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The production of electricity and coal: the anomaly of the Italian case

Coal in the world: 41% in 2011

41% of the electricity in the world is produced from coal, whose production in 2011 reached 6.8 million tonnes, with an increase of 5% compared to 2010.

... in Europe: 33%

In Europe 33% of the electricity is produced from coal - this percentage is stable compared to 2006 - and 30% from nuclear energy.

Italy is the only European country that while not using nuclear power has got a coal use percentage extremely low.

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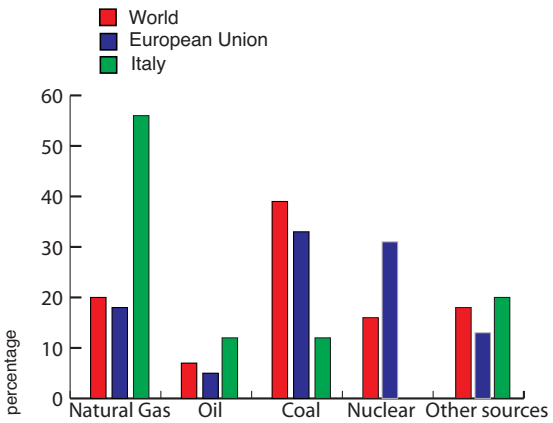
Eletric Energy resources



Source: IEA

... in Italy: 12%

Italian electricity production is unique in Europe: if in general the average of electricity production is for 60-70% generated from a mix of coal and nuclear power, **in Italy gas has got the predominance:** in 2010 the electricity production still came from gas for 60%, from burning oil for 8%, from coal for 12% and from renewable for 20%.

Beyond the small share of coal in the market, in Italy coal is affected by the effects of poor communication about it. Italians are indeed poorly informed on modern technologies of handling and combustion available today in Italy and **capable of making coal** a primary source of electricity which is perfectly compatible with the environment.

The European energy mix

In order to maintain the security and the competitiveness of energy resources **Europe expressed its intention to** limit its own electricity production from gas under 37.3% and to **maintain at least 45,4% from nuclear and coal also in 2020**.

This because, according to European Union's valuations, **without an energy policy in the next 20 to 30 years 70% of energy consumption will be covered by imported products from countries politically instable**.

The Italian energy mix

These predictions are already matter of concern in Italy since it is the only Country in the world to depend on gas for electricity production for more than 60%, importing 85% from abroad above all from Algeria and Russia.

The strong dependence on imported electricity is intended to grow gradually and constantly in the next years.

An anomaly: the strong dependence from gas

Whereas Europe will continue to base its electricity production by at least 60% on nuclear and coal power, Italy will rely, by the same percentage, on natural gas with the significant implications that will have in terms of safety of supply and the competitiveness of different sources.

Italian electric system is indeed forced to accept gas prices fixed by the "duopoly" because there are no real alternative sources because of the distance and consequently of too high transport costs. In fact natural gas to be brought into Italy by pipeline comes from Algeria and Russia which are considered highly unstable politically.

The energy bill

Mild temperatures and the slowdown in economic activity have decreased **the Italian energy demand, which in 2011 marked a dip of -2.1%**, highlighting a decrease in consumption of traditional sources, like natural gas and oil.

Coal consumption is recovering instead, having increased by 7% compared to 2010.

The 2011 Italian energy bill is estimated to be approximately Euro 62.7 billion, an increase of 9.7 billion (+18,4%) compared to 2010. Its weight on GDP has therefore reached 4.4%, the highest value in the last 20 years.

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Estimate of the energy bill in Italy

(million Euro)	1981	1985	1990	2000	2005	2008	2009	2010	2011
Solid fuels	790	1,167	731	1,009	1,892	2,927	1,782	2,270	2,934
Natural Gas	1,106	2,803	1,859	7,834	12,194	22,253	17,096	18,998	21,075
Oil	13,094	15,570	8,561	18,653	22,411	32,474	20,507	28,433	34,741
Other	300	603	867	1,524	2,136	1,948	2,458	2,409	2,736
Biofuels						335	534	847	1,239
Total energy bill million Euros nominal	**15,290**	**20,143**	**12,018**	**29,015**	**38,633**	**59,938**	**42,377**	**52,957**	**62,725**
million Euros real 2011	*58,699*	*48,141*	*21,798*	*36,675*	*43,693*	*63,295*	*44,411*	*54,652*	*62,725*
% Turnover VS GDP	*6.3*	*4.7*	*1.7*	*2.4*	*2.7*	*3.8*	*2.8*	*3.4*	*4.4*

Source: Data processed by Unione Petrolifera

In 2011 the international prices of coal marked a decrease: in December the closing prices on Newcastle, Richards Bay and Rotterdam reached approximately $112,28/t, $104,43/t and $111,58/t respectively, with a contraction of 14%, 15% and 11%.

