Stichting Onderzoek Multinationale Ondernemingen
Centre for Research on Multinational Corporations

Enel Today & Tomorrow

Hidden Costs of the Path of Coal and Carbon versus Possibilities for a Cleaner and Brighter Future

SOMO

May 2012

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Amsterdam, May 2012

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Colophon

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Hidden Costs of the Path of Coal and Carbon versus Possibilities for a Cleaner and Brighter Future
May 2012

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Enel's response to this report
SOMO provided Enel with an opportunity to provide comments on and corrections to a draft version of the corporate profile. Enel accepted this opportunity and provided comments but insisted that it strongly disagrees with SOMO's assumption that Enel's usage of coal is dangerous and contributes to premature deaths. Enel further disagrees with the methods used in the report and the way in which all the methods were employed. Some of Enel's comments have nevertheless been incorporated into the present version. The fact that Enel reviewed the draft and provided comments does not imply that the company approves of or endorses any part of the present report. Enel reserves all rights.

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1. Introduction

1.1. Context and point of departure

The electricity provided by power companies and the employment that electricity provision creates are economic goods that benefit society and drive economic and social development. Electricity companies are adept at publicizing these socio-economic goods in corporate communications, and indeed, they receive significant financial compensation – in the form of revenues – for providing these goods. However, in addition to paying electricity companies for the kilowatts used, society also pays a hidden price for these goods that often goes unreported and is not included on corporate financial balance sheets. These hidden, or 'externalized', costs take the form of negative effects on public health and agriculture, and the economic losses associated with these impacts. Electricity companies are understandably less interested in publicizing these significant negative impacts and costs to society than they are in promoting their positive impacts. However, in order to have an informed public debate about the advantages and disadvantages of various strategies for supplying society's demand for energy, all direct and indirect costs, benefits, and impacts associated with the different possible energy systems, these externalities must be brought to light and discussed in an open manner.

This report examines the activities, operations, and impacts of Italy-based multinational power company Enel. Headquartered in Rome, Enel is an energy giant. It is the largest power company in Italy, Spain, Slovakia, and a number of major emerging economies in Latin American. In these markets, Enel is a major player in several sub-sectors of the energy industry. Enel is Europe's overall second-largest electric utility by installed capacity. Although Enel provides both electricity and gas to its customers, this report focuses solely on Enel's electricity production. Gas that is sold directly to customers (*i.e.* not used for electricity production) is not taken into account in any of the calculations in this report.[1]

1.2. Aims and objectives

This report, commissioned by Greenpeace Italy, aims to raise public awareness about some of the hidden costs and benefits of Enel's electricity generation activities in order to contribute to an informed and open public debate about national and international energy strategies.

The present report presents a fact-based profile and analysis of Enel's current activities and operations. Based on these activities and operations, the present report employs methods found in the scientific and academic literature to estimate the company's impacts on employment, the climate, and public health. This provides a comprehensive picture of what Enel 'is today'. The report also provides a projection of what Enel's activities and impacts will comprise in the future based on the company's current construction of new power plants and its stated plans for additional new capacity. This provides an indication of what Enel '*will* be tomorrow' if it follows its 'business-as-usual' strategic business plan. Finally, the present report conducts a type of 'thought experiment' by envisioning a hypothetical future scenario for Enel. Based on a proposal from Greenpeace Italy involving an expedited shift from coal-fired power to renewable energy production, the present report calculates what Enel '*could* be tomorrow' if it were to abandon its

[1] Enel company profile, 30 September 2011, http://www.enel.com/en-GB/doc/group/profile/Enel_Company_profile_30_09_2011.pdf.

own strategic scenario and undertake to invest in heavily renewable energy rather than coal in Italy.

1.3. Research questions

In order to achieve these specific objectives and the overall aim, this report seeks to answer the following research questions:

1. What is Enel today?
    a) What basic company information can be gathered about Enel's current corporate structure and ownership, turnover and profits, geographical markets, market shares of electricity generation and supply, and number of employees?
    b) What characteristics does Enel's current electricity production park exhibit in terms of fuel mix of installed capacity (MW) and fuel mix of actual electricity production (GWh)?
    c) How many people does Enel currently employ?
    d) What is Enel's current contribution to climate change in terms of:
        - Aggregate CO_2 emissions and emission intensity?
        - Policy on climate change?
        - Public (financial) support Enel has received for its activities related to climate change?
        - Climate change initiatives and instruments Enel uses or is involved in?
    e) What other emissions to air from fossil fuel-based (in particular coal-fired) electricity generation can be attributed to Enel?
    f) Using the methods from the scientific literature identified in research question 2, what quantified impacts on public health and associated economic losses resulting from emissions to air of Enel's fossil-fuel based power plants can be determined?
    g) How much radioactive waste, total and per kWh of electricity generated, is currently attributable to Enel's nuclear power generation?
2. What will Enel be tomorrow?
    a) What is the fuel mix of the new electricity generation capacity currently being constructed by Enel?
    b) What is the fuel mix of future electricity generation capacity that Enel is currently planning or considering?
    c) Based on these investments and plans, what characteristics will Enel's future electricity production park exhibit in terms of fuel mix of installed capacity (MW)?
    d) Using methods found in the literature for calculating how much employment is generated by investment in electricity generation capacity based on various fuels and technologies, how much employment is Enel projected to generate in the future?
    e) Using methods found in the scientific literature for calculating the impact on public health and associated economic losses resulting from emissions to air of fossil-fuel based power plants, what quantified impacts on public health and associated economic losses will result from emissions to air of Enel's planned fossil-fuel based power plants?
    f) Based on these investments and plans, how much radioactive waste will be produced by Enel's planned expansion of nuclear power capacity?
3. How could Enel provide a brighter, cleaner Italian tomorrow?
    a) If Enel were to adopt a proposal from Greenpeace Italy involving an expedited shift from coal-fired power to renewable energy production, what would the result be in terms of the company's impacts of fuel mix of its production park, employment generation, emissions to air, and impact on public health?

1.4. Target groups

This report was commissioned by Greenpeace Italy to support their campaign for a more sustainable energy system in Italy and more broadly in Europe. The primary intended beneficiaries of the present research report are the societies and economies that pay the hidden costs of electricity provision. The report's target groups are policy makers, electricity companies, civil society organizations and any other individuals or groups interested in participating in an open and informed debate about energy systems.

1.5. Process and methods

Given the importance and complexity of the methods used for the present report, particularly regarding Enel's impact on public health and the associated costs, several specific elements of the research methods employed in the researching of this report are described in detail in Chapter 2 of the present report. This subsection contains a description of the more general methods and process followed in researching, reviewing and drafting the present report.

The researching of this report involved solely desk research methods. The primary sources of information relied upon in the research comprised scientific and academic literature; official Enel publications and information such as its sustainability reports, annual reports, and website; pollutant emissions data provided by Enel to the European Pollutant Release and Transfer Register (E-PRTR); corporate information databases such as Bloomberg and LexisNexis; and a scan of newspapers and websites.

SOMO provided Enel with an opportunity to provide comments on and corrections to a draft version of the corporate profile. Enel accepted this opportunity and provided comments but insisted that it strongly disagrees with SOMO's assumption that Enel's usage of coal is dangerous and contributes to premature deaths. Enel further disagrees with the methods used in the report and the way in which all the methods were employed. Some of Enel's comments have nevertheless been incorporated into the present version. The fact that Enel reviewed the draft and provided comments does not imply that the company approves of or endorses any part of the present report. Enel reserves all rights.

The interpretation and implementation of the methodology has also been reviewed by Dr. Mike Holland, author of a 2011 European Environmental Agency report on the costs of air pollution from industrial facilities[2], as well as experts at the Open University of the Netherlands and Greenpeace International. SOMO is grateful to these reviewers for their helpful comments and suggestions for improvement, but the contents of the present report remain the sole responsibility of SOMO.

1.6. Structure of the report

After a detailed description of the research methods in Chapter 2, the report proceeds to answer the research questions outline above, with Chapter 3 concentrating on answering research question 3 and the associated sub-questions, Chapter 4 focusing on research question 4 and sub-questions, and Chapter 5 answering research question 5 and sub-questions. The report concludes with some general implications and lessons.

[2] EEA, Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011 (Copenhagen: European Environment Agency, 2011).

2. Methodology

2.1. Methods used for quantifying impacts on public health

The methodology used by SOMO to quantify the public health impacts of air pollution from Enel's fossil fuel power plants in sections 3.6.3 and 4.3.2 has been developed for the European Environment Agency (EEA) by a consortium led by the UK consultancy firm AEA Technology plc. The report, entitled "Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011" (hereinafter "the EEA report"), has been used by the EEA to estimate the economic impacts caused by air pollution from industrial facilities. The approach has been fully documented by Holland *et al.*[3] and the EEA.[4]

The EEA report quantifies the damage costs to public health and the environment caused by emissions of pollutants by European industrial facilities. These damage costs are generated by, for example, medical costs of asthma patients whose illness has been aggravated by air pollution from industrial facilities[5], or the costs of damage to food crops caused by air pollution from ozone. The EEA uses pollutant emissions data from the European Pollutant Release and Transfer Register (E-PRTR), and bases its approach on policy tools and methods that had already been developed prior to the report.[6] The European Union's "Clean Air For Europe" (CAFE) programme is used as the source of figures related to damages per tonne of emissions of the main air pollutants. In addition to the EEA report, numerous reports and studies used by scientific agencies and policy makers around the world have employed methods based on the CAFÉ programme. It must be mentioned that the EEA methodology, like any methodology attempting to trace the complex relationship between pollution, public health, and economic costs to society, has limitations. These limitation are clearly presented in section 0 below. It also merits reiterating here that the present report relies entirely on the EEA's methodology. The present report merely applies the EEA methodology specifically to Enel's power plants in Italy. The only discretionary choice that SOMO has made is to report the costs of premature mortality due to emissions of pollutants from power plants in terms of value of a human life (Value of a Statistical Life, VSL), instead of reporting these costs in terms of value of a life year (Value of a Life Year, VOLY). Both the EEA and the United States Environmental Protection Agency use VSL (as is done here), but some experts prefer VOLY. Using the VOLY instead of the VSL would lead to a lower determination of overall costs.

The economic costs of air pollution from industrial facilities are largely derived from the costs of air pollution on human health. Key factors include the loss of human productivity due to illness, hospitalisation costs, and the costs of premature deaths of some of these patients. All of these factors are components of the overall economic impact of air pollution from industrial facilities, though the costs of premature deaths represent by far the largest share of the costs. Thus, the economic impact of air pollution cannot be calculated without also calculating and quantifying the

[3] Holland, M., Pye S., Watkiss P., Droste-Franke B. & Bickel P, Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas(Didcot, UK: AEA Technology Environment, 2005).

[4] EEA, Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011 (Copenhagen: European Environment Agency, 2011).

[5] Some sources in the literature suggest that asthma may also be caused by ambient air pollution, though this view is far from definitive. It should also be noted that industrial sources are not the only source of air pollution of concern– the transport, agriculture and domestic sectors all provide major contributions to the European air pollution climate.

[6] EEA, Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011 (Copenhagen: European Environment Agency, 2011).

costs of illness, disease, and premature deaths due to air pollution. The calculation of the cost of premature deaths depends on two factors: 1) the economic value that is given to the social preference to reduce risk to human health, which can be expressed in 'value of a statistical life' (VSL) or value of a life year (VOLY), and 2) the actual number of premature deaths.

The estimates of health impacts include five separate pathways. Emissions of particulate matter (PM) contribute to primary particulate matter concentrations. Emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) affect concentrations of secondary PM and ozone. The increased concentrations of PM and ozone cause a range of health impacts (see the box below).[7] Only the health impacts related to the three abovementioned emissions, PM, SO_2 and NO_x, are included in the SOMO estimates. Heavy metals and organic toxins are not included in the present study, but doing so would increase the calculated health impacts.

Common high-impact air pollutants

NO_X

Nitrogen oxides, such as nitrogen dioxide (NO_2), are a product of combustion processes and have adverse respiratory effects. NOx can cause bronchitis and in high concentrations, the oxides are toxic and cause inflammation. NOx can react or connect with other small particles to form small particulate matter that damages the lungs.[8]

SO_X

Sulphur oxides, like nitrogen oxides, can cause or aggravate respiratory problems and cardiac disease. Sulphur occurs naturally in most fossil fuels and sulphur dioxide (SO_2) are produced on a large scale in industrial processes, the most important of which is fossil fuel combustion.

PM_X

Particulate matter (PM) is a mixture of various small airborne particles. The components vary and include materials such as nitrogen and sulphur oxides, dust, metals, and soil. Upon inhalation, the small particles easily enter lung and heart cells, and damage the organs. This effect becomes stronger with decreasing particle size. Usually, PM_X is noted as PM_{10} or $PM_{2.5}$, whereby the number does not indicate the number of atoms but the maximum diameter of the particles in micrometers (µm). PM is emitted from fires and from reactions between emittants near roads and industrial facilities.

O_3

Ozone is a naturally occurring gas that can be found in the stratosphere as well as the atmosphere. Ozone at ground level is mostly formed through photochemical reactions between products that are created by human activities. Volatile organic compounds react with nitrogen oxides (NOx) under the influence of sunlight. Hereby, ozone is formed. When inhaled regularly, ozone can damage the respiratory system, which can even lead to premature death.[9]

Human health effects caused by exposure to ozone

"The relationship between the severity of the effect and the proportion of the population experiencing the effect can be presented as a pyramid. Many individuals experience the least serious, most common effects shown at the bottom of the pyramid. Fewer individuals experience the more severe effects such as hospitalization or death."[10]

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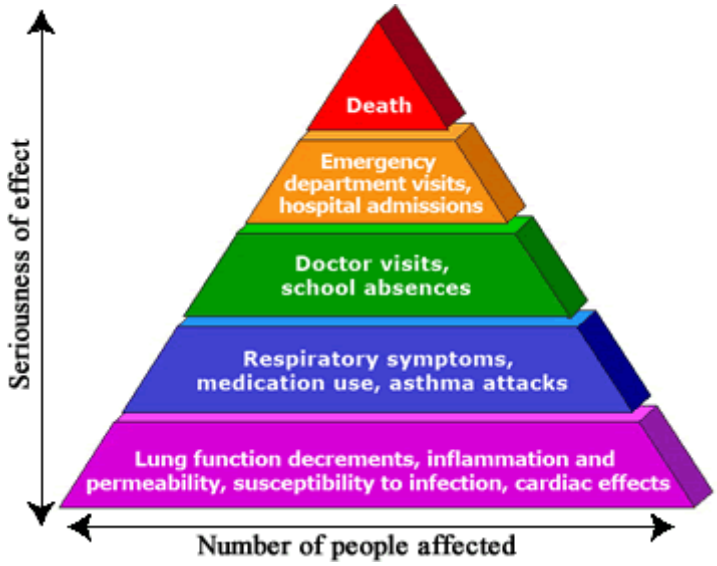
7 World Health Organization, http://www.who.int/mediacentre/factsheets/fs313/en/index.html (23 February 2012).
8 U.S. Environmental Protection Agency, http://www.epa.gov/air/nitrogenoxides/health.html (23 February 2012).
9 U.S. Environmental Protection Agency, http://www.epa.gov/o3healthtraining/population.html (24 April 2012).
10 U.S. Environmental Protection Agency, "*Health effects of ozone in the general population",* http://www.epa.gov/o3healthtraining/population.html (24 April 2012).

The U.S. Environmental Protection Agency illustrates the effects of exposure to ozone



The first step in implementing the methodology is obtaining data on air pollution emissions from Enel's power plants. For large operational industrial facilities in Europe, this data is available in the European Pollutant Release and Transfer Register (E-PRTR) database maintained by the EEA.[11] In order to calculate the projected emissions (in Chapter 4) of the four power plants that Enel is constructing or planning but which are not yet optional, several assumptions must be made. The basis of the projections in all cases are the environmental impact assessments (EIAs) for the plants and other publicly available information.[12] In addition, the following assumptions are made. All four plants are assumed to operate at 7,500 full load hours. Since Rossano Calabro values are given both as mg/Nm^3 and t/h, these were used to convert the others. The reported efficiencies for Rossano Calabro and Porto Tolle are the same, thus values were scaled up by higher output based on larger capacity. Nameplate capacity for Porto Tolle is assumed to be 1,980 MW. Nameplate capacity for Porto Romano includes two units of 800 MW, but given that some ambiguity exists about the two units, only one 800MW unit is used for the calculations in order to err on the side of a more conservative estimate of emissions. The emissions-to-concentration factors are adjusted for Italy, Romania, and Albania as appropriate.

The second step is estimating how the emissions affect the ambient concentrations of particulate matter and ozone that the population is exposed to. This is done with atmospheric modelling carried out by the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP programme). The models include data on population density and weather patterns on a given year. The output from the modelling is in the form of source-receptor matrices, which give the increase in exposure to ambient $PM_{2.5}$ and ozone (as µg/m^3/person) as a result of the emission of one tonne of SO_2, NO_x or $PM_{2.5}$. These matrices are calculated separately for each European country. EMEP describes the matrices as follows: "Source-receptor (SR) matrices give the change in various pollution levels in each receptor country

[11] EC DG ENV, European Pollutant Release and Transfer Register (E-PRTR) : Summary tables. (Brussels: European Commission Directorate-General for Environment, 2011). Available at http://www.eea.europa.eu/data-and-maps/data/member-states-reporting-art-7-under-the-european-pollutant-release-and-transfer-register-e-prtr-regulation-4.

[12] Base information for each plant found here: Rossano Calabro (http://www.autistici.org/difendiamolacalabria/wp-content/uploads/2010/05/SIA_ROSSANO-SNT_aprile2010.pdf), Porto Tolle (http://www.cslforum.org/publications/documents/Edmonton2011/Barbucci-TG-ZEPTProject-Edmonton0511.pdf), Porto Romano (http://www.scribd.com/doc/72026971/131/Ndikimet), Galati (http://www.mediu.gov.md/file/Evenimente/Memoriu%20de%20prezentare.pdf), all accessed 3 April 2012.

(or grid square) resulting from a change in anthropogenic emissions from each individual emitter. Such matrices are generated by reducing emissions for each emitter of one or more precursors by a given percentage (15% in this case), running the EMEP model with these reduced emissions, and comparing the resulting output fields with the base simulation, i.e. a simulation without any emission reduction. The reason for this procedure is to keep the chemical conditions as close to the original conditions as possible." SOMO uses new matrices that were prepared for the EEA report.[13] These matrices were not published but they were obtained from the authors of the report and are included in Appendix 1. As the dispersion of emissions from different industrial sources depends on factors such as stack height and flue gas velocity and temperature, sectoral adjustment factors are used to adjust the source-receptor matrices to reflect impacts from the power sector. The last step is using risk factors based on epidemiological studies to estimate health impacts resulting from the increases in ambient $PM_{2.5}$ and ozone concentrations. For example, it is estimated that if the ambient concentration of $PM_{2.5}$ increases by 10 µg/m^3 for a year, there will be approximately six premature deaths per 100,000 people.

