

South Korea

Energy efficiency report



Objectives:

– 38 Mtoe of end-user energy savings by 2030

Overview	2009		2000-2009 (% / year)	
Primary intensity (EU=100) ¹	154	--	-1.5%	-
CO ₂ intensity (EU=100)	161	--	-1.5%	-
CO ₂ emissions per capita (in tCO ₂ /cap)	10.6	--	1.9%	--
Power generation	2009		2000-2009 (% / year)	
Efficiency of thermal power plants (in %)	40	+	-0.3%	-
Rate of electricity T&D losses (in %)	4	++	-2.0%	+
CO ₂ emissions per kWh generated (in gCO ₂ /kWh)	489	-	1.2%	--
Industry	2009*		2000-2009* (% / year)	
Energy intensity (EU=100)	137	-	-3.7%	+
Share of industrial CHP in industry consumption (in %)	11	-	-3.2%	--
Unit consumption of steel (in toe/t)	0.34	+	1.2%	--

*2008 and 2000-2008 for steel

++ Among best countries + Better than the EU average - Below the EU average -- Among countries with lowest performances

Latest update: February 2011

¹ The European Union, as the best-performing region, is used as the benchmark.

1. Overview

1.1. Policies: 38 Mtoe of energy savings by 2030

Since 1993 South Korea has developed five-year Basic Rational Energy Utilization Plans. The 4th Basic Plan 2008-2012 set an energy intensity reduction target of 11.3 percent between 2007 and 2012. In 2008, South Korea announced its Basic National Energy Plan 2008-2030, which aims to reduce energy intensity by 46 percent between 2007 and 2030. The overall energy savings goal for 2030 is nearly 38 Mtoe, 44 percent of which should be from industry (17 Mtoe), 32 percent from the households and services sector (12 Mtoe), 19 percent from the transport sector (7 Mtoe), and 5 percent from the public sector (1.9 Mtoe).

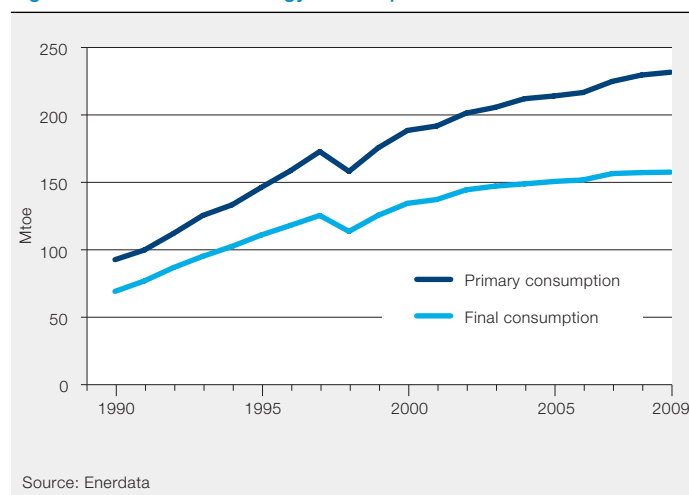
The Korean Energy Management Corporation (KEMCO), created in 1980 through the Rational Energy Utilization Act, implements the energy efficiency programs. The Rational Energy Utilization Act (1979) was amended in 2002, 2003 and 2008 to introduce new energy-saving measures. Three labeling programs have been launched to promote high-efficiency appliances: the Energy Efficiency Standards and Labeling Program (1992), the High-efficiency Appliances Certification Program (1996) and the E-Standby Program (1999).

South Korea's energy efficiency strategy includes building codes for new buildings over a certain size and a certification system; businesses with buildings that consume more than 2 ktoe/year can participate in Energy Saving Partnerships or enter into voluntary agreements. Businesses and individuals who invest in energy-saving facilities are entitled to tax reductions (up to 20 percent of investment costs for a year) or low-interest loans. Energy service companies (ESCOs) have been operating since 1992.

1.2. Energy consumption trends: buoyant energy consumption

South Korea's energy consumption per capita is more than twice as high as the world average (around 5 toe/cap in 2009) and has been higher than the OECD average since 2007 (+11 percent in 2009). The strong growth in total energy consumption (4.9 percent/year for primary consumption between 1990 and 2009) was only interrupted briefly by the Asian crisis in 1998.