However, the global trend appears to be toward **increasing thermoelectric power production from coal**, due to its lower and **more stable prices**.

These consequences are particularly experienced by **industries:** according to the latest annual report of the Energy Authority **Italian enterprises are forced to cope with prices above the European average**, with negative effect on the competitiveness in particular in energy-intensive sectors characterised by high energetic consumptions (such as paper, steel etc.).

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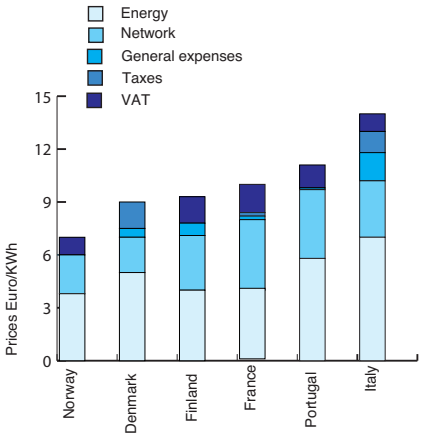
Energy prices for industries



Source: data processed by AEEG

The incapability to face an energy emergency

Our Country is also affected by infrastructural gaps with regards to the regasification plants (with the only exception of the plant in Rovigo, in production since 2009).

At present, Italy doesn't seem to be able to face a potential energy emergency, as it is the only European country not provided with appropriate plants – despite the fact that the usage of regasification technology in Europe is equivalent to 50% of the domestic consumption on average.

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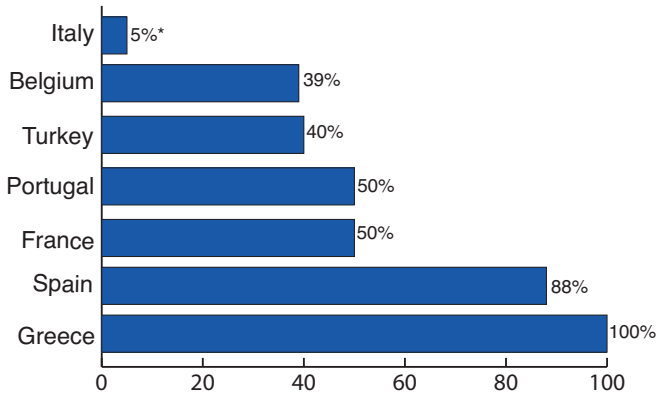
Current ratio between regasification capacity and gas consumptions



* *3% of Panigaglia to which is added 2% under construction in Rovigo
Source: AEEG

World Energy Outlook 2011

According to the forecasts outlined by the International Energy Agency (IEA) in "World Energy Outlook 2011", despite the uncertainty that defines the prospect of economic growth in the short term, in the baseline scenario **the demand for energy grows in an encouraging manner, increasing by a third between 2010 and 2035.**

In 2010 the global consumption of coal increased by 10.8% and **coal was, yet again, the energy source with the most rapid growth.**

According to the future scenario being examined, **the demand for coal could increase up to 65% until 2035**, overtaking oil as the dominant fuel in the overall mix of primary energy sources. In particular, based on the forecasts of the 2011 Coal Medium Term Market report, the consumption of coal in the next **5 years will continue to increase at the pace of 600 thousand tonnes a day, thanks to the strong demand in China and India.**

China's consumption of coal, in fact, represents nearly half of the global demand and in the New Policies Scenario the main target market for coal continues to move from the Atlantic to the Pacific. India is also doubling its consumption of coal and in the next decade (2020-2030) it will overtake the United States, becoming the number one global importer.

In all the WEO scenarios, **the adoption of clean coal technologies and CO_2 capture and storage (CCS) improves the long-term prospects of the use of coal.** An accelerated substitution of less efficient combustion technologies, would reduce both the CO_2 emissions of the electrical sector by 8%, and local atmospheric pollution.