2.1.1. Health effects and associated risk factors

Table 1: PM2.5 health effects quantified and risk factors used[14]

Health end-point	Cases per µg/m^3/person/year exposure
Chronic mortality (premature deaths)	6.07E-05
Chronic mortality (life years lost)	6.51E-04
Infant mortality (1 – 11 months)	1.05E-07
Chronic bronchitis, population aged over 27 years	2.85E-05
Respiratory hospital admissions, all ages	1.08E-05
Cardiac hospital admissions, all ages	6.68E-06
Restricted activity days (RADs) working age population	6.06E-02
Respiratory medication use by adults	5.14E-03
Respiratory medication use by children	6.21E-04
Lower respiratory syndromes (LRS), including cough, among adults with chronic symptoms	4.91E-02
LRS (including cough) among children	3.19E-02
Consultations for asthma, ages 0-14	3.08E-05
Consultations for asthma, ages 15-64	5.29E-05
Consultations for asthma, ages over 65	2.31E-05
Consultations for upper respiratory symptoms (excluding allergic rhinitis) ages 0-14	1.05E-04
Consultations for upper respiratory symptoms (excluding allergic rhinitis) ages 15-64	3.35E-04
Consultations for upper respiratory symptoms (excluding allergic rhinitis) ages over 65	1.13E-04
Restricted activity days, non-working age population	2.96E-02

[13] EEA, Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011 (Copenhagen: European Environment Agency, 2011).

[14] Holland, M., Pye S., Watkiss P., Droste-Franke B. & Bickel P, Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas(Didcot, UK: AEA Technology Environment, 2005), p.9.

Table 2: Ozone health effects quantified and risk factors used[15]

Health end-point	Cases per 10 µg/m^3/person/year increase in 8-hour daily average ozone[16]
Acute mortality (life years lost)[17]	1.80E-08
Respiratory hospital admissions, ages over 65	1.02E-08
Minor restricted activity days, ages 18-64	4.06E-05
Respiratory medication use by adults	1.48E-05
Minor restricted activity days, ages over 65	1.00E-05
Respiratory symptoms among adults	1.89E-04

2.1.2. Sample calculations

This section provides some sample calculations using the example of the Enel's Federico II coal-fired power plant in Italy. The source notes for all data and factors employed in these calculations are given below.

Table 3: Sample calculation of premature deaths and economic losses from $PM_{2.5}$ associated with Enel's Federico II coal-fired power plant in Italy

	PM10	NOx	SO2
Emissions, tonnes per year	473	7,300	6,540
		TIMES	
PM_{10} to $PM_{2.5}$ conversion factor	0.649	1	1
		TIMES	
Emissions-to-concentration factors for Italy	703.69	156.66	153.84
		TIMES	
Power sector adjustment factors	0.5	0.78	0.87
		EQUALS	
Increase in population-weighted concentrations, µg/m^3/person		1,875,407	
		TIMES	
Risk factor for chronic premature deaths		6.0665×10^{-5}	
		EQUALS	
Amount of premature deaths caused per year		113.77	
		TIMES	
Value of statistical life, M€		2.00	
		EQUALS	
Economic losses due to premature deaths, M€		227.54	

[15] Holland, M., Pye S., Watkiss P., Droste-Franke B. & Bickel P, Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas(Didcot, UK: AEA Technology Environment, 2005), p.10.

[16] As health impacts of ozone at concentrations below 35 parts per billion are not directly proven by epidemiological studies, the ozone concentrations used by EEA are SOMO35 (sum of mean ozone over 35 ppb).

[17] An average loss of life expectancy amongst those affected of 1 year is estimated.

Table 4: Sample calculation of premature deaths and economic losses from ozone associated with Enel's Federico II coal-fired power plant in Italy

	PM10	NOx	SO2
Emissions, tonnes per year	473	7,300	6,540
		TIMES	
Emissions-to-concentration factors for Italy	0	54,142	-9,496
		TIMES	
Power sector adjustment factors	0.5	0.78	0.87
		EQUALS	
Increase in population-weighted concentrations, µg/m^3/person		6,630,231	
		TIMES	
Risk factor for chronic premature deaths		1.7985×10^{-8}	
		EQUALS	
Amount of premature deaths caused per year		4.57	
		TIMES	
VOLY[18] (€ million)		€0.12	
		EQUALS	
Economic losses due to premature deaths (€ million)		0.549	

The same calculation is repeated for each health effect quantified. The valuation for CO_2 emissions was derived from EEA report, which assumes €33.6/tonne CO_2 and is based on methodology created by the UK government.[19]

Table 5: Source notes for numbers

Data	Reference
Emissions, tonnes per year	EC DG ENV[20]
PM10 to PM2.5 conversion factor	EEA[21]
Power sector adjustment factors	EEA[22]
Emissions-to-concentration factors for Italy	Holland et al[23]
Risk factor for chronic premature deaths	Holland et al[24]
VSL/VOLY, € million	Holland et al[25]

[18] The EEA analysis did not apply the VSL to ozone deaths because they were all linked to short term exposure to ozone (the PM analysis looked at response functions dealing with long term exposure).

[19] EEA, Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011 (Copenhagen: European Environment Agency, 2011), p.21.

[20] EC DG ENV, European Pollutant Release and Transfer Register (E-PRTR) : Summary tables. (Brussels: European Commission Directorate-General for Environment, 2011). Available at http://www.eea.europa.eu/data-and-maps/data/member-states-reporting-art-7-under-the-european-pollutant-release-and-transfer-register-e-prtr-regulation-4.

[21] EEA, Revealing the costs of air pollution from industrial facilities in Europe: EEA Technical Report No 15/2011 (Copenhagen: European Environment Agency, 2011), p.19.

[22] Ibid, p.68-9.

[23] Holland, M., Pye S., Watkiss P., Droste-Franke B. & Bickel P, Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas(Didcot, UK: AEA Technology Environment, 2005), p.23-24.

[24] Ibid, p.9-10.

[25] Ibid, p.9.

2.1.3. Limitations of the EEA methodology and potential impact on results

The EEA report upon which the calculations are based mentions that impact assessment and valuation methodologies are imperfect and are continuously being improved and refined. This implies that the methods employed to calculate damage costs are expected to be adjusted in future calculations. However, while the specific values of the quantified health impacts and economic costs may shift upward or downward as a result of fine-tuning the methodology, the overall direction and magnitude of the impacts are not likely to change. The EEA does not anticipate any major changes in results for importance of individual sectors and pollutants.[26]

The E-PRTR database from which the emission numbers for the calculations are taken is not an ideal database. Emissions are reported by industrial facilities themselves, and are not checked carefully by authorities. As it is assumed that no operator has interest in overstating its own emissions, the E-PRTR emissions data will more probably be underestimations than overestimations. Also, there is a threshold for reporting emissions under which emissions do not have to be reported. Another drawback of the E-PRTR database is that fuel consumption is not reported. Doing so would provide users with a more complete picture of the relative performance of a plant.

Damage cost calculations always contain uncertainties. They depend on the choice of exposure methods, dispersion models, and estimations of the impact of pollutants. These choices always involve a trade-off. The EEA has carefully chosen to work with methods and numbers that should not overestimate costs. For example, it is still unclear what the costs of greenhouse gas (GHG) emissions will eventually be for society, and estimates vary heavily. In the present report, we have chosen to always use the most conservative estimations from the EEA report. Thus, for GHG emissions, it was chosen to use the value of €33.6 per metric tonne assumed by the EEA[27]. While the current quotation for CO_2 on pointcarbon.com is around €7/t, many economists and environmental agencies expect that this value should and will be much higher. For example, the International Energy Agency projects in its *World Energy Outlook 2010* that the CO_2 price may rise to US$120 per tonne by 2035.[28]

Finally, it should be noted that the EEA methodology does not, nor was it intended to, include the socio-economic benefits of electricity production from power plants.

Despite these limitations, SOMO believes that the EEA report provides a sound methodological basis for estimating the public health impacts and associated costs of Enel's power plants.

2.2. Methods for calculating investments in new generation capacity: current construction works vs. future plans

In section 4.1 on Enel's investments in new electricity generation capacity, a distinction is made between current construction works and the company's future plans for investment. Current construction works are projects that are already under construction for which the Euros are already flowing, meaning that investment amounts are relatively certain (realizing, of course, that construction projects sometimes run over budget). On the other hand, future plans refer to

[26] EEA report *Revealing the costs of air pollution from industrial facilities in Europe*, p.12.

[27] It can also be argued that using marginal abatement cost is appropriate to valuate costs of CO2 emissions, which would be $70/ton for a 2 degree global warming scenario minimally.

[28] International Energy Agency, *World Energy Outlook 2010*, table 1.5: CO2 Price assumptions in selected regions by scenario ($ per tonne).

investment projects for which construction has not yet started and thus for which there remains a very real possibility that the company may still modify or cancel the project. Projects and investment figures for the latter category are far less certain and should thus be viewed with a higher degree of reservation.

It should be noted that construction works that were completed in 2011 are still included as ongoing construction works in this report. This is due to the fact that at time of writing this report (first quarter of 2012), the most recent information on Enel's investments and plans were its 2010 Annual, Sustainability and Environmental reports (see section 3.4), which include 2011 projects as on-going projects. On 8 March 2012, Enel published its "2011 Results & 2012-2016 Plans" presentation[29], but this does not contain comprehensive information on specific investments in electricity generation projects.

Finally, it should be noted that future investment plans are often announced, and an amount of money is mentioned without specifying the projects for which this money is reserved. In such cases, there is a high risk of 'double counting', as some of the projects for which this money is reserved have been announced, while others have not. It is often not specifically mentioned whether these projects are part of the overall announced investment budget or not. For this reason, overall investment figures that are not assigned to particular investment projects are not taken up in the tables for investment plans. However, they are mentioned in the text where relevant.

2.3. Methods used to calculate future employment generation

In section 4.2, SOMO estimates the employment that will be generated by the new capacity that Enel is currently constructing and planning. Future employment generation calculations are based on the methodology developed by Greenpeace International and the European Renewable Energy Council.[30] The method distinguishes between the number of 'person years' per MW installed capacity that will be created during the construction/manufacturing/installation period of a power plants and the jobs per MW installed capacity that are created and will continue to be required during the entire operational life time of a power plant. The calculations are based on the total nameplate capacity planned for each electricity generation technology (i.e. coal, hydro, wind, etc).

2.4. Methods used in the hypothetical scenario in Chapter 5

The scenario in chapter 5 is based on proposals by the European Renewable Energy Council and Greenpeace International[31] related to developing an electricity supply system based on renewable energy sources. Greenpeace's investment cost assumptions and predicted employment figures for various energy sources in 2020 and 2030 have been used as a basis for the calculations. The renewable energy breakdown was proposed by Greenpeace, and also took into consideration which options seem most appropriate for the Italian situation given technical potentials.

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[29] Enel presentation "2011 Results 2012-2016 Plans", 8 March 2012, Enel website, Investor, Presentations, 2012 <http://www.enel.com/en-GB/investor/annual_presentations/presentazione.aspx?id=2012_02> (03/03/2012).

[30] Greenpeace International and European Renewable Energy Council, "Energy [R]evolution – A sustainable world energy outlook", June 2010, p. 138, http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf.

[31] Greenpeace International and European Renewable Energy Council, "Energy [R]evolution – A sustainable world energy outlook", June 2010, p. 138, http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf.

3. What is Enel today?

3.1. Basic company information

Enel SpA[32] is an Italian multinational energy company, headquartered in Rome and listed on the Milan stock exchange. It is the largest power company in Italy, Spain, Slovakia and a number of major Latin American countries and is Europe's second-largest utility by installed capacity.[33] It is an integrated player which produces, distributes and sells electricity and gas. After the acquisition of the Spanish utility Endesa, Enel is now present in 40 countries with around 97,000 MW installed capacity and it serves 61 million power and gas customers.[34] Enel operates power plants for hydroelectric, thermoelectric, nuclear, geothermal, wind and photovoltaic power generation in 23 countries worldwide.[35] Enel's shares are divided among 1.4 million shareholders, the largest of which is the Italian Ministry for the Economy and Finance with 31.24% of shares.[36] Other shareholders include investment funds, pension funds and insurance companies.

3.1.1. Divisions

Four of Enel's divisions are involved in the generation of electricity. The Generation and Energy Management Division is responsible for the generation and sale of electricity in Italy and the trading on domestic and international markets. The Iberia and Latin America Division focuses on developing Enel's presence and coordinating its operations in the electricity and gas markets of Spain, Portugal and Latin America. The mission of the International Division is to support Enel's strategies for international growth, as well as to manage and integrate the foreign businesses not included in the Iberia and Latin America Division. The Renewable Energy Division develops and manages renewable energy operations worldwide. Table 6 gives an overview of where these divisions are active. In December 2008 Enel established Enel Green Power, the Group's company dedicated to developing and managing worldwide energy generation from renewable sources, operating around 6,500 MW in plants relying on hydro, wind, geothermal, solar and biomass sources in 16 countries in Europe and the Americas.[37] This subsidiary falls under the Renewable Energy Division.

Table 6: Enel's divisions and areas of activity

Division	Area
Generation and Energy Management	Italy
Iberia and Latin America	Spain, Portugal, Latin America, Ireland
International Division	France, Belgium, Central and South-Eastern Europe, Russia
Renewable Energy Division (incl. Enel Green Power)	Italy, Europe, Americas

[32] SpA stands for Società per Azioni and can be translated as joint stock company; a limited liability corporation.
[33] Enel company profile, 30 September 2011, http://www.enel.com/en-GB/doc/group/profile/Enel_Company_profile_30_09_2011.pdf.
[34] Enel company profile, 30 September 2011, http://www.enel.com/en-GB/doc/group/profile/Enel_Company_profile_30_09_2011.pdf.
[35] Enel website, Group, About us, Business, Production, http://www.enel.com/en-GB/group/about_us/business/production/index.aspx (01/02/2012).
[36] Enel company profile, 30 September 2011, http://www.enel.com/en-GB/doc/group/profile/Enel_Company_profile_30_09_2011.pdf.
[37] Enel Green Power website, About us, Where we operate, http://www.enelgreenpower.com/en-GB/company/worldwide/ (01/02/2012).

3.1.2. Financial results

In 2010, Enel generated just over EUR 73 billion in revenue, of which was EUR 64 billion was earned through electricity sales and transport. In comparison with 2009, revenues went up, which is attributed to increased sales and trade of electricity by the Iberia and Latin America Division and increased production and sale of electricity in Russia. The company's net income declined from €5.5 billion in 2009 to €4.3 billion in 2010, which is, according to the company, a result of the change in the method used to consolidate Endesa in the mother company.[38] For details on Enel's key financial results, see Table 7.

Table 7: Key results of the Enel Group 2009-2010, in EUR millions

Results	2010	2009
Total revenues	73,377	64,362
Revenues from electricity sales and transport	64,045	56,285
Operating income	11,258	11,032
Group net income	4,390	5,586

Source: Enel[39]

3.1.3. Market share

Enel is the leading producer and supplier of electricity in Italy. It has a market share of 41% of overall electricity sales to end-users, which includes both the regulated distribution and the free market.[40] In 2010 the company produced 24% of the total Italian electricity production, which meant a slight decrease (of 4%) compared to the previous year, due to reduced water availability.[41]

After EDF, E.ON, RWE, GDF Suez and Vattenfall, Enel is the sixth largest electricity producer in Europe (see Figure 1). It is the fourth largest (after EDF, E.ON and RWE) in consolidated electricity sales across the continent.[42] Enel is market leader in electricity production and sales in Italy, on the Iberian Peninsula through its subsidiary Endesa and Slovakia through Slovenské Elektrárne (SE) and has a significant presence in Romania.[43]

[38] In 2009 Enel completed the purchase of Endesa by buying 25.01% of the Endesa shares from Acciona. Enel press release, "ENEL COMPLETES ACQUISITION OF 25.01% OF ENDESA", 25 June 2009, http://www.enel.com/eWCM/salastampa/comunicati_eng/1616109-2_PDF-1.pdf.

[39] Enel website, Group, About us, Business, Results, http://www.enel.com/en-GB/group/about_us/business/results/ (01/02/2012).

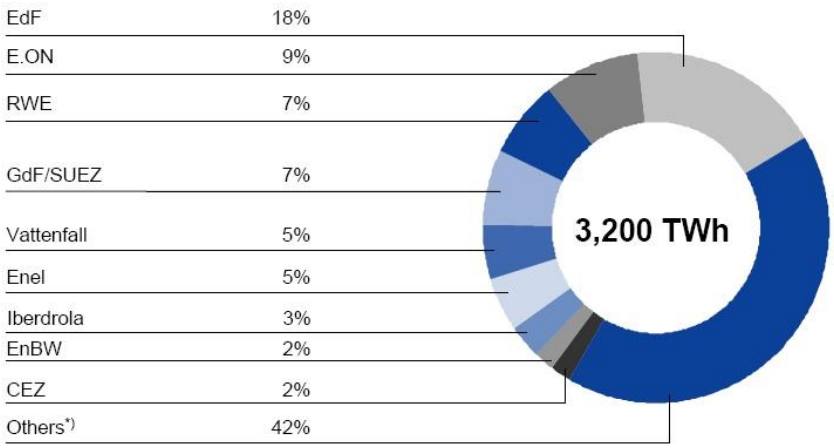
[40] Data for the year 2008, C. Schulke, "The EU's major electricity and gas utilities since market liberalization", Institut Francais de Relations Internationales, 2010, p. 79., http://www.scribd.com/doc/46591974/The-EU-s-Major-Electricity-And-Gas-Utilities-Since-Market-Liberalization (03/02/2012).

[41] Enel Annual Report 2010, p. 13.

[42] RWE presentation, "Facts & Figures | Update August 2011", p. 133, http://www.rwe.com/web/cms/mediablob/en/108808/data/114404/33/rwe/investor-relations/events-presentations/factbook/Facts-Figures-2011.pdf (03/02/2012).

[43] C. Schulke, "The EU's major electricity and gas utilities since market liberalization", Institut Francais de Relations Internationales, 2010, p. 205.., http://www.scribd.com/doc/46591974/The-EU-s-Major-Electricity-And-Gas-Utilities-Since-Market-Liberalization (03/02/2012).