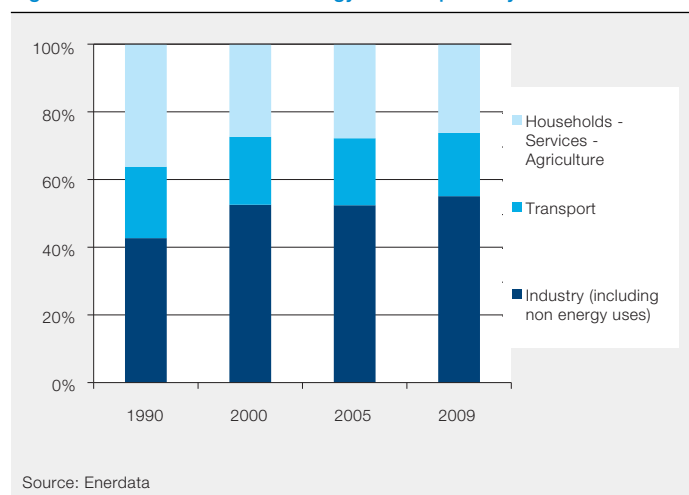
Figure 1: Total and final energy consumption trends



Oil is the most popular fuel in South Korea, with 40 percent of primary consumption in 2009 (54 percent in 1990), followed by coal (28 percent in 2009). Nuclear accounts for 17 percent of primary consumption (15 percent in 1990). The share of gas rose to 13 percent in 2009, from 3 percent in 1990. Biomass represents just 3 percent of primary consumption.

Industry is the largest consuming sector in South Korea and its share in final consumption is increasing from 43 percent in 1990 to 55 percent in 2009 (including non-energy uses), while the households and services sector share is falling, with its share dropping from 36 percent in 1990 to 26 percent in 2009. The share of transport has remained relatively stable over time (19 percent in 2009).

Figure 2: Distribution of final energy consumption by sector

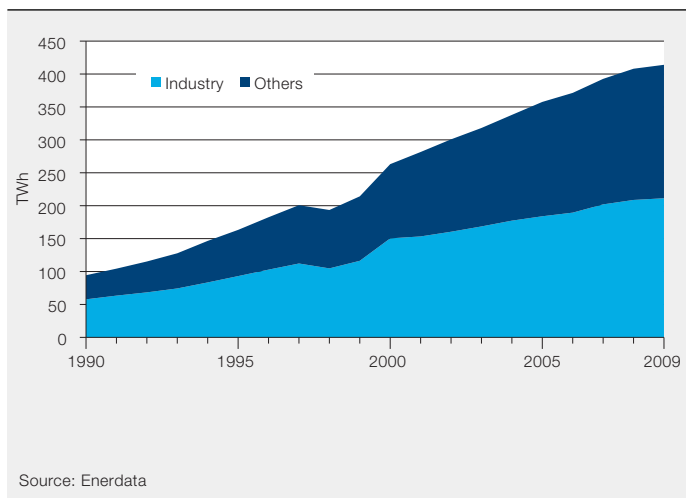


South Korea

Energy efficiency report

Electricity consumption per capita is high at around 8,500 kWh/cap in 2009, which is more than three times as high as the world average and 12 percent higher than the OECD average. Total electricity consumption is growing very rapidly: around 8 percent/year on average between 1990 and 2009, which is almost twice as fast as final consumption. The share of electricity in final energy consumption has almost doubled since 1990, from 12 percent to 23 percent in 2009.

Figure 3: Electricity consumption trends by sector



The electricity consumption growth of industry was rapid (+5.8 percent/year). However, this sector's share in electricity consumption fell from 61 percent in 1990 to 51 percent in 2009, as a result of an even stronger demand from the households and services sector (+9.2 percent/year).

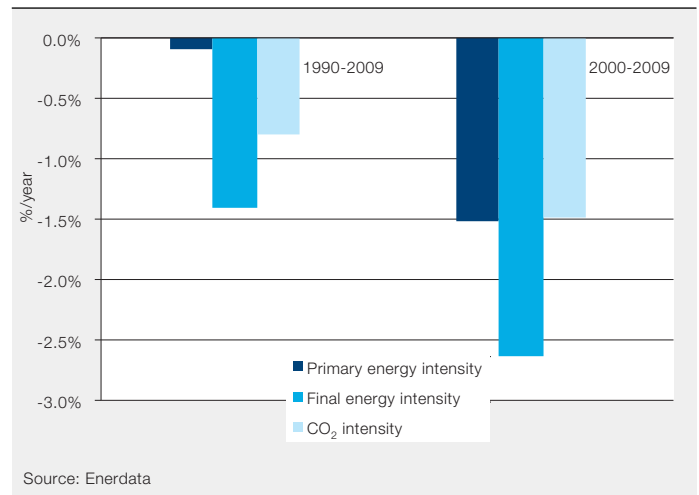
1.3. Energy efficiency and CO₂ trends: significant improvement for final consumers

Primary energy intensity (primary energy per unit of GDP, measured at purchasing power parity) is much higher than the EU average (around 50 percent). In 2009 primary energy intensity was almost at the same level as in 1990 (-0.1 percent/year).