According to IEA estimates, currently 1.3 billion people in the world still have no access to electricity (around 20% of the global population).

Economic and social growth is tightly connected to the use of electricity. The vast reserves, security of supply and the competitive costs, make **coal the only fuel that can satisfy the ever-growing demand for energy worldwide.**

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The advantages of coal

Coal is characterised by:

- **Security of supply and price predictability;**
- **Wide and long-lasting reserves;**
- **Cost-effectiveness;**
- **Labour intensiveness;**
- **Safety in transportation, storage and handling;**
- **Environmental friendly.**

Coal reserves in more than 100 countries...

Gas reserves are located in a few countries, instable on the political level, such as **Algeria and Russia.** World reserves of **coal** are geographically distributed **in more than 100 countries** and its reserves are placed in **very different areas** also from the point of view of **national political stability**.

... and for about 160 years

Several studies show that **security of supply from coal reserves is 2 times better than from natural gas and 3.5 times better than from oil**. Coal can guarantee supply for about 160 years.

Lower production costs

Coal's high competitiveness in energy mix **is** not only **due** to its elevated distribution in the world but also **to its very competitive production costs**.

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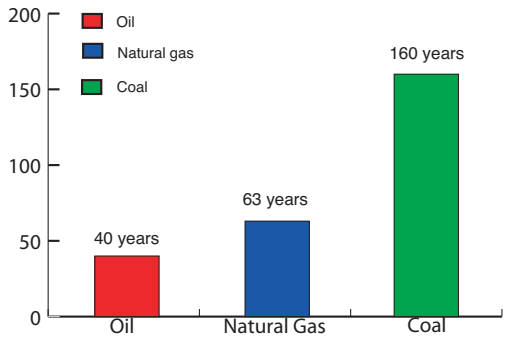
Security of supply: World reserves



Source: BP Amoco Statistical Review

It's been verified that the nuclear/coal generation cost is 20% lower than the combined cycle gas one. According to the latest survey from the Regulatory Authority for Electricity and Gas, the costs for electric energy production are:

- **2,18 Eurocents/Kwh from coal;**
- **5,51 Eurocents/Kwh from oil;**
- **6,34 Eurocents/Kwh from natural gas.**

This competitiveness is also due to **coal fixed cost, that is about 22% lower than other sources of generation. More than 62% of the Italian energy bill may be ascribed to supply costs.**

According to the Italian Authority, if Italian electric plants used as much coal as the rest of Europe, fuels cost on the entire amount of Kwh would decrease by 10%. Moreover if every Italian plants used coal, the Kwh would fall by 20%.

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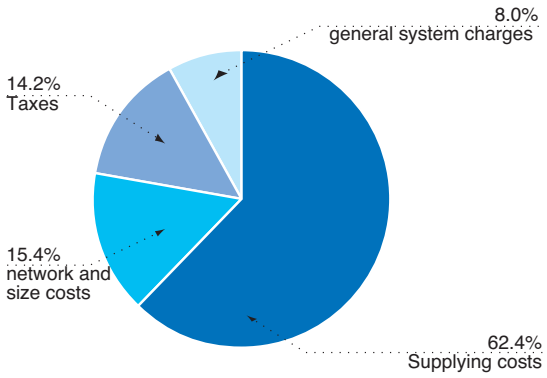
% Composition of electric charges for consumer



Source: elaboration on AEEG data

An intensive labour source

Though **electric energy production from coal** is the most competitive in Italy today, it is **"labour intensive"** with **a work force ration of 3:1** when comparing a coal-based power station with a combined cycle natural gas power station.

Kind of plant	Power	Personal consistency
Coal	4 sections of 300 Mw	487 assigned 0,37 assigned for Mw
Oil	4 sections of 320 Mw	311 assigned 0,24 assigned for Mw
Natural Gas CC	2 sections of 345 Mw	100 assigned 0,14 assigned for Mw

No risks for workers

Moreover the Industrial Department of **University of Brescia has carried on an Investigation about work risks in a coal plant**, monitoring the environment every year since 1987. **The analysis of the results** of 15 years of activity **has confirmed the absence of pathologies or diseases** in workers of the coal plant.