Figure 1: Largest companies in electricity generation in Europe, 2010



Source: RWE[44]

3.1.4. Countries

In 2010, Enel was present in 40 countries globally, with electricity production facilities installed in 23 of them.[45] The company's biggest and most important market is its home country Italy, followed by the Iberian Peninsula, Latin America and Russia. Table 8 shows a list of countries and regions where Enel has production facilities with installed capacities and the amounts of electricity generated in 2010. In its sustainability report, the company does not report separately on its production figures for certain countries, which is the reason that the regions Iberian Peninsula (Spain and Portugal), Latin America (Costa Rica, Guatemala, Panama, Mexico, Brazil, Chile, Argentina, Colombia, Peru and El Salvador) and North America (the United States and Canada) are grouped together.

Table 8: Countries/regions where Enel has production activities, 2010

Country/region	Installed capacity (MW)	Electricity generated (GWh)
Italy	40,522	81,600
Iberian Peninsula	23,810	69,900
Latin America	16,267	66,000
Russia	8,198	42,800
Slovakia[46]	5,401	21,000
Ireland	1,013	300
Bulgaria	850	4,700
North America	788	2,600
Greece	143	300
Morocco	123	700
France	102	100
Central Europe (Romania)	64	4
Total	**97,281**	**290,200**

Source: Enel[47]

[44] RWE presentation, "Facts & Figures | Update August 2011", p. 105, http://www.rwe.com/web/cms/mediablob/en/108808/data/114404/33/rwe/investor-relations/events-presentations/factbook/Facts-Figures-2011.pdf (03/02/2012).

[45] Enel Sustainability Report 2010, p. 10.

[46] The values for Slovakia include the Gabcikovo hydro plant with a net capacity of 739 MW which is managed, but not owned by Enel.

3.2. Public financial support for coal-based electricity generation

Enel has been granted a subsidy of €100 million by the European Union for its new Porto Tolle coal-fired power plant, primarily for the carbon capture and storage (CCS) 'demonstration' part of the plant, but also for the employment of new technology in the combustion process (the plant will be converted from oil-firing to coal-firing). Enel is also seeking financial support for the project from the Italian government.[48]

3.3. Use of the Clean Development Mechanism

In 2010, Enel was implicated in what has been called "the biggest environmental scandal in history"[49], involving greenhouse gas offsets under the Clean Development Mechanism (CDM) of the Kyoto Protocol. The CDM is described by the United Nations Framework Convention on Climate Change as allowing "emission-reduction projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2. These CERs can be traded and sold, and used by industrialized countries to a meet a part of their emission reduction targets under the Kyoto Protocol. The mechanism stimulates sustainable development and emission reductions, while giving industrialized countries some flexibility in how they meet their emission reduction limitation targets."[50]

The CDM appeared to contain a particularly perverse incentive related to the production and destruction of HCF-23. HCF-22, a chemical which is used for air conditioning and refrigeration, is forbidden in Europe but is still being produced in India and China. HCF-23 is a by-product of the HCF-22 production process and is an extremely strong greenhouse gas. By subsequently destroying the HCF-23, manufacturers of HCF-22 could receive carbon credits, which could be sold to large emitters of greenhouse gasses, such as Enel, to offset their own emissions.

Although HCF-23 represents less than 1% of registered CDM projects, HCF-23 project credits account for half of the 450 million carbon offsets issued by 2010. Selling HCF-23 projects was a profitable business for the producers of HCF-22, incentivising an unnecessary overproduction HCF-23 simply to be subsequently destroyed for CER credits.

When the EU planned to install a ban on HCFs, Enel lobbied intensively to have the ban postponed or cancelled. The company was then heavily criticised by the Environmental Investigation Agency and CDM Watch, who declared this "relentless lobbying" and described Enel's "cynical manipulation" of various European departments.[51]

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[47] Enel Sustainability Report 2010, p. 258 and p. 261.

[48] Ibid, p. 58.

[49] Quote Mark Roberts of the Environmental Investigation Agency, cited from website The Huffington Post, *UN Trading Scheme : $2.7 Billion Market Could Be 'Biggest Environmental Scandal in History',* 21 August 2010. http://www.huffingtonpost.com/2010/08/23/un-carbon-trading-scheme-_n_690958.html Viewed 24 April 2012.

[50] Cited from website United Nations Framework Convention on Climate Change. http://cdm.unfccc.int/about/index.html Viewed 24 April 2012.

[51] Bloomberg website. 18 November 2010. *Enel, RWE Lobbying Delays EU Curbs on Carbon Offsets.* Viewed 23 February 2012. http://www.bloomberg.com/news/2010-11-18/enel-rwe-lobbying-delays-curbs-on-un-offsets-cdm-watch-says.html.

3.4. Installed capacity and electricity production

In its annual report, Enel provides information on its installed capacity and electricity generated broken down by business divisions. In order to be able to determine the company's capacity and generation figures for Italy, Europe and the company as a whole, data from the company's 2010 Sustainability Report and the "2010 Results & 2011-2015 Plans" presentation[52] are used, meaning that the base year for all installed capacity and production figures is 2010. On 8 March 2012, Enel published its "2011 Results & 2012-2016 Plans" presentation[53], but the information provided in this report is much less detailed than what was already gathered for the 2010 year, so it was decided to maintain the 2010 figures for capacity and production (2010 is also used as the base year for calculating Enel's investments in section 4.1.)

This chapter presents Enel's figures on installed capacity and generated electricity for the company as a whole, for its production in Europe and for its production in Italy for the year 2010.

It has to be noted that Enel doesn't make a distinction between oil-fired and traditionally operated natural gas plants in its categorizations. The differentiation Enel makes is on the one hand Combined Cycle Gas Turbine (CCGT) gas plants and on the other hand gas plants with Open Cycle Gas Turbines (OCGT) and Steam Turbine (ST) oil plants. These categories are also used in this chapter.

3.4.1. Global

Globally, Enel's main source of power is natural gas: 40% of its installed capacity is composed of gas fired installations (OCGT and CCGT combined).[54] Gas is followed by hydropower with 32% and coal with 19% of the company's total installed capacity. Nuclear power (5%) and wind (3%) have a relatively small share in Enel's capacity.

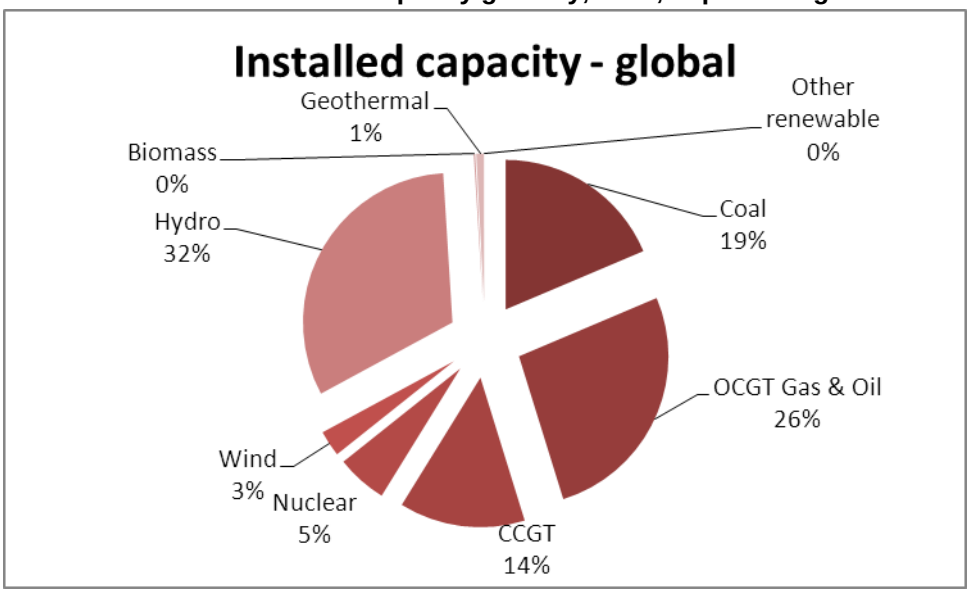
Figure 2 shows the fuel mix of Enel's global generation capacity.

[52] Enel presentation "2010 Results 2011-2015 Plans", 15 March 2011, pp. 59-62, Enel website, Investor, Presentations, 2011, http://www.enel.com/en-GB/investor/annual_presentations/?anno_curr=2011&anno_iniziale=2012&anno_finale=2005&id= (03/02/2012).

[53] Enel presentation "2011 Results 2012-2016 Plans", 8 March 2012, Enel website, Investor, Presentations, 2012 <http://www.enel.com/en-GB/investor/annual_presentations/presentazione.aspx?id=2012_02> (03/03/2012).

[54] It has to be noted that in this figure also the oil fired power plants have been calculated.

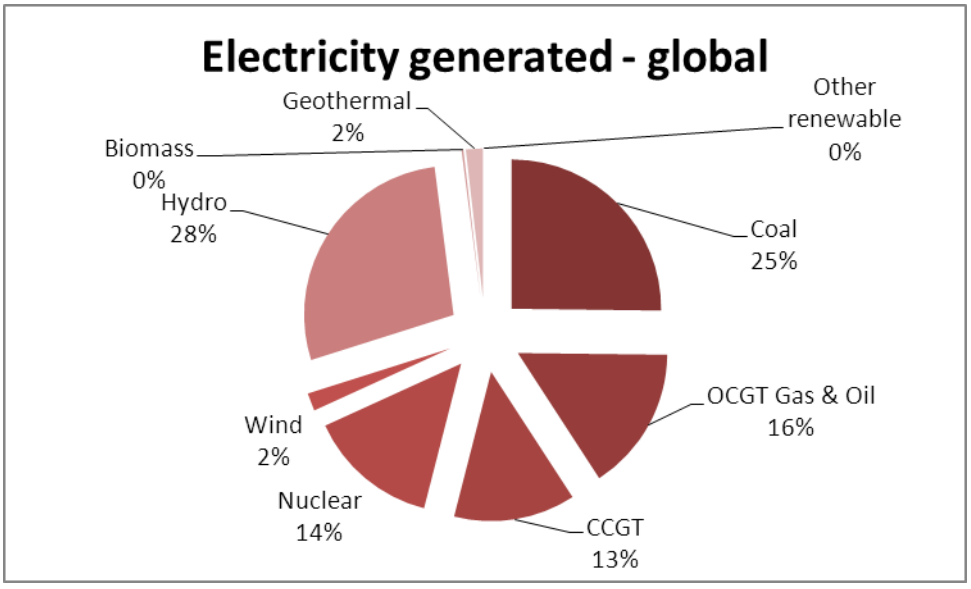
Figure 2: Fuel mix of Enel's installed capacity globally, 2010, in percentages



When it comes to the actual usage of Enel's power plants, we get a slightly different picture. In 2010, the company generated almost the same amount of electricity from natural gas (OCGT and CCGT together)[55], hydropower and coal: 29%, 28% and 25% of its total generated electricity, respectively. Nuclear power amounted for 14% of the total generation figures worldwide.

Figure 3 shows the fuel mix of the electricity that was generated by Enel in 2010 globally.

Figure 3: Fuel mix of Enel's electricity generated globally, 2010, in percentages



Enel's 2011 figures for electricity generated globally are similar, yet indeed slightly different: coal 29.3%, hydro 23.9%, CCGT 16.2%, nuclear 13.4%, OCGT 12.9%, and other renewables (wind, solar, geothermal, biomass) 4.3%.[56]

[55] The figures for OCGT also contain the figures for oil fired power plants.

[56] Enel presentation "2011 Results 2012-2016 Plans", 8 March 2012, Enel website, Investor, Presentations, 2012 <http://www.enel.com/en-GB/investor/annual_presentations/presentazione.aspx?id=2012_02> (03/03/2012).

Table 9 shows the absolute figures for Enel's fuel mix of installed capacity (in MW) and generated electricity (in GWh) in 2010.

Table 9: Fuel mix of Enel's installed capacity and electricity generated globally, 2010

Fuel type	Installed Capacity (MW)	Electricity generated (GWh)[57]
Coal	18,122	73,100
OCGT Gas & Oil	25,852	45,400
CCGT	13,248	38,200
Nuclear	5,332	41,200
Wind	2,731	5,600
Hydro	31,033	80,800
Biomass	154	600
Geothermal	775	5,300
Other renewable	34	30
Total	**97,281**	**290,200**

Source: Enel[58]

Enel's global hydroelectric capacity is the sum of hydro plants from natural flows (21,195 MW) and pumped storage facilities (9,839 MW).[59] Although pumped storage is generally not considered to be a renewable source of energy, it should be given a separate category and not included along with hydro. However, nearly all of the figures on fuel mix and production provided by Enel do include pumped storage along with hydro.

3.4.2. Europe

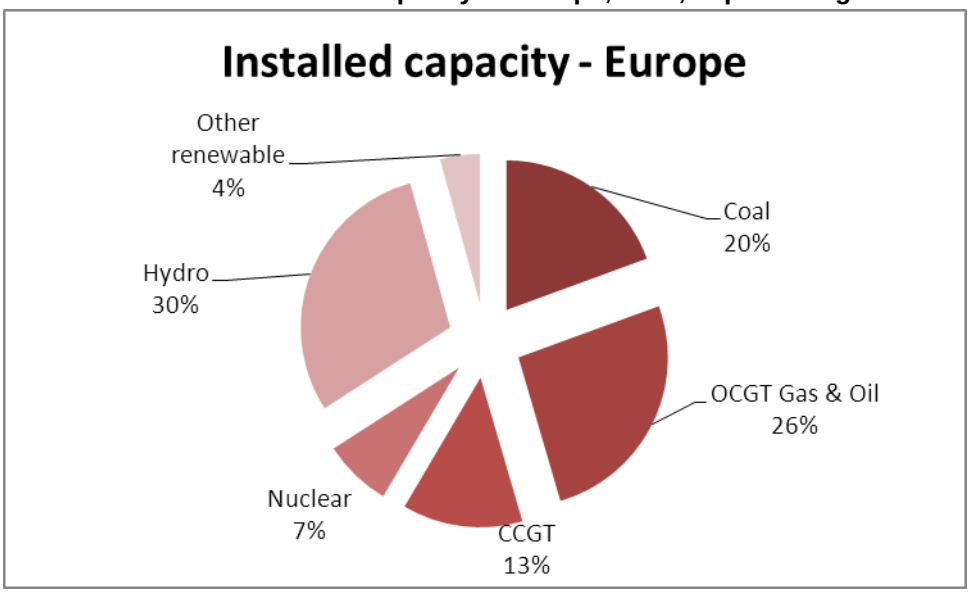
Enel reports on its capacity and generation figures in somewhat different manner for its global operations than when it comes to the regions where the company operates. For its regional breakdown, the thermal (coal, OCGT gas & oil and CCGT) and nuclear categories are maintained; however, when it comes to renewables, the only two categories are hydro and "other renewable" (wind, solar, geothermal, biomass together). Enel's categorization is followed when presenting the European figures for capacity and generation in this paragraph.

In Europe, Enel's main source of power is natural gas with 39% (26% OCGT gas & oil + 13% CCGT) of its total installed capacity, followed by 30% hydro, 20% coal, 7% nuclear and 4% "other renewable".

Figure 4 shows the fuel mix of Enel's installed capacity in Europe.

[57] See for more detailed figures on generated electricity for the year 2010: Enel Environmental Report 2010, p. 90 and p.93.
[58] Enel Sustainability Report 2010, p. 258 & p. 261.
[59] Enel Environmental Report 2010, p. 46.

Figure 4: Fuel mix of Enel's installed capacity in Europe, 2010, in percentages



The actual electricity generated by Enel's plants in Europe differs substantantially from the percentages of the company's installed capacity. Figure 5 shows the fuel mix of the electricity that was generated by Enel in Europe in 2010.

Figure 5: Fuel mix of Enel's electricity generated in Europe, 2010, in percentages

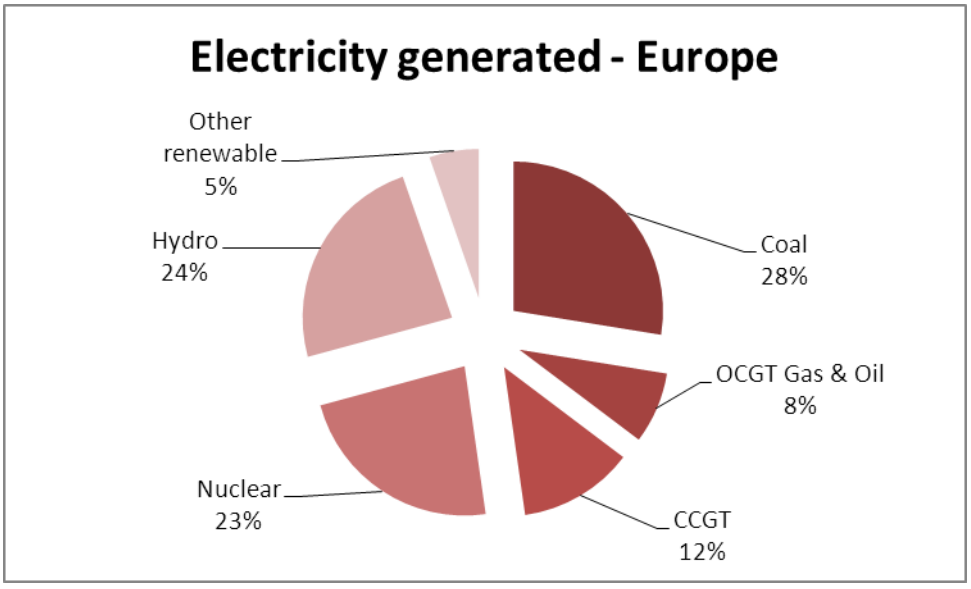


Table 10 shows the absolute figures for Enel's European fuel mix of installed capacity (in MW) and generated electricity (in GWh) in 2010.

Table 10: Fuel mix of Enel's installed capacity and electricity generated in Europe, 2010

Fuel type	Installed Capacity (MW)	Electricity generated (GWh)
Coal	13,990	49,252
OCGT Gas & Oil	18,758	13,816
CCGT[60]	9,380	22,236
Nuclear	5,332	41,153
Hydro	21,460	42,649
Other renewable	3,110	9,570
Total	**72,030**	**178,676**

Source: Enel[61]

3.4.3. Italy

Enel categorizes its capacity and generation figures for Italy in the same way as it does for the other regions it operates: coal, OCGT gas & oil, CCGT, nuclear, hydro and "other renewable" (wind, solar, geothermal and biomass). However, Enel does not have any nuclear power plants in Italy.

In its home market Italy, 45% of Enel's plants are fuelled by natural gas (30% OCGT & oil and CCGT together), followed by hydro energy (35%), coal (17%) and "other renewable" (3%).

Figure 6 shows the fuel mix of Enel's installed capacity in Italy.

