decline almost to the initial levels. This trend clearly seems to be linked to events regarding both oil prices and the nuclear sector (initially fission and then also fusion), which absorbed a considerable share (over half) of the public budgets for energy research.
Public expenditure in Italy on R&D in the field of energy, from 1990 to 2002, is given in Figure 14. It shows that the level of expenditure decreased to a little less than half of the level for 1990.

Figure 12 - R&D spending of some OECD countries in relation to the GDP. Year 2001 (%)



Source: OECD, MTSI database, May 2003

Table 10 - R&D spending in some OECD countries. Years 1981, 1991, 2001

Countries	1981 MUS$95	1981 %	1991 MUS$95	1991 %	2001 MUS$95	2001 %	Average annual % variations 1981/1991	1991-2001	1981-2001
Canada	6,041	2.6	9,690	2.6	16,122	3.3	4.8	5.2	5.0
Finland	879	0.4	1,902	0.5	4,185	0.9	8.0	8.2	8.1
France	17,407	7.4	27,236	7.3	30,704	6.3	4.6	1.2	2.9
Germany	27,787	11.8	42,019	11.2	47,827	9.8	4.2	1.3	2.8
Japan	43,111	18.3	82,681	22.1	96,532	19.8	6.7	1.6	4.1
Italy	7,668	3.3	13,450	3.6	13,557 (a)	2.8	5.8	0.1	3.0
United Kingdom	18,175	7.7	20,577	5.5	24,558	5.0	1.2	1.8	1.5
United States	114,530	48.6	176,603	47.2	252,939	52.0	4.4	3.7	4.0
Total	**235,597**	**100**	**374,157**	**100**	**486,424**	**100**	**4.7**	**2.7**	**3.7**

(a) 2000

Source: Ceris - Rome Section (Institutions and policies for science and technology) data processing of OECD data

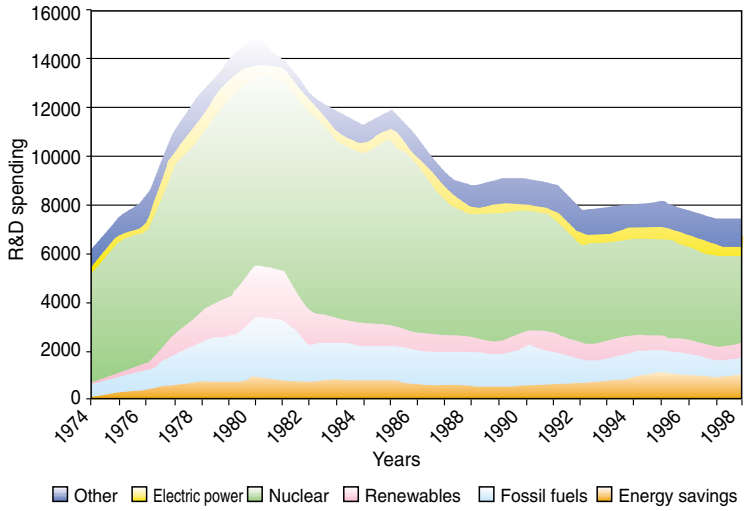
Table 11 - R&D spending in relation to the GDP in some OECD countries. Years 1980-2001 (%)

Countries	1980	1990	1995	1996	1997	1998	1999	2000	2001
Canada	1.2	1.5	1.7	1.7	1.7	1.8	1.8	1.9	1.9
Finland	1.2	1.9	2.3	2.5	2.7	2.9	3.2	3.4	3.4
France	1.8	2.4	2.3	2.3	2.2	2.2	2.2	2.2	2.2
Germany	2.5	2.7	2.3	2.3	2.3	2.3	2.4	2.5	2.5
Japan	2.0	3.0	2.9	2.8	2.8	2.9	2.9	3.0	3.1
Italy	0.8	1.3	1.0	1.0	1.1	1.1	1.0	1.1	...
United Kingdom	2.4	2.2	2.0	1.9	1.8	1.8	1.9	1.9	1.9
Spain	0.4	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0
Sweden	2.3 (a)	2.8 (b)	3.4	...	3.5	...	3.7	...	4.3
United States	2.5	2.7	2.5	2.6	2.6	2.6	2.8	2.8	2.8