...and agricolture

In 2008 Nomisma Energia issued a report entitled “Coal plants and Agriculture”, that underlined that coal plants have no impact on the pollution concentration level in the surrounding grounds.

Security for transport by sea...

As far as transport and use are concerned, coal guarantees high level of security thanks to the fact that it is nor inflammable, nor explosive, nor pollutant for the ground and the water.

In 1997 the International Maritime Organization (I.M.O.) approved the exclusion of coal, as opposed to oil and natural gas, **from the list of substances at risk and potentially harmful when transported by sea.** If a ship full of coal capsizes, then the coal would deposit itself on the bottom of the sea without causing any damage.

..and by land

As for the storage and handling of coal on land, there exist adequate techniques and equipment for covering and protecting both conveyor belts and storage facilities. These techniques are used in Italy and they reduce the spreading of dust, even in conditions of significant atmospheric turbulence.

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Coal and environmental impact

Environmental friendly

The less known coal's characteristic is for sure its environmental friendly quality, according to present laws.

That is particularly true in Italy, where 9 out of 13 coal plants have EMAS certification – the European environmental certification, more severe compared with ISO 14001. We are talking about 84% of the coal installed power (equal to about 9.500 Mw of power).

40% average of productivity

These plants excel also according to efficiency, with a **productivity of 40% compared with 35% of the European average and with 25% of Continental Europe**. Coal plants are even more productive with a performance of 46%.

The modern coal plants in Torrevaldaliga e Vado Ligure have already reached an efficiency rate of 46% and are among the most innovative plants in Europe.

Investments aimed at cutting pollution focus on two sides:

- Innovative techniques and processes that improve energy efficiency preventing the generation of polluting emissions at the source;
- Increasingly sophisticated smoke-treatment systems, such as desulphurizers, de-nitrificators and dust collectors.

The results of these investments are a rapid and significant reduction of all polluting emissions, achieving the following goals:

- **70% reduction** in emissions of sulphur dioxide (SO2) when compared with the rate of 20 years ago. Today **sulphur dioxide** emissions are equivalent at 100 mg/Nm^3. Recent legislations have fixed maxima at 200 mg/Nm^3;
- **Strong reduction in nitrogen oxides** (NOx). A first important decrease of nitrogen oxides emissions was registered during the 90s and today they can be valuated at 100 mg/Nm^3, a value **clearly lower than the one imposed by law** (the limit is fixed at 200 mg/Nm^3) ;
- **Reduction of dusts emissions:** in the **90s they were reduced of 63%**, in 2003 **another reduction of 75%** has been registered. Today dusts amount at around 15 mg/Nm^3 (the total reduction is not foreseen by the law) while the limit is 30 mg/Nm^3;
- **100% recycling of ash and chalk**. They can be easily reused for the production of pilling, cement, street paving and for the production of building material.

The coal and Kyoto

Moreover in 2000, 10 years before the Kyoto Conference established its objectives, Italian coal plants **had reduced carbon anhydride (CO_2) emissions of 7,6%**.

In consideration of Kyoto objectives **the Association has ordered a study on CO_2 emissions** to the Experimental Station for Fuels, Milan, in order to analyse the effective CO_2 emissions – **during the entire life cycle**.

In particular **the study compares CO_2 coal and gas emissions** not only during the combustion, but **also in the pre-combustion phases.**

The comparison of the whole life cycle decrease therefore the distances: **the greenhouse gases total emissions would result between 510 and 670 grams of CO_2 -equiv./kWh for gas** (420 if the gas would be produced in Italy) **and between 780 and 910 grams of CO_2 -equiv./kWh for coal.**

In fact, the pre-combustion data underline a higher level of CO_2 emission for gas, with peaks of 288 gr of CO_2 -equiv./kWh in the Russian gas case. While, for coal, the emission recorded are equal to 127 gr of CO_2-equiv./kWh in the case of extractions from underground mines and just 12 gr of CO_2-equiv./kWh for mines on the surface.