Figure 6: Fuel mix of Enel's installed capacity in Italy, 2010, in percentages

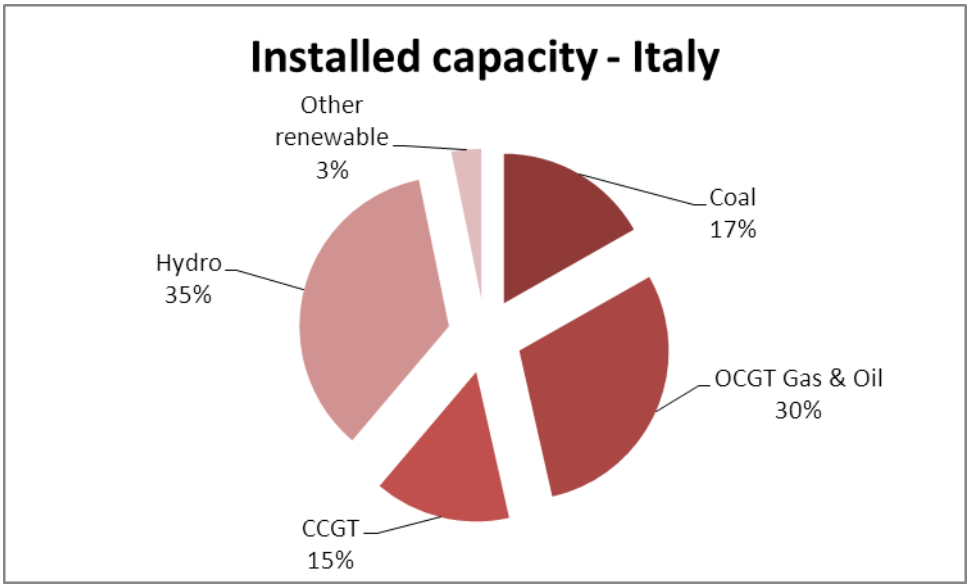


Figure 7 shows the fuel mix of the electricity that was generated by Enel in Italy in 2010.
Enel generated almost the same amount of electricity from coal and hydropower, both 34% of its total generation figures. Natural gas was used for 25% of the generation activities (22% CCGT and 3% OCGT gas & oil), while "other renewables was good for 7% of all electricity generated in 2010.

[60] Figures for CCGT include 123 MW of installed capacity and 689 GWh electricity generation in Morocco.

[61] The figures for installed capacity and electricity generation are composed of the figures for "Italy", "Iberia", "Centrel", and "SEE", as presented in the Enel presentation, "2010 Results 2011-2015 Plans", 15 March 2011, pp. 59-60, Enel website, Investor, Presentations, 2011, http://www.enel.com/en-GB/investor/annual_presentations/?anno_curr=2011&anno_iniziale=2012&anno_finale=2005&id= (03/02/2012).

Figure 7: Fuel mix of Enel's electricity generated in Italy, 2010, in percentages

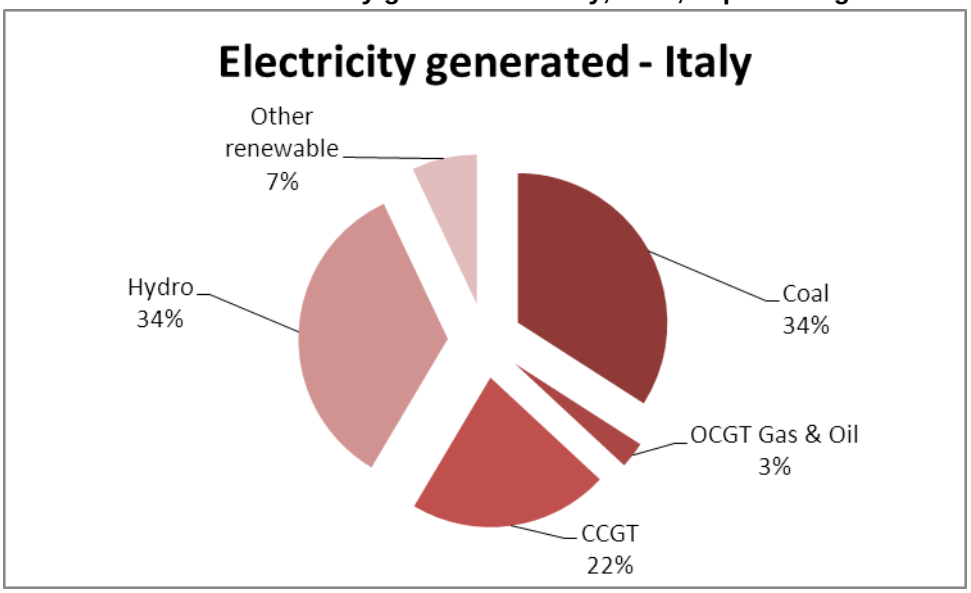


Table 11 shows the absolute figures for Enel's European fuel mix of installed capacity (in MW) and generated electricity (in GWh) in 2010.

Table 11: Fuel mix of Enel's installed capacity and electricity generated in Italy, 2010

Fuel type	Installed Capacity (MW)	Electricity generated (GWh)
Coal	6,804	27,798
OCGT Gas & Oil	12,021	2,313
CCGT	5,973	17,632
Nuclear	-	-
Hydro	14,417	28,068
Other renewable	1,307	5,758
Total	**40,522**	**81,569**

Source: Enel[62]

3.5. Employment

As of 31 December 2010, Enel had a total employee base of 78,313 people, of which 37,383 were employed in Italy and 23,268 in Europe outside of Italy. The company reports on the number of staff it employs per country, for details, see Table 12.

[62] Enel presentation, "2010 Results 2011-2015 Plans", 15 March 2011, pp. 59-60, Enel website, Investor, Presentations, 2011, http://www.enel.com/en-GB/investor/annual_presentations/?anno_curr=2011&anno_iniziale=2012&anno_finale=2005&id= (03/02/2012).

Table 12: Employment at Enel, 2010

Country/Region	Number of employees
Italy	37,383
Europe (excl. Italy)	23,268
Iberian Peninsula	*12,393*
France	*83*
Greece	*56*
Romania	*4,706*
Bulgaria	*511*
Slovakia	*5,374*
Belgium	*36*
Ireland	*109*
Russia	4,233
North America	319
South America	12,940
Other	2
Total	**78,145**[63]

Source: Enel[64]

3.6. Emissions, waste, and the impact on public health of Enel's current fossil fuel and nuclear power production

3.6.1. Enel's environmental policy

Before an assessment and analysis of the environmental impacts of Enel's operations is conducted, it is worthwhile to review the company's environmental policy. Enel defines three principles[65] upon which its environmental policy is based: safeguarding the environment, improving and promoting the environmental features of products and services, and creating corporate value.

Furthermore, the company has formulated some strategic targets, of which the most important are the following[66]:

- Application of internationally-recognized environmental management systems: currently the ISO 14001 certifications and EMAS registrations.
- Optimized integration of installations and buildings into the landscape, while conserving biodiversity: biodiversity conservation and biomonitoring projects and the mitigation of the visual impact of the company's activities (e.g. power distribution lines, mines)
- Mitigation of environmental impacts: applying best available technologies (BATs) and best practices in construction, operation and decommissioning of installations.
- Enlarging the company's renewables capacity and low-emission electricity generation: also including nuclear plants and combined-cycle plants.
- Efficient use of energy, water and raw materials.
- Optimized management of waste and liquid releases: decrease of waste production and of the polluting load of liquid releases.
- Development of innovative technologies, including carbon capture and storage (CCS), thermodynamic, hydrogen and photovoltaic power and smart grids.

[63] This figure excludes the 168 employees working at Enel branches (Italian offices abroad).
[64] Enel Sustainability Report 2010, pp. 269-270.
[65] Enel Environmental Report 2010, p. 18.
[66] Enel Environmental Report 2010, p. 19.

- Promotion of environmentally-sustainable practices among suppliers and contractors: training and monitoring of suppliers' and contractors' environmental performance.

Enel has enthusiastically adopted the Clean Development Mechanism and Joint Implementation instruments of the Kyoto Protocol, and is heavily involved in the carbon trade market.[67] Enel an initiative by the EU electricity industry umbrella group EURELECTRIC to achieve a carbon-neutral European electricity industry by 2050. To achieve this, Enel's strategy in the short term, besides working on the strategic targets mentioned above, is to use international emission credits, while on the long-term (from 2025 onwards) the company claims to expects to emit significantly less CO_2, when zero-emission generating capacity becomes available on a larger scale.[68] Enel and its subsidiary Endesa are members of the Carbon Disclosure Project's (CDP) Supply Chain initiative, which commits its members to assess the greenhouse gas emissions in their supply chains.[69]

3.6.2. Carbon and climate

One of the best-known and most influential impacts of electricity production, especially thermal power generation, is the large-scale release into the atmosphere of carbon dioxide (CO_2). The emission of this gas, along with other greenhouse gases that are produced in power plants, leads to climate change. Energy companies have a very large impact on worldwide carbon emissions and can be held responsible for their significant contribution to climate change.

According to Enel, Enel's total, worldwide direct and indirect greenhouse gas emissions amounted to 122.6 million tons of CO_2-equivalent in 2010 or 116.4 million tons of direct emissions.[70] During that same year, the company produced 290,176 GWh.[71] The company reports having generated 389 kg CO_2/MWh(eq).[72]

In the European Union,[73] Enel produced 177,095 GWh in 2010 and thereby emitted approximately 67.8 million tons of CO_2, resulting in an emission intensity of 379 kgCO_2(eq)/MWh.[74] Total emissions in Italy amounted to 34.4 million tons of CO_2, or 34.5 million tons of CO_2-equivalent in 2010.[75] Having generated a total of 81,180 GWh[76], the Italian emission intensity thus amounted to 422 kg CO_2/MWh.[77] In its Environmental Report, Enel states that the Italian emissions are seeing a downward trend and that the performance of 422 kg CO_2 /MWh is remarkable when compared to the emissions of 618 kg CO_2 /MWh[78] in 1990, the base year of the Kyoto Protocol targets.

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67 Enel Environmental Report 2010, p. 178.
68 Enel Environmental Report 2010, p. 43.
69 Carbon Disclosure Project, "CDP Supply Chain 2011 – Members", https://webadmin.cdproject.net/en-US/Programmes/Documents/CDP-Supply-Chain-Members-2011.pdf
70 Enel Sustainability Report 2010, p. 179.
71 Enel SpA Investor Relations, 2010 Results, 2011-2015 Plan. 'Growth and rewarding returns with financial discipline'. London, March 15 2011. Pdf, p.60.
72 Enel Sustainability Report 2010, p. 179.
73 That is, in Portugal, Spain, Italy, Slovakia, Greece, Bulgaria, France , Romania and Ireland.
74 CO2 and CO2(eq) Emissions figures for Portugal, Spain, Italy, Slovakia, Bulgaria, France, Romania and Ireland together have been divided by production figures for these countries, resulting in 382 kg CO2(eq)/MWh. For figures, see Enel Environmental Report 2010, pp. 126-214.
75 Enel Environmental Report 2010, p. 151.
76 Enel Environmental Report 2010, p. 149.
77 Enel Environmental Report 2010, p.161.
78 Enel Environmental Report 2010, p. 161.

3.6.3. Impact on public health and costs of emissions to air

According to data drawn from the European Pollutant Release and Transfer Register (E-PRTR) of the European Environment Agency, which contains data from all major polluting industrial facilities in Europe, the energy sector is by far the leading air polluting sector in Europe. Damage costs from air pollution generated by the energy sector are out of proportion when compared to any of the other industrial sectors in Europe.[79] All of the top "highest damage" industrial sites in Europe are power generating facilities. Two of Enel's facilities are included in the E-PRTR list of industrial sites with the highest estimated damage costs from emissions to air. Enel's Slovak thermal power plant 'Elektrárne Nováky' is number 15 on the E-PRTR list of facilities with the highest estimated damage costs from emissions to air (excluding CO_2)[80], and the company's Italian thermal power plant Federico II in Brindisi is number 18 on the E-PRTR list of industrial facilities generating the greatest damage costs from emissions of selected pollutants to air (NOx, SOx, PM10, CO_2)[81]. Many of Enel's European thermal power plants are present in the top-191 facilities which generate 50% of all costs (€102-169 billion in 2009) to human health and to the environment.[82]

Using emission data from the E-PRTR and applying the EEA method described in section 2.1 above, the annual impacts on public health and associated financial costs of Enel's fossil-fuel based power plants in Europe can be calculated and quantified. Table 13 and Table 14 reveal the impacts based on the 2009 emissions from Enel's plants. In interpreting these results in both tables, the limitations of the EEA methodology, which are described in section 0, should be kept in mind.

[79] European Environment Agency, Technical Report No 15/2011. 'Revealing the costs of air pollution from industrial facilities in Europe', figures 3.6 and 3.7, p. 32.

[80] European Environment Agency, Technical Report No 15/2011. 'Revealing the costs of air pollution from industrial facilities in Europe', figure 3.5, p. 29.

[81] European Environment Agency, Technical Report No 15/2011. 'Revealing the costs of air pollution from industrial facilities in Europe', figure 3.1, p. 25.

[82] European Environment Agency website, viewed 23 February 2012. http://www.eea.europa.eu/pressroom/newsreleases/industrial-air-pollution-cost-europe.

Table 13: Emissions to air from Enel's fossil fuel-based power plants in Italy and the associated health and financial impacts, 2009

Enel facility	Emissions to air (t)				Exposure		Health and financial impacts associated with Enel emissions				
	PM 10	NOx	SOx	CO_2	$PM_{2.5}$	SOMO35 (ozone)	Prema-ture deaths	(€) Crop damages	Costs air pollution (€)	Costs CO_2 (€)	Total Costs (€)
Coal-fired plants											
Genova		3,320	4,910	1,670,000	1,062,840	99,641,016	66	575,313	152,761,077	56,112,000	208,873,077
Federico Ii (Brindisi Sud)	473	7,300	6,540	13,000,000	1,875,407	254,252,853	119	1,372,376	269,785,802	436,800,000	706,585,802
Eugenio Montale (La Spezia)	106	1,790	1,870	2,340,000	493,228	60,143,627	31	329,794	70,924,771	78,624,000	149,548,771
Torrevaldaliga Nord (Civitavecchia)		835	769	2,860,000	204,956	28,909,416	13	156,449	29,508,784	96,096,000	125,604,784
Sulcis	93	15	3,030	2,240,000	607,538	37,468,468	38	235,241	87,185,030	75,264,000	162,449,030
Fusina	104	2,500	2,010	4,300,000	598,268	88,970,832	38	475,788	86,121,948	144,480,000	230,601,948
Porto Marghera		380	284	315,000	84,445	13,701,359	5	72,863	12,167,398	10,584,000	22,751,398
Pietro Vannucci (Bastardo)	112	2,220	4,620	1,010,000	915,199	55,583,071	57	350,969	131,341,715	33,936,000	165,277,715
TOTAL COAL	**888**	**19,825**	**24,033**	**27,735,000**	**5,841,881**	**638,670,642**	**366**	**3,568,792**	**839,796,526**	**931,896,000**	**1,771,692,526**
Other (non-coal) fossil fuel-based power plants											
Piombino		322	671	475,000	129,153	8,054,681	8	50,884	18,541,876	15,960,000	34,501,876
Porto Corsini		360		990,000	43,991	15,203,078	3	75,816	6,380,618	33,264,000	39,644,618
Augusta		516	1,440	306,000	255,781	9,894,171	16	72,338	36,689,614	10,281,600	46,971,214
Porto Empedocle		369	329	262,000	89,123	12,865,042	6	69,411	12,833,187	8,803,200	21,636,387
Porto Tolle		127	250	208,000	48,979	3,297,873	3	20,439	7,032,895	6,988,800	14,021,695
Rossano		197		268,000	24,073	8,319,462	2	41,488	3,491,616	9,004,800	12,496,416
Livorno		301	794	240,000	143,049	6,151,640	9	43,358	20,522,395	8,064,000	28,586,395
Priolo Gargallo		529		1,600,000	64,642	22,340,079	4	111,407	9,375,964	53,760,000	63,135,964
La Casella		452		1,360,000	55,233	19,088,309	4	95,191	8,011,221	45,696,000	53,707,221
Leri		207		148,000	25,295	8,741,770	2	43,594	3,668,856	4,972,800	8,641,656

Table 13 continued

Enel facility	Emissions to air (t)				Exposure		Health and financial impacts associated with Enel emissions				
	PM $_{10}$	NOx	SOx	CO_2	$PM_{2.5}$	SOMO35 (ozone)	Prema-ture deaths	(€) Crop damages	Costs air pollution (€)	Costs CO_2 (€)	Total Costs (€)
Montalto Di Castro		998	1,210	2,650,000	283,897	32,149,604	18	179,651	40,833,154	89,040,000	129,873,154
Termini Imerese		950		2,020,000	116,087	40,119,234	8	200,070	16,837,743	67,872,000	84,709,743
Assemini		671		130,000	81,994	28,336,848	6	141,313	11,892,764	4,368,000	16,260,764
Maddaloni		210			25,661	8,868,462	2	44,226	3,722,027	0,00	3,722,027
Portoscuso		157		123,000	19,185	6,630,231	1	33,064	2,782,659	4,132,800	6,915,459
Bari				128,000	0	0	0	0	0	4,300,800	4,300,800
Pietrafitta		131		275,000	16,008	5,532,231	1	27,589	2,321,836	9,240,000	11,561,836
Santa Barbara		176		442,000	21,507	7,432,616	1	37,066	3,119,413	14,851,200	17,970,613
TOTAL NON-COAL FOSSIL FUEL		**6,673**	**4,694**	**11,625,000**	**1,443,658**	**243,025,331**	**94**	**1,286,905**	**208,057,838**	**390,600,000**	**598,657,838**
TOTAL ALL FOSSIL FUEL	**888**	**26,498**	**28,727**	**39,360,000**	**7,285,539**	**881,695,973**	**460**	**4,855,697**	**1,047,854,364**	**1,322,496,000**	**2,370,350,364**
Coal's percentage of the total (%)	**100**	**75**	**84**	**70**	**80**	**72**	**80**	**73**	**80**	**70**	**75**

Source: Emissions from E-PRTR Database. Calculations of health and financial impacts associated with emissions using EEA methodology

Table 14: Emissions to air from Enel's coal-fired power plants in Europe (ex-Italy) and the associated health and financial impacts, 2009

Enel facility	Emissions to air (t)				Exposure		Health and financial impacts associated with Enel emissions				
	PM_{10}	NOx	SOx	CO_2	$PM_{2.5}$	SOMO35 (ozone)	Prema-ture Deaths	(€) Crop damages	Costs air pollution (€)	Costs CO_2 (€)	Total Costs (€)
TETs "Enel Maritsa iztok 3" (BUL)		3,870	14,900	4,950,000	1,335,058	269,494,425	86	728,267	193,505,377	166,320,000	359,825,377
Central Termoelétrica do Pego (POR)	60	2,210	1,340	2,830,000	127,925	4,256,949	8	243,166	18,625,213	95,088,000	113,713,213
CENTRAL TERMICA DE ANDORRA (=Teruel) (SPAIN)		10,000	11,700	2,610,000	1,474,364	353,397,657	96	2,061,735	214,847,958	87,696,000	302,543,958
UPT COMPOSTILLA (SPAIN)	390	8,420	3,770	2,640,000	749,296	354,979,616	52	1,921,160	110,518,231	88,704,000	199,222,231
UNIDAD DE PRODUCCIÓN TERMICA AS PONTES (SPAIN)	264	7,460	4,990	5,220,000	800,393	298,929,636	54	1,651,883	117,439,796	175,392,000	292,831,796
CENTRAL TÉRMICA LITORAL DE ALMERÍA (SPAIN)	564	9,740	14,000	5,090,000	1,737,725	319,621,228	111	1,928,832	252,284,081	171,024,000	423,308,081
Slovenské elektrárne a.s. - Elektrárna Vojany, závod (SLOV)		1,390	446	898,000	263,353	115,708,980	18	385,748	38,927,755	30,172,800	69,100,555
Slovenské elektrárne a.s.-Elektrárne Nováky, závod (SLOV)		3,820	32,400	2,450,000	4,922,819	174,158,416	302	818,824	698,085,984	82,320,000	780,405,984
Total EU excluding Italy	**1,278**	**46,910**	**83,546**	**26,688,000**	**11,410,932**	**1,890,546,908**	**727**	**9,739,613**	**1,644,234,395**	**896,716,800**	**2,540,951,195**

3.6.4. Nuclear waste

Enel claims to be one of Europe's leading operators of nuclear power plants. Enel has no nuclear facilities in Italy, but it does produce nuclear power in 11 nuclear power plants in Slovakia and in Spain.[83] Enel is also planning to invest more in new nuclear facilities. The company is actively involved in nuclear forums in Italy and in the wider EU, works on enlarging nuclear production in Spain and Slovakia, and is collaborating with French company EdF on the construction of a new nuclear power plant, Flamanville 3, in France.[84] More information about these investment plans for nuclear energy can be found in section 4.1. Outside Europe, Enel has no nuclear facilities.