(...) not available; (a) 1981; (b) 1989

Source: Ceris - Rome Section (Institutions and policies for science and technology) data processing of OECD and ISTAT data for Italy. Year 2001

Figure 13 - Overall government spending on R&D in the energy field in IEA countries (MUS$)



* Figures at the prices and exchange rates for 2002

Source: ENEA data processing of IEA data

The reduction essentially concerned research on horizontal technologies or, nevertheless, technologies not specifically classified in any of the other categories, as well as nuclear research.

The latter, concentrating on thermonuclear fusion and fission, safety issues and the treatment of nuclear waste.

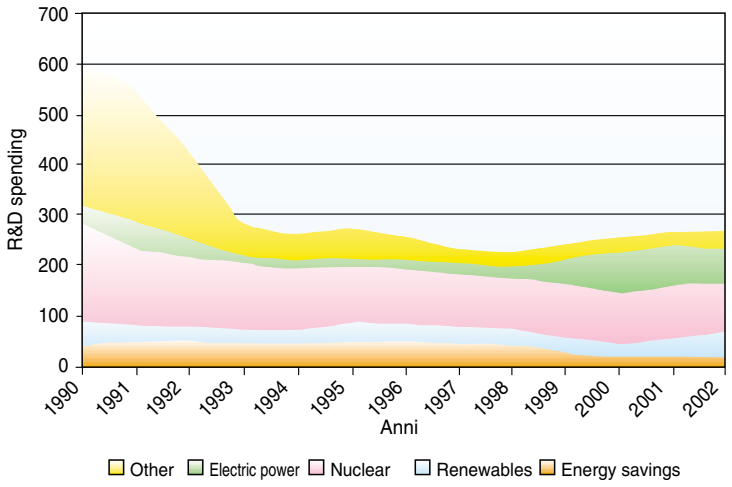
However, there appears to be a decline in research activities on energy savings and efficiency, that concentrated mainly on savings in the residential sector and, in part, the industrial sector, and there was a similar trend in the transportation sector.

Public investment in research on technologies for the exploration, extraction, transport and refining of hydrocarbons, as well as for coal transformation and combustion, are not included since this sector is the concern of private industry (mainly oil companies and electric power utilities).

Public spending is currently concentrated on: nuclear technologies; conversion, transmission and accumulation of electric power; renewable energy sources. The latter is an area where, in the last three years, there are signs that research is being resumed after a long period of inactivity.

In Italy, an important share of public research in the field of energy is carried out by ENEA.

Figure 14 - Government spending on R&D in the energy field in Italy. Year 1991 (MUS$)



* Figures at the prices and exchange rates for 2002

Source: ENEA data processing of IEA data

Table 12 gives the trend of ENEA spending in research (in millions of euro at 1995 prices) in 1990 and from 1995.

The trends already recorded for national data purposes, are comprised in the data on ENEA's research spending. However, it should be observed that, in recent years, the commitment to nuclear fission, connected to nuclear safety and waste treatment obligations, amounts to around 20% of ENEA's entire annual spending.

Expenditure also continues in fusion research, which is closely related to the participation in the international project, ITER. The level of spending on renewables appears to be declining.

With regard to solar energy, research has shifted, in more recent years, towards high-temperature solar technologies for electric power generation.

The project for the production of high temperature heat from the sun represents an important commitment in this direction.

It plays an important strategic role due to its potentials, both in relation to the need for diversifying energy sources, reducing greenhouse gas emissions, and its capacity for technological innovation, in support of the competitiveness of the Italian industrial system.