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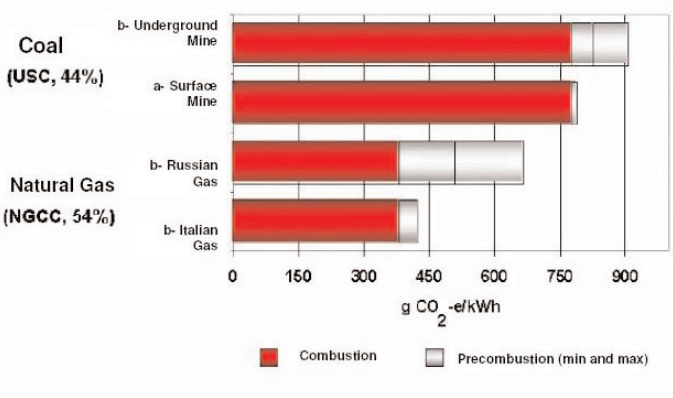
CO_2 emissions in the entire life cycle



The research

Aiming at increasing the compatibility of coal with the environment and the electric production efficiency, **several research initiatives have been launched in all major countries.**

ENEL's pilot plant in Brindisi

Among the recent most innovative projects there is the one launched by ENEL, in collaboration with Eni at the Federico II plant in Brindisi, to build **a demo plant for CO_2 capture and storage**. The plant, unveiled in March 2011 is the first in Italy and will be able to store 8,000 tonnes of CO_2 each year.

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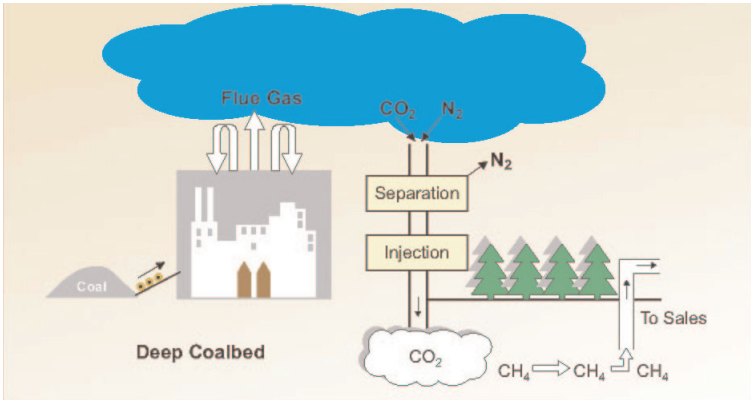
The "carbon capture"



The projects, which involves, other than the capture of CO_2 from plant's smokes, the compression, the transport and the geological transportation in a salt water bearing, **is one of the most advanced in the world** for the demonstration on pre-commercial scale of CCS: implemented on a smaller scale in Brindisi, operating from 2012, it is going to be developed at Porto Tolle'splant, which will be implemented and able to operate from 2015. Enel, which is carrying out the experiment in collaboration with Eni, obtained a first incentive of € 100 million from European Union as it falls in the European Economic Recovery Plan.

Porto Tolle project

Adding to that, the **ENEL plant in Porto Tolle** is planned to be converted to coal, as **one of the six CCS projects which will benefit from European funding.**

Total funding estimated for the installation of the **new CCS technology on a 660 MW coal unit** is Euro 100 million. The capture system will be able to treat emissions corresponding to 250 MW of electricity generation.

ENEA, in collaboration with Ansaldo and Sotacarbo, is conducting a study on **Sulcis coal gasification** with CO_2 separation and hydrogen production. Furthermore **ENEL** has completed a pilot project to **produce hydrogen from coal**, to be implemented within the Consortium for Hydrogen in Venice.

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Coal plants in Italy

Imports

Italy imports via sea about 90% of its coal demand, on a fleet composed by 60 ships with a carrying capacity of 4,6 million of tons. **Import countries are different:** the main ones are the USA, South Africa, Australia, Indonesia and Colombia, but there are also Canada, Cina, Russia and Venezuela.

Sulcis

The only coal source in Italy is located in Sulcis Iglesiente basin, in South-West of Sardinia. In 1972 mining activities in this basin were suspended but since 1997 the basin has been studied by several researchers in order to evaluate new solutions to use in an environmental friendly way the coal of Sulcis. At present, the production is about 1 Million tons yearly.

Italian operators have in pipeline projects for the conversion of coal of a big part of their production and for the deployment of existing plants never used for coal combustion.