According to Enel, the Slovak nuclear power plants released the following radioactive materials into the atmosphere in 2010: 8.51 TBq of noble gases, 0.608 MBq of Iodine 131, 18.7 MBz of aerosoles beta and gamma, 6.49 kBq for aerosol alpha, and 74.7 kBq of strontium 89 and 90. Disposed radionuclides were 19,359 GBq of tritium.[85] The Spanish plants released 71,013 GBz of tritium in discharged waste waters, as well as corrosion and fission products: 10 GBq.
Atmospheric emissions were reported to be 15 TBq of noble gases, 89 MBq of iodine, 6,567 MGz of aeosol beta and gamma, 31 kBGq of aeosol alpha, and 2,896 kBq of strontium 89 and 90.[86]

In 2010, Enel had an installed nuclear capacity of 5,332 MW and produced 41,200 GWh, divided over Slovakia and Spain[87]. Assuming normal parameters in Enel's nuclear process, this amount of production leads to 149.8494 tons of spent fuel, 1387.023 t UF6 (which is 937.8790 tons of depleted U); 560911.1 tons of mill tailings; and 2810904 tons of waste rock at uranium mines.[88]

Enel states that by law, 'decommissioning and waste disposal are the exclusive responsibility of government organisations' in every country in which the Enel Group is active. [89] However, it should be noted that in many of the countries where nuclear waste is produced by third parties for the Enel Group, such as in uranium mining countries, nuclear waste is hardly managed at all.

[83] Enel website, viewed 24 February 2012. http://www.enel.com/en-GB/group/production/nuclear_power/enel/.
[84] Enel website, viewed 23 February 2012. http://www.enel.com/en-GB/sustainability/our_responsibility/enel_nuclear/.
[85] Enel Environmental Report 2010, p.191.
[86] Enel Environmental Report 2010, p.206.
[87] Enel website, viewed 23 February 2012. http://www.enel.com/en-GB/sustainability/our_responsibility/enel_nuclear/ownership.aspx?it=-3.
[88] Calculations carried out with Nuclear Fuel Chain Waste Activity Calculator , WISE Uranium Project. http://www.wise-uranium.org/nfca.html.
[89] Cited from Enel Sustainability Report 2010, p.199.

4. What will Enel be tomorrow?

4.1. Enel's investments in new electricity generation capacity worldwide

Enel's investments in new electricity generation capacity are classified into two distinct categories: current construction works and the company's future plans for investment. Current construction works are projects that are already under construction for which the Euros are already flowing, meaning that investment amounts are relatively certain (realizing, of course, that construction projects sometimes run over budget). On the other hand, future plans refer to investment projects for which construction has not yet started and thus for which there remains a very real possibility that the company may still modify or cancel the project. Projects and investment figures for the latter category are far less certain and should thus be viewed with a higher degree of reservation. A more thorough description of this distinction and the methods used for the compiling Enel's investments in new generation capacity can be found in section 2.2 of the methodology above.

This section opens with an overview of all Enel investments in new electricity generation capacity (i.e. current construction works plus future plans) around the world in sub-section 4.1.1. Subsequent sub-sections then present separately the current construction works in Europe and Italy (4.1.2) and the future plans in Europe and Italy (4.1.3). Finally, sub-section 4.1.4 lists all of Enel's investments (i.e. including both current construction and future plans) outside of Europe.

It should be noted that construction works that were completed in 2011 are still included as ongoing construction works in this report. This is due to the fact that at time of writing this report (first quarter of 2012), the most recent information on Enel's investments and plans were its 2010 Annual, Sustainability and Environmental reports (see section 3.4), which include 2011 projects as ongoing projects. On 8 March 2012, Enel published its "2011 Results & 2012-2016 Plans" presentation[90], but this does not contain comprehensive information on specific investments in electricity generation projects.

4.1.1. Overview of all Enel investments (current construction & future plans)

This paragraph provides a summary overview of all of Enel's investments in new electricity generation capacity globally. The overview includes both current construction works and future plans. The summarized figures presented here are based on the more detailed information broken down on a per project basis that can be found in sub-sections 4.1.2, 4.1.3, and 4.1.4.

Table 15 lists Enel's current (2010) global installed capacity figures per fuel type, its current construction works and future plans within and outside of Europe, and an estimation of what fuel mix Enel's global production park will have if/when all investments are completed as planned.

[90] Enel presentation "2011 Results 2012-2016 Plans", 8 March 2012, Enel website, Investor, Presentations, 2012 <http://www.enel.com/en-GB/investor/annual_presentations/presentazione.aspx?id=2012_02> (03/03/2012).

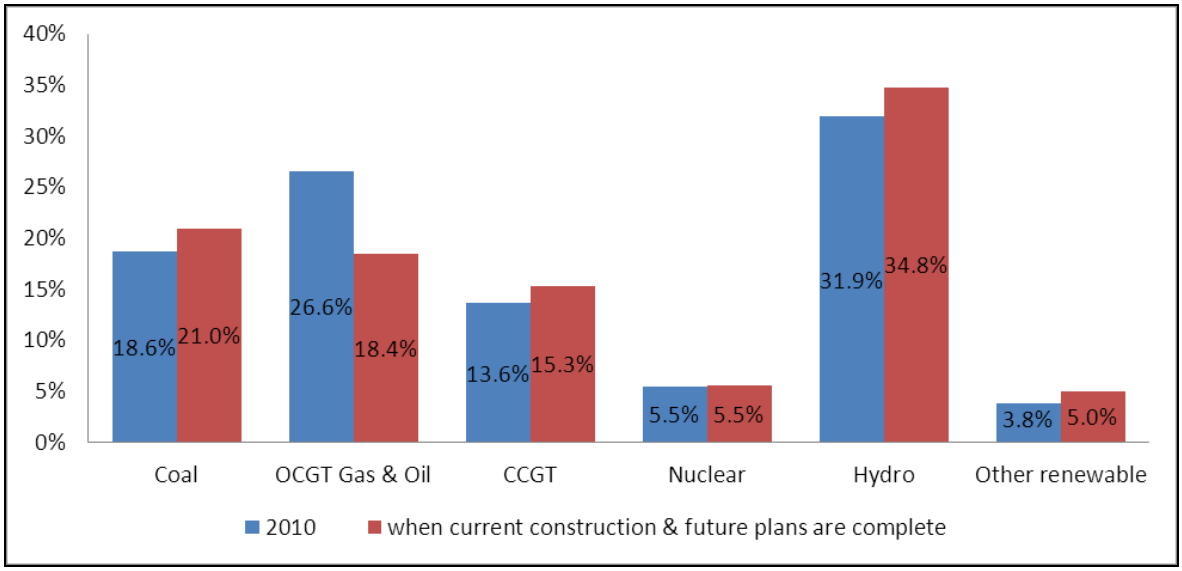
Table 15: Enel's global installed capacity when current construction & future plans are complete, per fuel type, in MW

Fuel type	Global installed capacity in 2010	Current construction + future plans in Europe	Current construction + future plans outside Europe	Global installed capacity when current construction + future plans are complete
Coal	18,122	4,277	2,410	24,809
OCGT Gas & Oil	25,852	-4,040	0	21,812
CCGT	13,248	3,031	1,887	18,166
Nuclear	5,332	1,231	0	6,563
Hydro	31,033	943	9,216	41,192
Other renewable[91]	3,694	904	1,273	5,871
Total	**97,281**	**6,346**	**14,786**	**118,413**

Based on detailed calculations in sub-sections 4.1.2, 4.1.3, and 4.1.4 below

Figure 8 provides a graphical comparison of the fuel mix of Enel's current (2010) global production park with the projected fuel mix of the production park if/when all current construction and future plans are complete. The most significant change is expected to occur in the company's OCGT gas & oil capacity, which will decrease by 8.2%. This is a result of Enel not planning to build any new traditional gas and oil plants, and the fact that the company plans to convert some currently oil-fired plants into coal-fired units. The company's hydro capacity will see an increase of approximately 2.9%, which is mainly due to Enel's investments in hydro Latin America through its subsidiary Endesa. Enel's coal-fired capacity is set to increase by 2.3%, primarily attributable to several new coal-fired projects in Europe and two oil-to-coal conversions in Italy. Other generation technologies will see more marginal increases. CCGT is projected to increase 1.7% and "other renewables" (mainly wind and solar) by 1.2%. Enel is investing in new nuclear capacity, but nuclear's overall contribution in Enel's production park will remain unchanged.

Figure 8: Fuel mix of Enel's global installed capacity in 2010 vs. when current construction & future plans are complete, in percentages



Based on detailed calculations in sub-sections 4.1.2, 4.1.3, and 4.1.4 below

[91] For the category "other renewable", the figures for Enel's 2010 installed capacity are the combined capacity figures for the company's wind, biomass, geothermal and "other" categories. Enel Sustainability Report 2010, p. 258.

Table 16 shows Enel's European investments in Euros for the projects currently under construction and for the company's future plans. The invested amounts have to be interpreted with caution as they are based simply on information provided by the company (see sub-sections 4.1.2 and 4.1.3 below for details), and often only incomplete figures are available.

Table 16: Enel's investments in new production capacity in Europe, in EUR million

Fuel type	Current construction	Future plans	Total investment
Coal	-545[a, b]	5,000[a]	**4,455**[a]
OCGT Gas & Oil	n/a	0	**0**
CCGT	996[a]	433[a]	**1,429**[a]
Nuclear	3,816[a]	0	**3,816**[a]
Hydro	0	535[a]	**535**[a]
Wind	180[a]	0	**180**[a]
Solar	n/a	0	**0**[a]

[a] No exact figures available – interpret with caution; [b] the minus indicates a divestment
Based on detailed calculations in sub-sections 4.1.2, 4.1.3, and 4.1.4 below

4.1.2. Enel's investments currently under construction in Europe & Italy

This section details at Enel's investments in new electricity generation capacity that are already under construction and thus for which the investments are relative certain, in Europe and Italy. All investments mentioned are projects which are. It should be noted that construction works that were completed in 2011 are still included as ongoing construction works here. This is due to the fact that at time of writing this report (first quarter of 2012), the most recent information on Enel's capacity figures were its 2010 Annual, Sustainability and Environmental reports (see paragraph 3.4) in which the capacity figures for projects completed in 2011 have not yet been taken into consideration.

Europe

In Europe, Enel has several new investments in the pipeline, of which the vast majority in CCGT gas plants: almost 2,000 MW of the 3,000 MW total investments in Europe. Second in line are the company's nuclear investments, with around 1,200 MW under construction. Investments in renewable energy sources make up 23% of the total investments, with 615 MW in wind energy and 70 MW in solar power. In Europe Enel does not have any hydropower stations under construction at the moment. Enel is planning to abandon the Bulgarian market. It has sold its recently renovated coal fired power plant. Renewable facilities in the country will also be sold.[92]

Table 17 shows the investment figures per fuel type for plants which are currently under construction. The invested amounts (in EUR million) have to be interpreted with caution as no complete figures could be gathered for most of the categories. The figures in Table 17 show the aggregate figures from Table 18.

[92] SeeNews Southeast Europe, 14 September 2011, *Enel Maritsa East 3 to be renamed Contour Global Maritsa East 3.*

Table 17: Enel's investments in new production capacity in Europe - under construction, per fuel type

Fuel type	Costs (EUR mln)	Capacity (MW)	Capacity in %
Coal	-545 [a, b]	-663 [a, b]	**77% non-renewable**
OCGT Gas & Oil	n/a	-140	
CCGT	996 [a]	1,914	
Nuclear	3,816 [a]	1,231	
Hydro	0	0	**23% renewable**
Wind	180 [a]	615	
Solar	n/a	70	
Total	**4,447** [a]	**3,027** [a]	**100%**

[a] No exact figures available – interpret with caution; [b] the minus indicates a divestment
Based on detailed information in Table 18 below

Table 18 shows the company's projects currently under construction. As noted above, projects which have been completed in 2011 are also included. Negative figures relate to projects which either have been sold in 2011 (the Maritza East 3 plant in Bulgaria) or for which conversion from oil to gas-firing results in smaller capacity figures (the Tarbert plant in Ireland).

Table 18: Enel's investments in new production capacity in Europe - under construction, per project

Project name	Location	Fuel type	Date in operation	Amount (EUR million)	Output Capacity (MW)	Project Status
Maritza	Bulgaria	Coal (lignite)	2011	-545	-663	Asset sold[93]
Tejo II	Portugal	Gas (CCGT)	2011	n/a	425	Construction complete[94]
Besós 5	Barcelona (ES)	Gas (CCGT)	2011	436	859	Construction complete[95]
Marcinelle	Wallonia (B)	Gas (CCGT)	2011	290	400	Construction complete[96]
Granadilla	Tenerife (ES)	Gas (CCGT)	2011	270	230	Construction complete[97]
Almaraz	Cácares (ES)	Nuclear	2011	n/a	19	Construction complete[98]

[93] In June 2011, Enel sold its shareholding of 73% in the 908 MW Maritza lignite plant in Bulgaria. Enel press release, "ENEL FINALIZED THE SALE OF ITS STAKE IN MARITZA", 28 June 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645331 (10/02/2012)

[94] Total capacity is 851 MW, Endesa has a 50% share. Endesa presentation "Consolidated results 1H 2011", 29 July 2011, p. 9., http://www.endesa.com/EN/ACCIONISTAS/ANALISTAS/Presentaciones/Endesa%201H%202011%20Presentation%20en.pdf

[95] Endesa press release, "Endesa starts up the new Besòs 5 combined cycle plant featuring cleaner, safer and more efficient technology", 30 March 2011, http://www.endesa.com/en/saladeprensa/noticias/Paginas/EndesaStartsUpTheNewBesos5CombinedCyclePlantFeaturingCleanerSaferAndMoreEfficientTechnology.aspx (07/02/2012);
Enel annual report 2010, p. 13., Enel Interim financial report at September 30, 2011, p. 24., Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012.

[97] In November 2011 the second unit of the Granadilla CCGT was put into operation raising the plant's installed capacity by 230 MW to 743 MW. The plant is operated by Endesa. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012; Ibero-Russian Chamber of Commerce press release, "A second CCGT has been inaugurated in Tenerife by Endesa", 29 November 2011, http://iberorusa.com/en/blog/2011/11/29/second-ccgt-has-been-inaugurated-tenerife/ (10/02/2012).

[98] The addition of 19 MW capacity to the reactor is part of a four-year power uprate of the Almaraz plant, which was finished in 2011. Endesa presentation "Consolidated results 1H 2011", 29 July 2011, p. 9.,

Energonuclear	Cernavoda, Romania	Nuclear	Unit 3: 2016 Unit 4: 2017	366	132	Under construction[99]
Mochovce III, IV	Slovakia	Nuclear	2012-2013	2,700	880	Under construction[100]
Flamanville III	Cherbourg (F)	Nuclear	2016	750	200	Under construction[101]
Tarbert	County Kerry (Ireland)	Oil	2016	n/a	-140	Plans approved[102]
Portoscuso	Sardegna (I)	Wind	2012	n/a	90	Partially complete[103]
Los Llanos	Burgos (ES)	Wind	2011	n/a	38	Construction complete[104]
Granujales	Cádiz (ES)	Wind	2011	n/a	24	Construction complete[105]
Sociedad Eólica de Andalucía	Cádiz (ES)	Wind	2011	n/a	12	Takeover[106]
Kouloukonas	Rethymnon (GR)	Wind	2011	n/a	5	Construction complete[107]
Zoodochos	Kozani and	Wind	2011	n/a	38	Construction

http://www.endesa.com/EN/ACCIONISTAS/ANALISTAS/Presentaciones/Endesa%201H%202011%20Presentation%20en.pdf; Enel presentation "2010 Results 2011-2015 Plans", 15 March 2011, p. 38., Enel website, Investor, Presentations, 2011, http://www.enel.com/en-GB/investor/annual_presentations/?anno_curr=2011&anno_iniziale=2012&anno_finale=2005&id= (03/02/2012); Nuclear Engineering International, "Almaraz 1&2 power uprate", 26 August 2011, http://www.neimagazine.com/story.asp?sectionCode=76&storyCode=2060519 (07/02/2012).

99 Total capacity is 1,440 MW, costs are expected to be about EUR 4 billion, Enel has a 9.15% share. World Nuclear Association, "Nuclear Power in Romania", October 2011, http://www.world-nuclear.org/info/inf93.html (07/02/2012)

100 Enel Annual Report 2010, p. 13.; Kranimex.sk website, "Liebherr 630 EC-H25 Litronic in the completion of Units 3 and 4 Nuclear power plant Mochovce", no date, http://www.kranimex.sk/en/about/news/Liebherr-630-EC-H25L-Mochovce (15/02/2012).