Contrary to primary intensity, final energy intensity (final energy per unit of GDP) decreased significantly, by 1.4 percent/year between 1990 and 2009 indicating improvements in consumer energy efficiency. Those divergent trends between the primary and final intensities can be explained by increasing losses in power generation. Those losses are due to the very rapid increase in electricity consumption and the high share of low-efficiency power plants in the electricity generation mix; since 2009 coal-fired, oil-fired and nuclear power plants have accounted for more than 80 percent of power generation. Larger improvements took place between 2000 and 2009, with final intensity declining by 2.6 percent/year.

CO₂ intensity (CO₂ emissions per unit of GDP) decreased slightly by 0.8 percent/year between 1990 and 2009. Most of that decrease (around 90 percent) can be attributed to fuel substitutions: the share of oil and coal in primary consumption declined by 13 percentage points between 1990 and 2009.

Figure 4: Energy and CO₂ intensity trends



2. Power generation

2.1. Policies: 11% share of renewables in total energy consumption by 2030

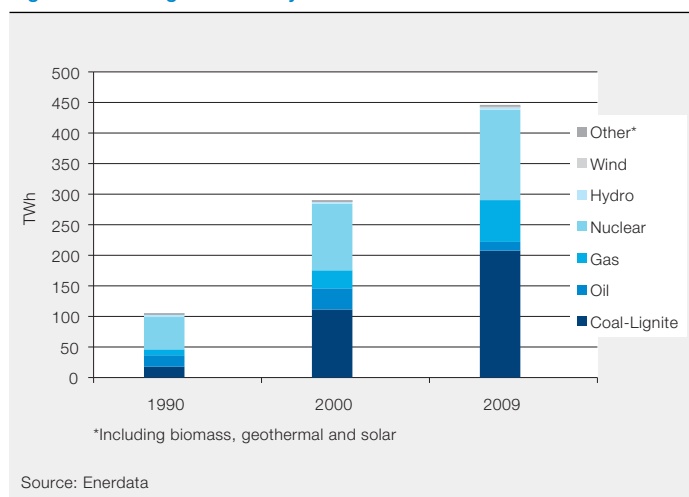
According to its National Energy Plan 2008-2030, South Korea aims to produce 11 percent of the energy it consumes from renewables by 2030; intermediate targets are set at 4.3 percent in 2015 and 6.1 percent in 2020.

The government provides subsidies to accelerate the development of renewables, and more specifically to reach its target of "one million green homes" equipped with PV, solar thermal or wind installations. Subsidies are granted to regions to carry out renewable projects. Low-interest loans were created to cover up to 90 percent of the installation cost of renewable facilities (up to 50 percent for large corporations) and up to 20 percent of the investment can be tax-exempted. Renewable Energy Service Companies (RESCOs) were created in 2005 to contribute to the development of the domestic renewable industry. In 2002 South Korea also introduced feed-in tariffs for PV, wind, hydropower, waste, biomass and biogas, tidal power and fuel cells. Incentive tariffs for PV will be changed into a Renewable Portfolio Standard (RPS) as of 2012. In 2005 nine energy companies signed an agreement with the government, known as the Renewable Portfolio Agreement, to invest in renewable energies.

2.2. Power generation trends by source: nuclear power overtaken by coal generation

South Korea's electricity mix is divided between thermal generation (65 percent in 2009) and nuclear power (33 percent). The share of coal has increased dramatically, from 17 percent in 1990 to 47 percent in 2009, while gas-fired generation rose from 9 percent to 15 percent. The share of oil fell from 18 percent to 3 percent. CO₂-free generation accounts for 35 percent of the power mix and mainly consists of nuclear power (renewables account for less than 2 percent).