Today in Italy there are 13 coal plants:

- Plant of **North Brindisi (BR)** owned by EDIPOWER SpA. The company Uses coal in 2 sections of 320 MW.
- Plant of **Fiumesanto (SS):** owned by E.ON ITALIA, has got 2 sections of 320 MW.
- Plant of **Monfalcone (GO)** in Friuli Venezia Giulia region: owned by A2A, is made of 4 sections, two fuelled by coal of 165 and 171 MW and two by burning oil of 320 MW.
- Plant of North **Torrevaldaliga (Civitavecchia, RM)** owned by ENEL SpA, is composed by three sections of 660 MW, that have been completely converted from oil to coal. **The plant is in production since 2009.**

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Coal plants in Italy

- Plant of **Vado Ligure**, owned by TIRRENO POWER, is made of 4 sections of which two of 330 MW each fuelled by coal. The project for the construction of a new high-efficiency coal unit of 460 MW, consisting in he substitution of existing sections as well as the realization of a new unit, has been approved by Regione Ligura in March 2010.

- Plant of **Brescia** owned by ASM of Brescia is made of one section of 70 MW and is fuelled by coal.

- Plant of **South Brindisi**, owned by ENEL, is made of four sections of 660 MW each fuelled by coal. A 50MW pilot plant for geological capture and storage of CO_2 has been unveiled in March 2011. The construction of this plant falls in the agreement signed by Eni and Enel in October 2008 aimed at developing the following technology on an industrial scale.

- Plant of **Genoa**, owned by ENEL SpA, is made by two units fuelled by coal, one of 295 MW.

- Plant of **Sulcis** owned by ENEL SpA, is made of one unit of 240 MW fuelled by coal.

- Plant of **Fusina (Veneto)** owned by ENEL SpA, is made of one unit of 165 MW, one of 171 MW, and two of 320 MW fuelled by coal.

- Plant of **Marghera** owned by ENEL SpA is made of two units of 70 MW fuelled by coal.

- Plant of **La Spezia** owned by ENEL SpA is made of four units of which one is of 600 MW and is fuelled by coal.

- Plant of **Bastardo (Perugia)** owned by ENEL SpA is made of two units of 75 MW fuelled by coal.

In addition to the 13 existing coal plants, the following projects:

- The plant in **Porto Tolle**, owned by ENEL, which in January 2011 obtained the authorisation by the Minister of Economic Development for the conversion of **4 oil groups into 3 high-efficiency (> 45%) coal groups,** with a total power of 1,980 MW.

- The **SEI project** in Saline Joniche will count on a plant, **fueled by coal dust**, **equipped with two twin lines with a total power of 1,320 MWe.** The plant will reach a **very high efficiency (more than 45%), by reducing the coal consumption and the emissions that will be remarkably lower than law limits (-50%).**

  In October 2010 VIA (Environmental Impact Assessment) Commission gave the authorization to proceed with works.

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Highlights of the Association

The Association

Founded in 1897 the Association, with more than 90 member companies, is the only association representing the entire coal value chain from coal mining groups to electricity and steel producers, cement manufacturers, shipping firms, terminal operators, maritime agents, surveyors, engineering companies, boiler makers, bulk handling equipment manufacturers.

Fast facts 2010

Turnover:	**6 billion Euros**	
Induced turnover:	**500 million Euros**	
Coal imports:	**2.500 billion Euro per year**	
Employees:	**9,000, of which:**	**direct: 6,000** **undirect: 3,000**
Members:	**over 90**	

Italian commitment

On a national level the Association sits on the Board of Directors of the Fuel Experimental Station and participates in the work of the Subcommittee on fuel within the Ministry of Industry and Trade.

International commitment

On an international level, Assocarboni is member of CIAB (Coal Industry Advisory Board) - a section of the International Energy Agency of Paris, which brings together more than 40 companies (both energy producing and electric generation companies) from 14 different countries - of CAG (Coal Advisory Group) - a European Commission working group involved in coal research grants - of WCA (World Coal Association) in London and of the "Working Party on Coal" of the ECE-UN Energy Committee in Geneva.

The chairman

Since 1999 Andrea Clavarino is the Assocarboni Chairman. Mr. Clavarino has been working with the Coeclerici Group since 1980, where he holds today the position of **Coeclerici Logistics CEO**. Mr Clavarino is also **member of the CIAB** - Coal Industry Advisory Board, **the consultative body of the International Energy Agency of Paris.**