101 Estimated costs have increased from EUR 3.3 bn in 2005 to EUR 6 bn in 2011. Also, the year of completion has changed from 2012 to 2016. Total capacity is 1,600 MW. Enel has a 12.5% stake. Enel Sustainability Report, p. 201., Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012.

102 Endesa Ireland is planning to convert the 590 MW oil fired Tarbert power station into a 450 MW CCGT plant in two phases. The second phase is scheduled to be completed in 2016. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012; Endesa Ireland Limited, "Proposed Power Plant at Tarbert, Co. Kerry – Non-Technical Summary", p. 1, December 2009, http://www.tarbertpowerproject.com/documents/Environmental%20Impact%20Statement/NTS/Non-Technical%20Summary.pdf.

103 Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012; Enel Environmental Report 2010, p. 160; 4-traders website, "Enel S.p.A.: ENEL GREEN POWER: SARDINIA, THE FIRST 40 MW OF WIND POWER COME ONLINE AT PORTOSCUSO", 10 November 2011, http://www.4-traders.com/ENEL-S-P-A-70935/news/ENEL-S-P-A-ENEL-GREEN-POWER-SARDINIA-THE-FIRST-40-MW-OF-WIND-POWER-COME-ONLINE-AT-PORTOSCUSO-13885383/ (09 02/2012).

104 Enel press release, "ENEL GREEN POWER STARTS UP A FURTHER 66 MW IN SPAIN AND PORTUGAL", 1 December 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1648685 (09/02/2012).

105 Enel press release, "ENEL GREEN POWER STARTS UP A FURTHER 66 MW IN SPAIN AND PORTUGAL", 1 December 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1648685 (09/02/2012).

106 In April 2011 Enel Green Power Espana bought 16.57% of SEA, raising its interest to 63.34% from the previous 46.67%. SEA owns two wind farms in Andalucia: Planta Eólica del Sur with 42 MW and Energía Eólica del Estrecho with 32 MW. Enel press release, "ENEL GREEN POWER ESPANA PURCHASES 16.67% OF SOCIEDAD EOLICA DE ANDALUCIA", 8 April 2012, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1642590 (10/02/2012).

107 Enel press release, "ENEL GREEN POWER'S NEW WIND FARM BRINGS TOTAL INSTALLED CAPACITY IN GREECE TO 186 MW", 30 August 2011, http://www.enel.com/ewcm/salastampa/comunicati_eng/1646645-1_PDF-1.pdf

Pighi and Panaghia Soumela	Veria (GR)					complete[108]
Salbatica II	Dobrogea (Romania)	Wind	2011	n/a	70	Construction complete[109]
Salbatica I	Dobrogea (Romania)	Wind	2011	n/a	40	Construction complete[110]
Chlogos and Prophet Elias	Corinth (GR)	Wind	n/a	n/a	28	Under construction[111]
Corugea	Romania	Wind	2011	108	70	Construction complete[112]
Moldova Noua	Romania	Wind	2011	72	48	Partially complete[113]
Alto do Marco	Portugal	Wind	2011	n/a	12	Construction complete[114]
Expansion Alvaiazere	Alvaiazere (P)	Wind	n/a	n/a	8	Partially in operation[115]
Sources de la Loire	Saint Cirgues en Montagne (F)	Wind	2011	n/a	18	Construction complete[116]
Moulin à Vent	Champagne Ardenne (F)	Wind	2011	n/a	10	Construction complete[117]
Coulonges	Poitou-Charentes (F)	Wind	2011	n/a	38	Construction complete[118]

[108] Zoodochos Pighi (24 MW) and Panaghia Soumela (14 MW) together make up the total capacity of 38 MW. Enel press release, "ENEL GREEN POWER GROWS IN THE GREEK WIND SECTOR", 27 July 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645885 (10/02/2012).

[109] Ewind.es website, "Enel inaugurated 70 MW wind farm in Northern Dobrogea", 22 October 2011, http://www.evwind.es/noticias.php?id_not=14307 (08/02/2012).

[110] Total capacity of the plant is 70 MW, the construction of the initial 30 MW of the plant has been finished in 2010 already. Enel press release, "ENEL GREEN POWER STARTS UP AN ADDITIONAL 40 MW OF WIND POWER IN ROMANIA", 30 June 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645365 (10/02/2012).

[111] Chlogos (19 MW) and Prophet Elias (9 MW) together make up the total capacity of 28 MW. Enel press release, 13 April 2011, "ENEL GREEN POWER LAUNCHES A 28 MW WIND PROJECT IN GREECE", http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1642671 (10/02/2012).

[112] The total costs for the Corugea and Moldova Noua wind power stations together are EUR 180 mln. The cost division between the two plants have been made according to the installed capacities (70 mw – 48 MW): 60%-40%. Enel Green Power press release, "ENEL GREEN POWER REACHES NEW INSTALLED CAPACITY TARGET FOR 2011", 29 December 2011, http://www.enelgreenpower.com/en-GB/media_investor/press_releases/release.aspx?iddoc=1649685; Enel press release, "ENEL GREEN POWER: AGREEMENT WITH EKF TO FINANCE WIND PROJECTS IN ROMANIA", 21 October 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1647905 (10/02/2012).

[113] 25 MW of the total 48 MW have been put into operation in 2011. The total costs for the Corugea and Moldova Noua wind power stations together are EUR 180 mln. The cost division between the two plants have been made according to the installed capacities (70 mw – 48 MW): 60%-40%. Enel Green Power press release, "ENEL GREEN POWER REACHES NEW INSTALLED CAPACITY TARGET FOR 2011", 29 December 2011, http://www.enelgreenpower.com/en-GB/media_investor/press_releases/release.aspx?iddoc=1649685; Enel press release, "ENEL GREEN POWER: AGREEMENT WITH EKF TO FINANCE WIND PROJECTS IN ROMANIA", 21 October 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1647905 (10/02/2012).

[114] Enel press release, "ALTO DO MARCO WIND FARM ENTERS OPERATION IN PORTUGAL", 13 October 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1647625 (10/02/2012).

[115] Originally the plant had an installed capacity of 10 MW. The capacity increase will be an additional 8 MW, of which 4 MW has been operational since January 2011. Enel press release, "ENEL GREEN POWER STARTS UP A FURTHER 66 MW IN SPAIN AND PORTUGAL", 1 December 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1648685; Enel press release, "ENEL GREEN POWER STARTS UP A FURTHER 54 MW IN SPAIN AND PORTUGAL", 15 June 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1644785 (09/02/2012).

[116] Enel press release, "ENEL GREEN POWER CONSOLIDATES ITS GROWTH IN WIND POWER IN FRANCE ", 5 September 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1646744 (10/02/2012).

[117] Enel press release, "ENEL GREEN POWER STARTS OPERATING A NEW WIND FARM IN FRANCE", 14 July 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645645 (10/02/2012).

[118] Enel press release, "ENEL GREEN POWER: FURTHER GROWTH IN THE FRENCH WIND SECTOR", 1 July 2011,

Valdihuelo	Ávila (ES)	Wind	2011	n/a	16	Construction complete[119]
Aguilón	Aguilón (ES)	Wind	2011	n/a	50	Construction complete[120]
Strambino	Strambino (I)	Solar	2011	n/a	2	Construction complete[121]
Taranto	Taranto (I)	Solar	2011	n/a	2	Construction complete[122]
Nola	Nola (I)	Solar	n/a	n/a	25	Under construction[123]
Barrafranca	Barrafranca (I)	Solar	2011	n/a	5	Construction complete[124]
ESSE	Calabria (I)	Solar	2011	n/a	3	Construction complete[125]
Canaro	Rovigno (I)	Solar	2011	n/a	6	Construction complete[126]
Other Solar plants in Italy	Italy	Solar	2011	n/a	22	Construction complete[127]
Kourtesi I	Ilia (GR)	Solar	2011	n/a	5	Construction complete[128]

http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645385 (10/02/2012).

[119] Enel press release, "ENEL GREEN POWER STARTS OPERATING A NEW WIND FARM IN SPAIN", 4 August 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1646288 (10/02/2012).

[120] Enel press release, "ENEL GREEN POWER STARTS UP A FURTHER 54 MW IN SPAIN AND PORTUGAL ", 15 June 2012, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1644785 (10/02/2012).

[121] The total capacity of the plant is 2.5 MW, Enel has a 60% share. Enel Annual Report 2010, p. 297; Enel Green Power website, Plants, Projects, Italy, Strambino, http://www.enelgreenpower.com/en-GB/plants/projects/italy/strambino/ (07/02/2012).

[122] The total capacity of the plant is 3 MW, Enel has a 51% share. PV Magazine, "Enel and Marcegaglia inaugurate PV system in Taranto", 17 February 2011, http://www.pv-magazine.com/news/details/beitrag/enel-and-marcegaglia-inaugurate-pv-system-in-taranto_100002260/ (07/02/2012).

[123] Enel press release, "ENEL GREEN POWER EXPANDS SOLAR POWER IN SICILY", 6 December 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1649165 (07/02/2012).

[124] Enel press release, "ENEL GREEN POWER EXPANDS SOLAR POWER IN SICILY", 6 December 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1649165 (07/02/2012).

[125] ESSE is a joint venture between Enel Green Power and Sharp Solar Energy. Total installed capacity of the plant is 5 MW. Enel Green Power press release, "ENEL GREEN POWER AND SHARP COMPLETE THE SERRAGIUMENTA PHOTOVOLTAIC PLANT IN CALABRIA", 20 January 2011, http://www.enelgreenpower.com/en-GB/media_investor/press_releases/release.aspx?iddoc=1640145 (09/02/2012).

[126] Enel press release, "ENEL GREEN POWER: NEW PHOTOVOLTAIC PLANT IN VENETO ENTERS INTO SERVICE", 1 September 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1646687 (10/02/2012).

[127] Other solar plants which have been completed in 2011 in Italy are: the 5 MW Serragiumenta (Cosenza) plant, the 3 MW Deruta (Perugia) plant, the Adrano (Catania) photovoltaic field which, with an installed capacity of 9 MW, the 4.8 MW San Gillio (Turin) plant and the 500 kW Sesto Campano (Isernia), which is located in the Cesima upper basin of the Presenzano hydroelectric plant. Enel press release, "ENEL GREEN POWER: SERRE PERSANO PHOTOVOLTAIC PLANT BACK IN OPERATION", 31 August 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1646665 (10/02/2012).

[128] Enel press release, "ENEL GREEN POWER STARTS OPERATING ITS FIRST PHOTOVOLTAIC PLANT IN GREECE", 19 October 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1647807 (10/02/2012).

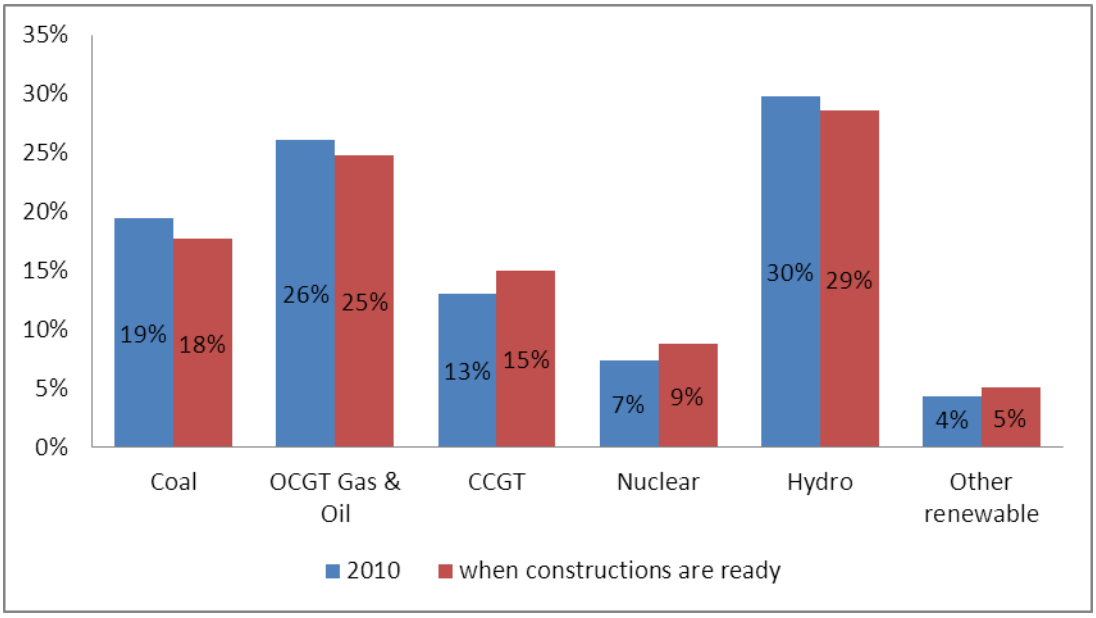
Table 19 shows Enel's installed capacity figures at the moment that all of the current projects under construction from Table 18 have been realized.

Table 19: Enel's installed capacity in Europe - when constructions are ready, in MW

Fuel type	Installed capacity 2010	Under construction	Installed capacity when constructions are ready
Coal	13,990	-663	13,327
OCGT Gas & Oil	18,758	-140	18,618
CCGT	9,380	1,914	11,294
Nuclear	5,332	1,231	6,563
Hydro	21,460	0	21,460
Other renewable	3,110	685	3,795
Total	**72,030**	**3,027**	**75,057**

Figure 9 shows Enel's European installed capacity in percentages: the blue columns show the company's current installed capacity (2010) and the red columns show the percentages at the moment that current projects under construction have been realized. Coal, OCGT gas & oil and hydro will be decreasing with 1%, while CCGT and nuclear capacity will see a 2% increase and "other renewables" (mostly wind and some solar) will increase by 1%.

Figure 9: Fuel mix of Enel's European installed capacity in 2010 vs. when constructions are ready, in percentages



Italy

This sub-paragraph takes a look at Enel's plants under construction in Italy. At the moment Enel has several solar plants and one wind farm under construction[129] in Italy. Table 20 summarizes the investment figures for plants which are currently under construction in Italy. Note that Enel is not currently constructing any coal, OCGT gas & oil, CCGT, nuclear or hydro facilities in Italy. Wind

[129] Enel is currently adding another wind park (Portoscuso, in the Sulcis Iglesiente area) to its three wind plants in Sardinia, of which the first 40 MW have come online in November 2011. When in full operation, Portoscuso will have a 90 MW capacity, which brings Sardinian wind capacity to 250 MW. Source: ENP Newswire, 14 November 2011, *Enel Green Power-Sardinia, the first 40 MW of wind power come online at Portoscuso*.

and solar projects are thus the only types of plants currently being constructed in Italy. Figures in Table 20 are aggregate numbers for Enel's Italian projects under construction from Table 18.

Table 20: Enel's investments in new production capacity in Italy currently under construction, per fuel type

Fuel type	Investment (€ million)	Capacity (MW)
Coal	0	0
OCGT Gas & Oil	0	0
CCGT	0	0
Nuclear	0	0
Wind	n/a	90
Solar	n/a	65
Total	**n/a**	**155**

As the company is currently constructing only 155 MW of new capacity in Italy, this will not significantly affect the company's fuel mix in its home country. Table 21 shows Enel's installed capacity in 2010 compared to the situation when the current projects under construction have been completed. Investments in wind and solar plants are shown together under "other renewable". Changes for all fuel types are under 1%, so the overall change in the company's fuel mix in Italy after the current projects under construction have been built will be negligible.

Table 21: Enel's installed capacity in Italy when current construction projects are completed, in MW and %

Fuel type	Installed capacity in 2010 (MW)	Currently under construction (MW)	Installed capacity when current construction projects are complete (MW)	Installed capacity in 2010 (%)	Installed capacity when current construction projects are complete (%)
Coal	6,804	0	6,804	16.8%	16.7%
OCGT Gas & Oil	12,021	0	12,021	29.7%	29.6%
CCGT	5,973	0	5,973	14.7%	14.7%
Nuclear	0	0	0	0.0%	0.0%
Hydro	14,417	0	14,417	35.6%	35.4%
Other renewable	1,307	155	1,462	3.2%	3.6%
Total	**40,522**	**155**	**40,677**	**100%**	**100%**

4.1.3. New generation capacity: future plans

This paragraph analyses Enel's plans for future investments in the European Union and Italy. Projects plans for the regions outside of Europe (Americas and Russia) are included in section 3.3. below. The plans mentioned in this paragraph are projects which are in a certain phase of development, but for which construction works have not started yet. Figures for planned project have to be interpreted with caution, as these projects have a higher possibility to get cancelled or modified than the projects mentioned in paragraph 4.1, because construction works have not started yet.

Europe

The majority of Enel's investment plans in Europe are coal fired power stations: the company is planning to increase its coal capacity with around 5,000 MW. It has to be noted that the majority of these coal investments are plant conversions from oil-firing to coal firing. Due to these conversions, the company's oil capacity will decrease with around 4,000 MW. Coal and oil are followed by

CCGT gas power plants with a total installed capacity of 1,117 MW. Pumped storage hydro plants (943 MW), wind (159 MW) and solar plants (60 MW) make up the remaining 35% of all of Enel's investment plans in Europe. Regarding plans for new nuclear capacity, in 2009 Enel and French utility EDF signed an agreement for the construction of four Evolutionary Pressurised Reactor (EPR, third-generation) power plants in Italy with a capacity of approximately 1,600 MW each.[130] However, after the Fukushima melt down in Japan and a subsequent referendum with negative outcome on nuclear power in Italy in 2011, these plans seem to have been abandoned.[131] This project has not been included in the tables below.

Table 22 shows the aggregate investment figures per fuel type for plants which have been announced, but for which construction has not yet begun. The invested amounts (in EUR million) have to be interpreted with caution as no complete figures could be gathered for most of the categories. The figures in Table 22 show the aggregate figures from Table 23.

Table 22: Enel's future plans for investments in new production capacity in Europe, per fuel type

Fuel type	Costs (EUR mln)	Capacity (MW)	Capacity in %
Coal	5,000*	4,940	**65% non-renewable**
OCGT Gas & Oil	0	-3,900	
CCGT	433*	1,117	
Nuclear	0	0	
Hydro	535*	943	**35% renewable**
Wind	0	159	
Solar	0	60	
Total	**5,968***	**3,319**	**100%**

* No exact figures available
Source: see Table 23

Table 23 shows the company's investment plans per project. Negative figures indicate conversion projects: Enel's plant in Porto Tolle and the Rossano Calabro plant in Calabria are both set for conversion from oil-firing (negative capacity figure) to coal-firing (positive capacity figure).