Figure 5: Power generation by source



2.3. Efficiency of the power sector: rising share of combined-cycle power plants

The average efficiency of power generation increased slightly between 1990 and 2000; it then remained stable at around 38 percent (2009). This improvement is linked to the growth in the efficiency rate of thermal power plants (from 32 percent in 1990 to around 40 percent since 2000), which was achieved through a switch to natural gas in the generation mix and through a growing share of combined cycle power plants in the thermal capacity. Combined cycle power plants now account for one third of the thermal capacity.

Figure 6: Efficiency of power generation and thermal power plants

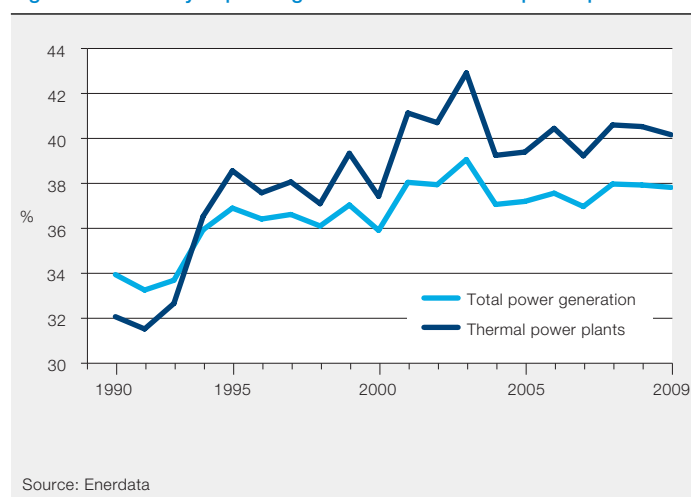
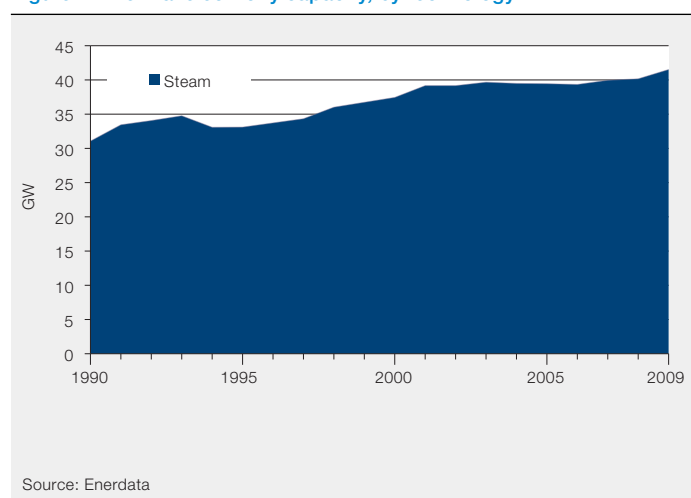


Figure 7: Thermal electricity capacity, by technology

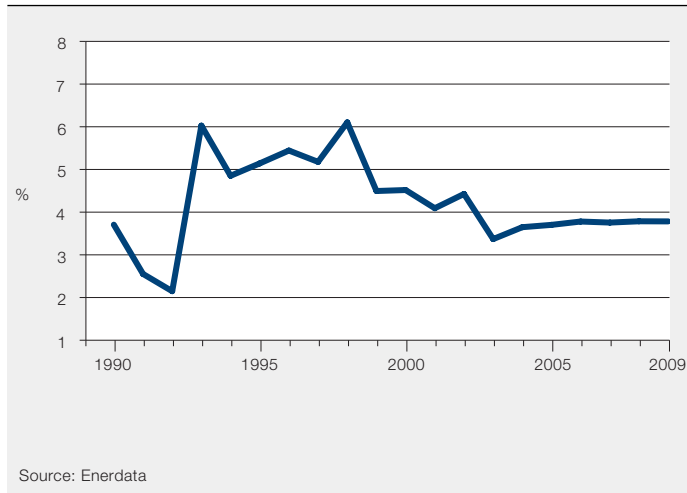


South Korea's rate of T&D losses is among the lowest in the world (3.8 percent in 2009).