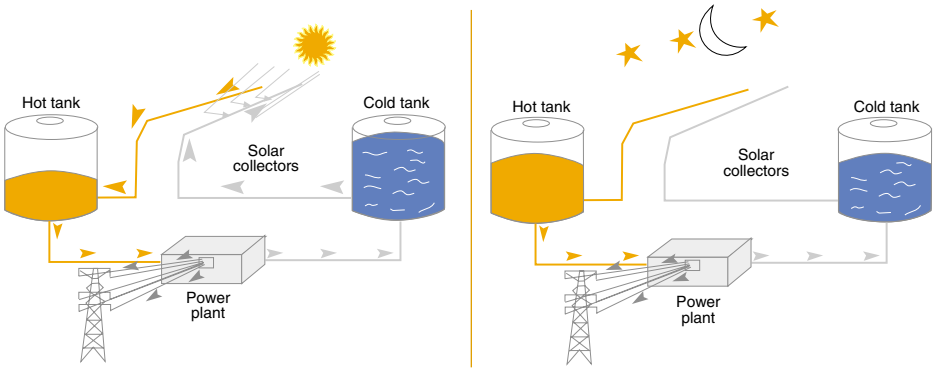
Table 12 - ENEA spending on R&D in the energy field ($Meuro_{95}$)

	1990	1995	1996	1997	1998	1999	2000	2001	2002
Savings and efficiency	39.88	45.14	45.72	42.55	42.68	20.18	15.95	17.29	15.11
Renewables	40.47	35.33	33.03	30.56	28.68	21.92	24.63	22.26	24.97
Nuclear (fusion and safety)	175.98	93.27	94.96	93.86	88.67	78.51	83.30	87.16	63.00
Generation and accumulation	26.10	13.22	13.57	12.56	13.21	13.64	13.63	9.88	7.71
Other technologies and research	241.44	56.81	38.46	27.24	29.57	23.97	22.43	30.19	21.42
Total	**523.87**	**243.77**	**225.74**	**206.78**	**202.81**	**158.23**	**159.95**	**166.79**	**132.2**

Source: ENEA

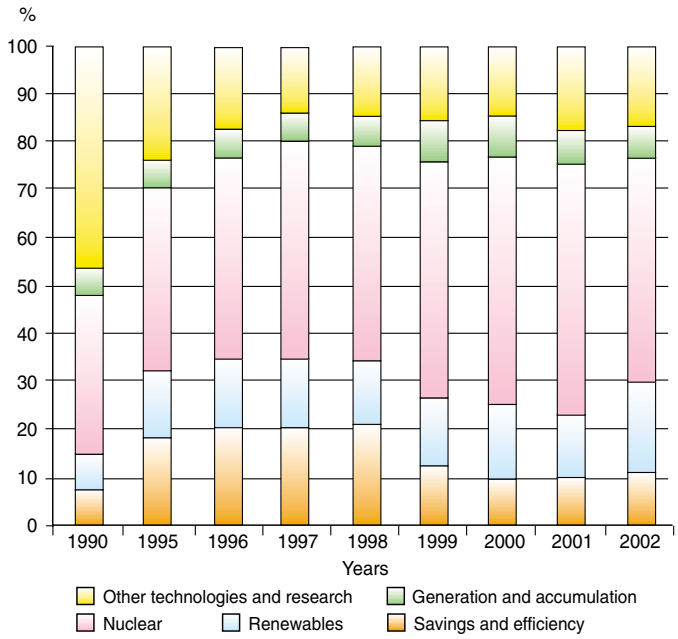
A pre-industrial prototype of the system is under study in collaboration with ENEL (the largest Italian utility for electric power) for an application at the ENEL plant of Priolo Gargallo in Siracusa (Figure 15).
The overall trend of the research mix in the field of energy undertaken by ENEA over the period 1990-2002, is given in Figure 16.

Figure 15 - Innovations in the ENEA's concentrating Solar Power Project



- Thermal accumulation with two tanks for a full decoupling of the collection phase from the phase of solar energy use
- Innovative project for the solar collector with regard to both the reflecting solar panels and the support structure
- Innovative project for the tube receiving higher operating temperatures (550 °C)
- Use of a mixture of salts fused into thermo vector fluid, less toxic than the mineral oil used up until now

Figure 16 - ENEA spending on R&D in the energy field (%)



Source: ENEA

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