Table 23: Enel's investments in new production capacity in Europe - plans, per project

Project name	Location	Fuel type	Date in operation	Amount (€ million)	Output Capacity (MW)	Status
Porto Romano Energy Complex	Durres, Albania	Coal	n/a	n/a	800	Planning phase[132]
Porto Tolle	Rovigo (I)	Coal	2014	2,500	1,980	Conversion status

[130] Enel Sustainability Report 2009, p. 147.
[131] Utility Week, "Italian power left in a muddle", 6 July 2011, http://www.utilityweek.co.uk/news/news_story.asp?id=195617&channel=0&title=Italian+power+left+in+a+muddle (10/02/2012).
[132] Installed capacity for the plant is unclear: Enel website states that the plant will have 800 MW capacity, while other sources like the project's EIA states that the plant will have two 800 MW units bringing the total installed capacity to 1,600 MW. For calculations in this report, the 800 MW capacity figure is used. Enel website, Group, Worldwide, Albania, http://www.enel.com/en-GB/group/worldwide/albania/ (10/02/2011); Porto Romano TPP EIA quoted in: P. Trzaskowski and F. Bacheva-McGrath, "Over the edge - Enel's plans to export its pollution to Porto Romano, Albania", (Tirana: CEE Bankwatch Network, April 2010), p. 8., http://bankwatch.org/sites/default/files/PortoRomanoOverTheEdge.pdf.

						unclear[133]
Rossano Calabro	Calabria (I)	Coal	2016	1,200	1,260	Planning conversion[134]
Galati	Galati, Romania	Coal	2017	1,300	900	Project approved[135]
Livadia	Livadia, Viotia (GR)	Gas (CCGT)	2015	n/a	332	Plan approved[136]
Evros	Evros (GR)	Gas (CCGT)	2015	n/a	315	Unclear[137]
Great Island	Great Island (Ireland)	Gas (CCGT)	n/a	300	190	Plans approved[138]
La Pereda	Mieres (ES)	Gas (CCGT)	2015	133	280	Plans approved[139]
Porto Tolle	Rovigo (I)	Oil	2014	0	-2,640	Conversion status unclear[140]

[133] Enel plans to convert its oil fired Porto Tolle power plant into a coal fired one. The current capacity of 2,640 MW is to be reduced to 1,980 MW (3x660 MW), with 250 MW fitted with carbon capture and storage (CCS) technology. The current status of the project is unclear, as the Italian high court has overturned the government's approval for conversion in May 2011. The reduction in oil capacity is taken up elsewhere in the same table. The CCS part of the plant is financed partly by the European Union. Enel Environmental Report 2010, p.54; Enel Sustainability Report 2010, p. 58.; Enel Porto Tolle website, Porto Tolle Power Plant, Conversion of coal, http://www.portotolleproject.com/impianto_porto_tolle/conversione_carbone; The Engineer, "Enel "astonished" by clean-coal project ruling", 19 May 2011, http://www.theengineer.co.uk/channels/process-engineering/enel-astonished-by-clean-coal-project-ruling/1008719.article#ixzz1PLoUXudM; Bellona, "Porto Tolle CCS project approval overruled", 15 June 2011, http://www.bellona.org/news/news_2011/Porto_Tolle_CCS (13/03/2012).

[134] Enel plans to convert its oil fired Rossano Calabro power station into a coal multi-fuel power plant. The project involves part-conversion to coal-firing to give 800 MW, with a further 460 MW fuelled by methane, solar thermal and biomass, for a total installed capacity of 1,260 MW. However, as the ratio between methane, solar and biomass is unclear, the investment is taken up as a 100% coal investment. The decrease in oil capacity is taken up elsewhere in the same table. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012.

[135] Galati City Council has approved the project, construction works will start by late 2012 or in early 2013 and will take three to four years. Once fully operational, the power plant will create 200 new jobs. Financiarul, "Romania: Galati City Council approves construction of 900 MW thermal power plant", 23 September 2011, obtained through Lexis Nexis, http://www.financiarul.ro/2011/09/23/termocentrala-de-peste-un-miliard-de-euro-in-zona-libera-galati/ (12/02/2012).

[136] Total capacity is 443 MW. The plant is being constructed by Enelco, which is a 75%-25% joint venture between Enel and Prometheus Gas. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012.

[137] Total capacity is 450 MW. The plant is being constructed by Enelco, which is a 75%-25% joint venture between Enel and Prometheus Gas. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012; Prometheus Gas website, Activities, Participations, ENELCO, http://www.prometheusgas.gr/content.asp?lang=1&ssid=15 (10/02/2012).

[138] The Great Island power plant currently operates on Heavy Fuel Oil (HFO) with a maximum electrical output capacity of 240 MW. The plant will be enlarged with a 430 MW CCGT unit and once operational, the HFO unit will be shut down. The plant is operated by Endesa Ireland. Construction is scheduled to start in 2012. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012; Great Island Power Project website, Project description, http://www.greatislandpowerproject.com/project-description.html (10/02/2012).

[139] Total costs are estimated at EUR 190 mln, total installed capacity will be 400 MW. Endesa has a 70% ownership. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012.

[140] Enel plans to convert its oil fired Porto Tolle power plant into a coal fired one. The current capacity of 2,640 MW is to be reduced to 1,980 MW (3x660 MW), with 250 MW fitted with carbon capture and storage (CCS) technology. The current status of the project is unclear, as the Italian high court has overturned the government's approval for conversion in May 2011. The increase in coal capacity is taken up elsewhere in the same table. Costs (around EUR 2.5 bn) are also included elsewhere in the same table to avoid double counting. The CCS part of the plant is financed partly by the European Union. Enel Environmental Report 2010, p.54; Enel Sustainability Report 2010, p. 58.; Enel Porto Tolle website, Porto Tolle Power Plant, Conversion of coal, http://www.portotolleproject.com/impianto_porto_tolle/conversione_carbone; The Engineer, "Enel "astonished" by clean-coal project ruling", 19 May 2011, http://www.theengineer.co.uk/channels/process-engineering/enel-astonished-by-clean-coal-project-ruling/1008719.article#ixzz1PLoUXudM; Bellona, "Porto Tolle CCS project approval overruled", 15 June 2011, http://www.bellona.org/news/news_2011/Porto_Tolle_CCS (13/03/2012).

Rossano Calabro	Calabria (I)	Oil	2016	0	-1,260	Planning conversion[141]
Moralets	Spain	Hydro (pumped storage)	2014	175	379	Development stage[142]
Girabolhos	Portugal	Hydro (pumped storage)	2017	360	364	Development stage[143]
Canary Islands	Canary Islands (ES)	Hydro (pumped storage)	2017	n/a	200	Development stage[144]
ENEOP	Portugal	Wind	n/a	n/a	159	Development stage[145]
Teulada and Serre Persano	Cagliar and Salerno (I)	Solar	n/a	n/a	60	Permits awarded[146]

Table 24 shows what Enel's installed capacity figures in Europe will look like at the moment that all of the current projects under construction from Table 18 have been built and all future plans from Table 23 have been realized.

[141] Enel plans to convert its oil fired Rossano Calabro power station into a coal multi-fuel power plant. The project involves part-conversion to coal-firing to give 800 MW, with a further 460 MW fuelled by methane, solar thermal and biomass, for a total installed capacity of 1,260 MW. However, as the ratio between methane, solar and biomass is unclear, the investment is taken up as a 100% coal investment. The increase in coal capacity is taken up elsewhere in the same table. Costs (around EUR 1.2 bn) are also included elsewhere in the same table to avoid double counting. Platts Power in Europe, "PIE's new plant tracker No. 618", 23 January 2012.

[142] The plant will be upgraded from its current capacity of 221 MW to 600 MW. Endesa presentation "endesa analyst day – 17th May 2011", p. 42., http://www.endesa.com/EN/ACCIONISTAS/ANALISTAS/Presentaciones/EndesaAnalystDayMay17th_en.pdf.

[143] Endesa presentation "endesa analyst day – 17th May 2011", p. 42., http://www.endesa.com/EN/ACCIONISTAS/ANALISTAS/Presentaciones/EndesaAnalystDayMay17th_en.pdf.

[144] Endesa presentation "Consolidated results 1H 2011", 29 July 2011, p. 9., http://www.endesa.com/EN/ACCIONISTAS/ANALISTAS/Presentaciones/Endesa%201H%202011%20Presentation%20en.pdf.

[145] Enel Green Power España has a 40% stake in the ENEOP consortium, which is building wind projects in Portugal. Enel's share corresponds to 480 MW of which 321 MW were already in operation as of September 2011. Enel press release, "ENEL GREEN POWER: ENEOP RECEIVES EIB PROJECT FINANCE TO INSTALL 376 MW IN PORTUGAL", 21 December 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1649485; Enel press release, "ENEL GREEN POWER ESPAÑA BUYS SOCIEDAD TÉRMICA PORTUGUESA (TP) THROUGH FINERGE, ITS PORTUGUESE SUBSIDIARY", 9 June 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1644367 (10/02/2012).

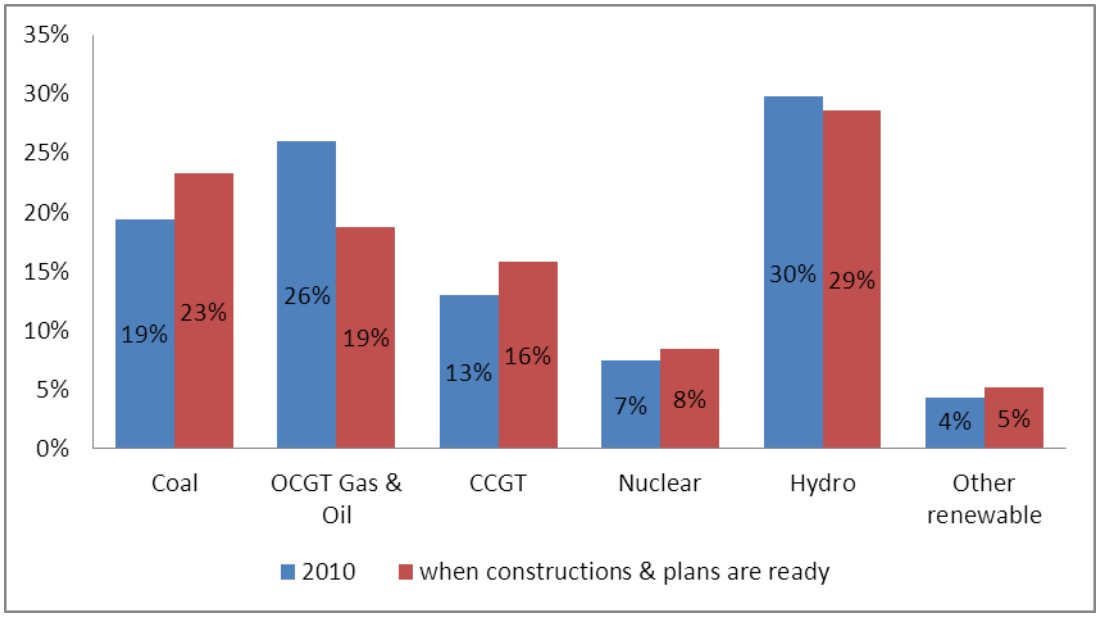
[146] Enel press release, "ENEL GREEN POWER: TWO LOTS FROM DIFESA SERVIZI SPA TO DEVELOP 60 MW OF PHOTOVOLTAIC PLANTS", 29 November 2011, http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1648604 (10/02/2012).

Table 24: Enel's installed capacity in Europe - when current construction projects & future plans are ready, in MW

Fuel type	Installed Capacity 2010	Currently under construction	Future plans	Installed capacity when current construction & future plans are completed
Coal	13,990	-663	4,940	18,267
OCGT Gas & Oil	18,758	-140	-3,900	14,718
CCGT	9,380	1,914	1,117	12,411
Nuclear	5,332	1,231	0	6,563
Hydro	21,460	0	943	22,403
Other renewable	3,110	685	219	4,014
Total	**72,030**	**3,027**	**3,319**	**78,376**

Figure 10 shows Enel's European installed capacity in percentages: the blue columns show the company's current installed capacity (2010) and the red columns show the percentages at the moment that current projects under construction have been built and all current plans have been realized. The following fuels will see an increase in in the company's fuel mix: coal (4%), CCGT (3%), nuclear (1%) and "other renewables" (wind and solar – 1%.). OCGT gas & oil and hydro will be decreasing with 7% and 1%, respectively.

Figure 10: Fuel mix of Enel's European installed capacity in 2010 vs. when current construction projects & future plans are complete, in percentages



Italy

This sub-paragraph analyses Enel's future plans for investments (investments for which construction works have not yet started) in Italy. At the moment the company has planned to convert two of its oil-fired power plants to coal fired unit (the Porto Tolle and Rossano Calabro plants) and to build a solar power plant in Italy. Table 25 summarizes these plans. Please note that only the fuel types for which plans are known are included in the table – CCGT, nuclear and hydro are not mentioned, as Enel has currently no plans for these categories in Italy. Figures in Table 25 are aggregate numbers for Enel's Italian plans from Table 23.

Table 25: Enel's future plans for investments in new production capacity in Italy, per fuel type

Fuel type	Costs (EUR mln)	Capacity (MW)
Coal	3,700	3,240
Oil	0*	-3,900
Solar	n/a	60
Total	**3,700***	**-600**

* No exact figures available

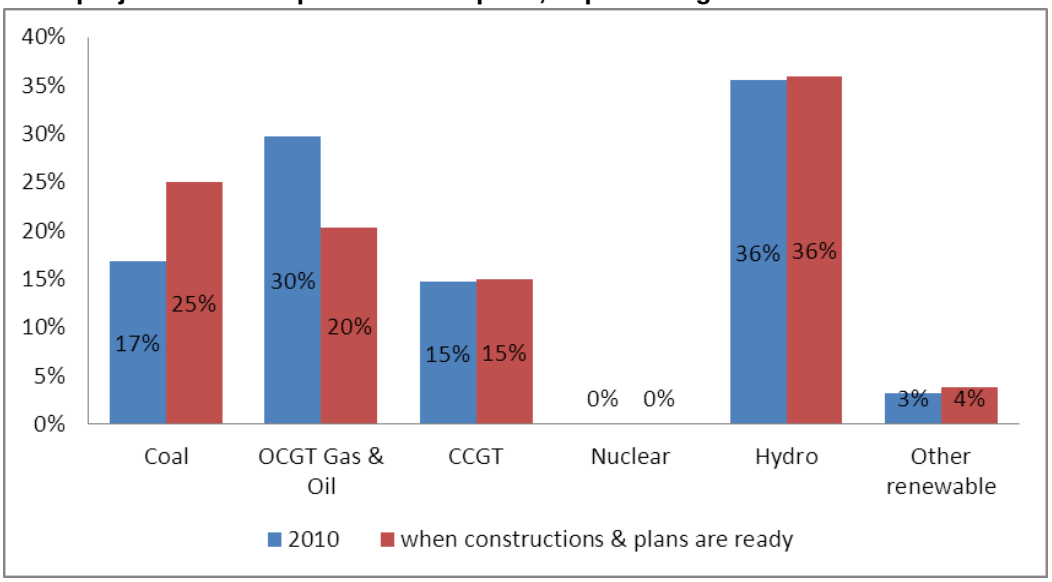
In Italy Enel is planning to increase its coal capacity by approximately 3,240 MW, while reducing the capacity of its oil-fired plants by 3,900 MW. Together with the increase in solar capacity of 60 MW, this leads to a net reduction of its total installed capacity in Italy with 600 MW. Table 26 shows Enel's installed capacity in 2010 compared to the situation when the current projects under construction have been completed and all of the company current plans have been realized. Investments in wind and solar plants are shown together under "other renewable".

Table 26: Enel's installed capacity in Italy - when current construction projects & future plans are complete, in MW

Fuel type	Installed capacity in 2010	Under construction	Plans	Installed capacity when constructions are ready
Coal	6,804	0	3,240	10,044
OCGT Gas & Oil	12,021	0	-3,900	8,121
CCGT	5,973	0	0	5,973
Nuclear	0	0	0	0
Hydro	14,417	0	0	14,417
Other renewable	1,307	155	60	1,522
Total	**40,522**	**155**	**-600**	**40,077**

Figure 11 shows Enel's Italian installed capacity in percentages: the blue columns show the company's current installed capacity (2010) and the red columns show the percentages at the moment that current projects under construction have been built and all current plans have been realized. The major changes will take place in the company's coal and oil capacities: coal will see an increase of 8%, while OCGT gas & oil will decrease by 10%. All other categories will not change significantly – below 1%.

Figure 11: Fuel mix of Enel's Italian installed capacity in 2010 vs. when current construction projects & future plans are complete, in percentages



4.1.4. Investment plans outside of Europe

Outside Europe, Enel operates in three regions: Latin America, North America and Russia. This paragraph analyzes the company's investments in these three regions. In its most important market outside of Europe, Latin America, the company operates through its subsidiary Endesa. Also Endesa's investments have been included. It has to be noted that unlike for Enel's investments in Italy and Europe, no distinction is made between projects which are under construction and project plans.

Table 27 shows Enel's investments in Latin America, North America and Russia. In the table investments in all stages of development are included: from promotional or conceptual stage until actual construction. Please note that all plants which have been described as "thermal plant" without any more specification by Enel or its subsidiary Endesa are included in the category "coal" in the table below. Outside Europe, Enel invests mainly in hydroelectric capacity: around 9,000 MW out of the total 15,000 MW of investments. Hydro is followed by coal with around 2,400 MW of investments, CCGT with 1,900 MW and other renewables with 1,300 MW. For details, see Table 27 below.

Table 27: Enel's investments outside of Europe, in MW, 2010

	Chile	Brazil	Colombia	Peru	Argentina	Other LatAm.	US	Russia	Total
Coal	1,360	850		200					2,410
OCGT Gas & Oil									
CCGT	500			300	267			820	1,887
Nuclear									
Hydro	4,421	1,653	1,857	1,235		50			9,216
Other renewable	407	493		98			275		1,273
Total	**6,688**	**2,996**	**1,857**	**1,833**	**267**	**50**	**275**	**820**	**14,786**

Source: Enel and Endesa[147]

[147] Endesa presentation "endesa strategic plan 2011-15", p. 9., http://www.jsda.or.jp/shiraberu/foreign/info3/kobetsu/9568(20110324)1.pdf; Endesa presentation "endesa analyst day – 17th May 2011", pp. 84-92.