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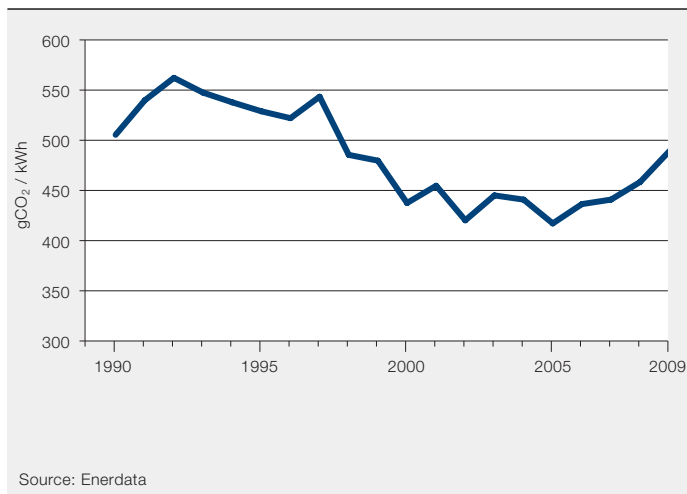
Energy efficiency report

Figure 8: Electric T&D losses



Despite a significant share of nuclear power (33 percent), the carbon factor (CO₂ emissions per kWh produced) is high at around 500 gCO₂/kWh. The downward trend in CO₂ emissions per kWh was broken in 2005 when the growth in nuclear generation was interrupted.

Figure 9: CO₂ emission factor for power generation



3. Industry

3.1. Policies: 17 Mtoe of energy savings by 2030

The Basic National Energy Plan 2008-2030 sets an energy use reduction target of nearly 17 Mtoe in industry by 2030 (a 13 percent reduction, approximately, from a BAU scenario).

KEMCO promotes five-year voluntary agreements with industrial groups; businesses that enter into voluntary agreements or invest in energy-saving technologies are entitled to financial and technical support and tax credits covering up to 20 percent of the investment cost. Since 2007 large energy consum-

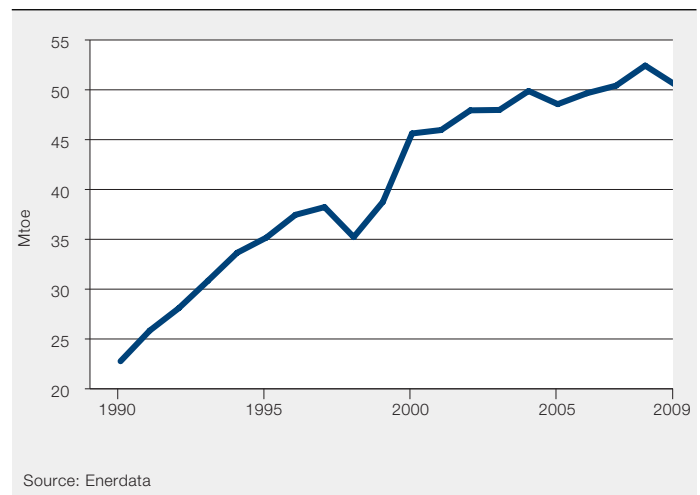
ers (over 2 ktoe / year) have to carry out mandatory energy audits every 5 years; in the case of small and medium sized enterprises (under 5 ktoe / year) up to 90 percent of the audit costs can be subsidized. Under the Integrated Energy Supply Act (1999), industries that invest in CHP plants for their own supply of heat are entitled to tax reductions.

The Energy Saving Partnership Program (ESP) aims to share new energy saving technologies within the industrial branches; factories consuming more than 20 ktoe can participate in the ESP (over 10 ktoe in the automobile, food, electrical and electronics industries). To date, 195 companies are involved in this program, which has made it possible to save 285 ktoe of fuel and 393 GWh of electricity between 2000 and 2007.

3.2. Energy consumption trends: soaring industrial energy demand

The energy consumption of South Korea's industry doubled between 1990 and 2000 (despite the 1998 drop caused by the Asian crisis) and grew by 1.3 percent / year between 2000 and 2008. In 2009 energy consumption fell by 6.7 percent, as industry was hit by the global economic downturn.

Figure 10: Industrial energy consumption



The energy mix in industrial consumption changed dramatically between 1990 and 2009. The share of oil, which accounted for 48 percent of energy consumption, fell significantly and now accounts for just 11 percent. Oil was progressively replaced by electricity (from 22 percent to 36 percent of industrial consumption) and by gas (from 1 percent in 1993 to 11 percent in 2009). Coal consumption remained stable at around 30 percent. Since 2000, biomass has accounted for 5 percent of industrial consumption.

The share of the energy-intensive sectors in industrial energy consumption is high (62 percent in 2009). The steel industry is

the main consuming sector, accounting for 33 percent of consumption in 2009 (26 percent in 1990), followed by the chemical industry (15 percent) and the non-metallic mineral branch (11 percent in 2009, down from 15 percent in 1990). The paper and pulp industry accounts for just 4 percent of industrial consumption.

Figure 11: Energy consumption of industry, by source

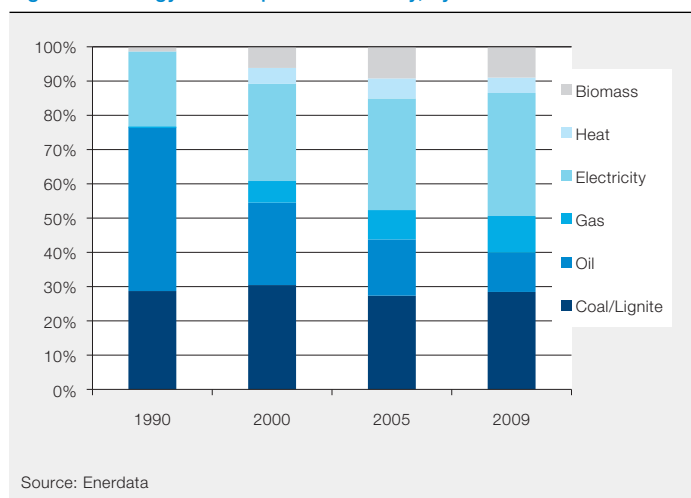
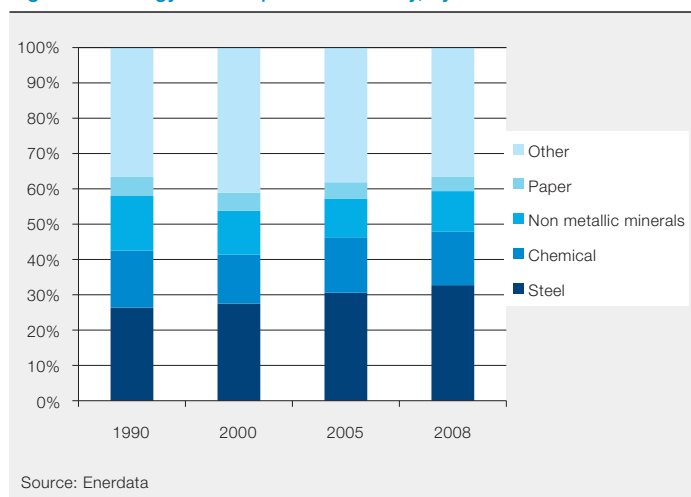


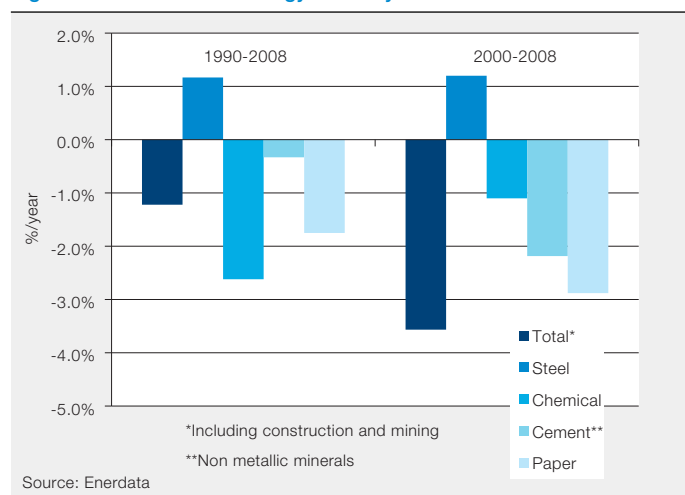
Figure 12: Energy consumption of industry, by branch



3.3. Energy intensity trends: efficiency gains hindered by steel sector

Between 1990 and 2008, the decrease in industrial energy intensity was limited (-1.2 percent/year) despite efficiency gains in the chemical industry (-2.6 percent/year), the cement industry (-0.3 percent) and the paper branch (-1.8 percent/year). This was because energy consumption per ton of steel produced during the same period grew by 1.2 percent/year offsetting the improvements in the other branches.

Figure 13: Trends in the energy intensity of industrial branches



The share of industrial CHP in electricity consumption is relatively low in South Korea. Since 2006, CHP has covered about 11 percent of industrial electricity consumption.

Figure 14: Share of industrial CHP in industrial consumption



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