For the different countries, the following plants have been included in the table above:

- Chile: Bocamina II, Alcalde 1&2, Celta 2 (coal); Quintero, Cierre CC Tal-Tal (CCGT); HidroAysen (50% Enel), Los Condores, Neltume, Piruquina, Choshuenco, Huechun, El Bardon, Vallecito, Puelo, Futaleufu (hydro); Renaico, Puelche, Lebu and Taltal (other renewable).
- Brazil: UTE Noreste, UTE Sudeste (coal); Paraiba do Sul, Jamanxim, Cachoeira dos Patos Carreiro (hydro); Eolicos 1&2, Rio Grande do Norte & Pernabuco & Bahia wind (other renewable).
- Colombia: El Quimbo, Guaicaramo, Sumapaz, Chapasia, Oporapas and Campohermoso (hydro)
- Peru: Talara (coal), Chimbote (CCGT), Curibamba, Moyopampa, Yanacoto, Milloc, Rio Maranon, Rio Santa (hydro); Yacila and Nazca (other renewable)
- Argentina: Vuelta de Obligado (CCGT – 33% Enel)
- Other Latin America: Chucas (hydro in Costa Rica)
- US: Rocky Ridge (50% Enel) and Caney River (wind)
- Russia: Nevinnomysskaya GRES and Sredneuralskaya GRES (CCGT).

4.2. Employment

A recent report by the European Renewable Energy Council and Greenpeace provides a methodology for calculating the jobs created by investments in various types of electricity generation capacity.[148]

Table 28: Employment factors for new installed electricity generation capacity, by fuel type

Fuel	Construction, Manufacturing & Installation (Person years/MW)	Operation & Maintenance (Jobs/MW)
Coal	7.7	0.1
Gas	1.5	0.05
Nuclear	16	0.3
Biomass	4.3	3.1
Hydro	11.3	0.2
Wind (onshore)	15.4	0.4
Wind (offshore)	28.8	0.7
Solar PV	38.4	0.4
Geothermal	6.4	0.7
Solar thermal	10	0.3
Ocean	10	0.3
Energy efficiency	0.29 jobs /GWh	

Source: EREC & Greenpeace[149]

http://www.endesa.com/EN/ACCIONISTAS/ANALISTAS/Presentaciones/EndesaAnalystDayMay17th_en.pdf; Enel press releases: http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1649865; http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1649585; http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1647565; http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1642205; http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1646505; http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645804; http://www.enel.com/en-GB/media/press_releases/release.aspx?iddoc=1645667 (22/02/2012).

[148] Greenpeace International and European Renewable Energy Council, "Energy [R]evolution – A sustainable world energy outlook", June 2010, p. 138, http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf

[149] Ibid.

Based on these employment factors, Enel's plans to build 3,240 MW[150] of new coal-fired power plants in Italy will create approximately 25,000 person-years of work for the construction, manufacturing and installation of the plants. Once construction is finished, the 3,240 MW of coal-fired capacity will require 324 jobs to operate and maintain.

The retiring of 3,900 MW[151] of oil and gas-fired capacity in Italy will lead to a loss of 195 jobs.

Enel's investments in 60 MW[152] of solar capacity in Italy, will create 2,304 person-years for construction, manufacturing and installation of the plant. For operation and maintenance of the solar systems, 24 jobs will be generated.

4.3. Emissions, waste, and the impact on public health of Enel's future fossil fuel and nuclear power production

4.3.1. Carbon and climate

Future carbon emissions for Italy remain obscure. No technical details are available for Enel's Carbon Capture and Storage (CCS) plans at Porto Tolle. The emissions of the Rossano plant cannot yet be predicted.

As an experiment, CCS is currently being tested at Enel's Brindisi plant. So far, the results have been extremely disappointing, putting the plans for CCS possibilities at Porto Tolle in serious question. CCS is a technique that remains technically unproven and highly controversial for many reasons.

Enel has not yet produced an environmental impact assessment for the planned Porte Tolle CCS plant. Nevertheless, it is has been predicted that at a minimum the Porto Tolle coal-fired power plant will still emit 0.77 tons of CO_2 per MWh, which is about the same as the current oil-fired power plant at Porto Tolle.[153] Other sources predict an annual production of 1 million tons of CO_2.[154]

4.3.2. Impact on public health and costs of emissions to air

In Italy, Enel will continue to contribute to air pollution by having new installed coal-fired capacity. Enel's predictions for emissions for the proposed new Porto Tolle plant for SO2/NOx/PM (mg/Nm3) are: 100/100/15 (hourly basis).[155] Rossano, Italy's oil-fired power plant that will be converted to a coal-fired plant, will also be responsible for future emissions. Outside of Italy, Enel is planning to invest in Romania's Galati plant, and in the Albanian plant of Porto Romano. The proposed 800 MW Porto Romano Energy Complex in Albania is estimated to produce the following air pollutants: 44,800 tonnes of bottom ashes, 401,600 tonnes of fly ashes and 9,328,000 tonnes of CO_2

[150] See table 26.
[151] See table 26.
[152] See table 26 and above.
[153] The Financial Times, 31 July 2008, *Italy's Enel opens new coal-fired power plant.* Website viewed 29 February 2012. http://www.ft.com/intl/cms/s/0/b0c5c612-5e5f-11dd-b354-000077b07658.html#axzz1nn7zVPCY.
[154] Website The Engineer, 19 May 2011, *Enel "astonished" by clean-coal project ruling*. Viewed 26 February 2012. http://www.theengineer.co.uk/channels/process-engineering/enel-astonished-by-clean-coal-project-ruling/1008719.article#ixzz1PLoUXudM.
[155] Enel presentation, Pietro Barbucci, Enel - Engineering & Innovation Division, "Enel's projects in Clean Coal and CCS" IEA Energy Efficiency and Clean Coal Technologies Workshop, Moscow, 25th-27th October 2010, p. 20., http://www.iea.org/work/2010/ee_cc/barbucci.pdf.

emissions annually. Estimates for CO_2 emissions are based on 8,000 hours of annual operation with 1,166 tonnes emitted per hour.[156]

Table **29** reveals the projected emissions to air from Enel's four planned coal-fired power plants in Europe and the associated health and financial impacts. Assumptions made for these calculations can be found in the footnotes. Note that Rossano Calabro emissions are excluding the gas-fired part.

Table 29: Projected emissions to air from Enel's planned coal-fired power plants in Europe and the associated health and financial impacts[157]

Enel facility	Emissions to air (t per year)				Exposure, per year		Health and financial impacts associated with Enel emissions, per year				
	PM_{10}	NO_X	SO_X	CO_2	$PM_{2.5}$	SOMO35 (ozone)	Prema-ture deaths	Crop damages (€)	Costs air pollution (€)	Costs CO_2 (€)	Total Costs (€)
Rossano Calabro (Italy)[158]	300	1,800	1,800	4,719,000	529,405	61,144,257	33	343,908	76,656,843	158,558,400	235,215,243
Porto Tolle (Italy)[159]	347	3,564	3,564	9,791,000	991,675	121,065,628	62	680,938	143,611,898	328,977,600	472,589,498
Porto Romano (Albania)[160]	180	2,700	2,700	4,360,000	338,965	177,655,035	24	N/A	49,926,213	146,496,000	196,422,213
Galati (Romania)[161]	200	2,700	2,700	4,360,000	651,932	210,297,405	43	656,721	95,297,064	146,496,000	241,793,064
TOTAL	1,027	10,764	10,764	23,230,000	2,511,976	570,162,325	163	**at least 1,681,567**	365,492,018	780,528,000	1,146,020,018

Source: See below for sources of emission figures and assumptions. Calculations of health and financial impacts associated with emissions using EEA methodology

4.3.3. Nuclear waste

Enel was very actively involved in a lobby for nuclear power in Italy[162] but cannot make any nuclear plans for Italy after the 2011 referendum in which future nuclear power was rejected by the Italian people. Enel does remain actively involved in nuclear operations and in lobbying for the nuclear sector, for instance by founding a Nuclear Forum in Italy, and by financing conferences on nuclear energy.[163]

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[156] P. Trzaskowski and F. Bacheva-McGrath, "Over the edge - Enel's plans to export its pollution to Porto Romano, Albania", (Tirana: CEE Bankwatch Network, April 2010), p. 14., http://bankwatch.org/sites/default/files/PortoRomanoOverTheEdge.pdf.

[157] Assumptions need to be made in order to obtain an idea of any future emissions and health impacts. These are the assumptions used here: 7500 full load hours for all plants; as Rossano Calabro values are given both as mg/Nm3 and t/h, these were used to convert the others. Porto Tolle: 1980 MW, Porto Romano: both 1 and 2 units of 800 MW but only one was calculated. Reported efficiencies for Rossano Calabro and Porto Tolle are the same; coal will probably be similar ,thus values were scaled up by higher output. Note that this calculation does not consider eventual emissions to air that may be captured by CCS technology that Enel is planning to employ.

[158] Rossano Calabro http://www.autistici.org/difendiamolacalabria/wp-content/uploads/2010/05/SIA_ROSSANO-SNT_aprile2010.pdf.

[159] Porto Tolle http://www.cslforum.org/publications/documents/Edmonton2011/Barbucci-TG-ZEPTProject-Edmonton0511.pdf.

[160] Porto Romano http://www.scribd.com/doc/72026971/131/Ndikimet.

[161] Galati http://www.mediu.gov.md/file/Evenimente/Memoriu%20de%20prezentare.pdf.

[162] See e.g. Enel, EDF, and The European House/Ambrosetti 2010, *Nuclear power for the economy, the environment and development.*

[163] Enel Sustainability Report 2010, p.56.

In Slovakia, with units 3 and 4 of the Mochovce nuclear power plant being completed, another 880 MW of production capacity has been created. This capacity will be activated in 2012/2013.[164] Enel is collaborating with Electricité de France in the construction of a new 1,600 MW nuclear power plant (type European Pressurised Reactor, in Flamanville).

Likewise, Enel will be involved in the construction of another French reactor of the same type, in Penly. Once finished, these reactors will not be operated by Enel. In Russia, Enel is collaborating with Rosatom in order to commonly develop new power plants. It is as yet unknown whether Enel will be involved in operating any Russian plants.

In total, Enel's current construction projects will lead to an additional 1,231 MW[165] of nuclear power This leads to the following amount of nuclear waste per annum: 34.59629 tons of spent fuel, 320.2272 tons of UF6 (is 216.5317 tons depleted U), 129,499.7 tons of mill tailings, and 648,964.1 tons of waste rock at uranium mines.[166]

[164] Enel Sustainability Report 2010, p.34.
[165] See table 24.
[166] Calculations carried out by use of the WISE Uranium Nuclear Fuel Chain Waste Activity Calculator.

5. How could Enel provide a brighter, cleaner Italian tomorrow?

Greenpeace Italy has a vision of how Enel could provide a brighter and cleaner future for Italy involving an expedited shift from coal- fired and nuclear power to renewable energy production. This chapter seeks to project what the impact on investments, capacity, jobs, emissions and public health would be if Enel were to abandon its own strategic scenario and the Greenpeace plan to invest in heavily renewable energy rather than coal and nuclear power in Italy.

Greenpeace Italy's vision on how Enel could provide for a cleaner Italian tomorrow is the following: Greenpeace Italy requests that, by 2020, Enel cut its current (2010) production of coal-fired electricity in Italy by 50%, and replace that lost production with the same amount of additional renewable production in Italy.

This 'additional' production from renewables thus means additional production on top of what is expected to be produced by the current construction plans and future investments that Enel already has in the pipeline. By 2030, all of Enel's coal-fired electricity production in Italy should be phased out and be replaced by additional renewable production.

5.1. Investments

In 2010 and 2011, Enel had around 6,800 MW of total installed coal-fired capacity in Italy.[167] With this capacity, the company produced 27,798 GWh and 32,423 GWh of electricity in 2010 and 2011, respectively. To be able to produce the same amount of GWh of electricity from renewables, Enel has to build renewable power plants with a higher total installed capacity than its coal-fired plants, as renewable power plants cannot operate at full power continuously as they depend on natural resources such as wind and the sun. As the power of sun and the wind vary according to weather circumstances, power plants that depend on these renewable resources can only produce full power during a limited amount of hours per year.

Thus, the amount of hours that a renewable power plant can produce electricity in one year is lower than that of coal-fired plants (which can burn coal at nearly full power most of the year). This is known as the capacity factor: the ratio between the energy that is actually supplied by the power plant during a year, and the theoretical energy provided if the same plant were operated at full-rated nameplate capacity during the same time period.

Table 30 shows the consequences in installed capacity and electricity production for Enel in Italy, where it to follow Greenpeace Italy's vision.

[167] Enel presentation "2010 Results 2011-2015 Plans", 15 March 2011, pp. 59-62, Enel website, Investor, Presentations, 2011, http://www.enel.com/en-GB/investor/annual_presentations/?anno_curr=2011&anno_iniziale=2012&anno_finale=2005&id= (03/02/2012) and Enel presentation "2011 Results 2012-2016 Plans", 8 March 2012, pp. 48-51, Enel website, Investor, Presentations, 2012 < http://www.enel.com/en-GB/investor/annual_presentations/presentazione.aspx?id=2012_02 > (15/03/2012).

Table 30: Required shift in Enel's coal-fired capacity and electricity production in order to be in line with Greenpeace Italy's vision

Year	Coal capacity (MW)	Electricity production from coal (GWh)
2010	6,800	32,400
2020	3,400	16,200
2030	0	0

In order to be able to produce the same amount of electricity from renewables as from the gradually phased-out coal plants, Enel would need to build additional renewable-based capacity as presented in Table 31. The figures in Table 31 are calculated assuming the following capacity factors for renewables in Italy[168]:

- Hydropower: 42% (3,700 productive hours/year)
- Solar PV: 15% (1,300 hours/year)[169]
- Solar CSP: 23% (2,000 hours/year)
- Wind onshore: 18% (1,600 hours/year)
- Wind offshore: 23% (2,000 hours/year)[170]
- Geothermal: 74% (6,500 hours/year)
- Wave and tidal energy: 10% (877 hours/year)
- Biomass: 74% (6,500 hours/year).

It should be noted that the capacity factors used for the calculations used here are very conservative in order to avoid any unrealistically optimistic estimation of investment costs in renewable energy technologies. For example, the capacity factor of offshore wind could be increased to 2,400 hours/year. Assuming higher capacity factors would reduce the estimated investment costs. In addition to capacity factors, varying construction costs and technical potentials in Italy for the different renewable energy sources and technologies have been taken into consideration. For investment costs per fuel type, see Table 33.

Table 31: Required shift in Enel's capacity and electricity production from renewables in order to be in line with Greenpeace Italy's vision

Year	Production by renewables* (GWh)	Renewables capacity* (MW)
2010	0	0
2020	16,200	9,800
2030	32,400	19,600

*Capacity on top of current renewable project under construction and future plans in the pipeline

The following breakdown of renewable energy sources is envisioned by Greenpeace Italy: onshore wind 50%, solar PV 20%, offshore wind 20%, biomass 5.5%, ocean 2%, hydropower 1.5%, solar thermal 0.5%, geothermal 0.5%.[171] Table 32 applies these percentages to the targets of additional renewables capacity in 2020 (9,800 MW) and 2030 (19,600 MW). It should be noted that e.g. solar CSP and geothermal energy may be considered suitable options for Italy (capable of producing a

[168] Capacity factors provided by Greenpeace Italy, e-mail received April 2012.

[169] G. B. Zorzoli, President of the Italian Chapter of International Solar Energy Society (ISES), personal communication with Giuseppe Onufrio, 10/5/2012.

[170] G. Gaudiosi, "Energia Eolica Offshore in Italia", 2008, ftp://gis.dipbsf.uninsubria.it/Eolico_biblio/Energia%20Eolica_OFFSHORE%20in%20Italia.pdf (15-5-2012)

[171] The energy mix described proves to be both a cost-efficient as well as reasonable energy mix for Italian circumstances. However, depending on local political, social, geographical, financial and environmental circumstances, Enel could opt for another breakdown of renewable energy sources.

significant amount of energy) however, as their construction costs are relatively high, their contribution is minimised in the renewable energy mix proposed by Greenpeace.

Table 32: Additional renewables capacity in 2020 and 2030 in % and MW, as proposed by Greenpeace Italy

Fuel type	Percentage	Capacity construction in period 2011-2020 (MW)	Capacity construction in period 2021-2030 (MW)	Target capacity by 2030 (MW)
Wind onshore	50%	5,063	5,063	10,125
Wind offshore	20%	1,620	1,620	3,240
Solar photovoltaic	20%	2,492	2,492	4,985
Biomass	5.5%	137	137	274
Wave and tidal	2%	370	370	739
Hydro	1.5%	66	66	131
Solar CSP	0.5%	41	41	81
Geothermal	0.5%	12	12	25
Total	**100%**	**9,800**	**9,800**	**19,600**

Most renewable technologies will become more cost efficient in the future as technological design improves and the technologies reach economies of scale. The required amount of investment to develop additional capacity will therefore decline.

Table 33 shows the anticipated investment costs per fuel type in USD/MW of installed capacity for the periods 2011-2020 and 2012-2030, and the total investment costs in mln USD for additional renewables capacity for Enel, were it to follow the scenario envisioned by Greenpeace Italy. Please note that the costs for decommissioning Enel's current coal capacity in Italy have not been included in this table.

Table 33: Cost of constructing new capacity for electricity generation based on renewable sources of energy in 2011-2020 and 2021-2030

	2011-2020		2021-2030		2030
Fuel type	**Investment costs* (USD/kW)**	**Total costs (mln USD)**	**Investment costs* (USD/kW)**	**Total costs (mln USD)**	**Total expenses by 2030 (mln USD)**
Wind onshore	998	5,052	952	4,820	9,872
Wind offshore	1,540	2,495	1,460	2,365	4,860
Solar PV	1,776	4,426	1,027	2,560	6,986
Biomass	2,435	334	2,377	326	660
Wave and tidal	2,806	1,037	2,158	798	1,835
Hydro	2,952	194	3,085	203	396
Solar CSP	5,044	204	4,263	173	377
Geothermal	9,184	114	7,250	90	205
Total		**13,857**		**11,333**	**25,190**

*Based on: Greenpeace International and the European Renewable Energy Council[172]

[172] Greenpeace International and European Renewable Energy Council, "Energy [R]evolution – A sustainable world energy outlook", pp. 54-57., June 2010, http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf.

Total costs for 2020, based on the Energy [R]evolution report by Greenpeace International and the European Renewable Energy Council calculations for future cost developments, amount to USD 13.9 billion (EUR 10.7 billion)[173], while total investment costs to install the proposed additional capacity of renewable energy until 2030 will amount to around USD 25.2 billion (EUR 19.4 billion).

5.2. Employment

The alternative scenario for Enel will also have consequences with regards to employment. These effects are shown in Table 34. The table shows the amount of person-years of work created by the construction, manufacturing and installation of the different types of plants and the jobs required to operate and maintain these plants for the years 2020 and 2030. Negative figures relate to the decommissioning of coal plants and hence indicate the job losses associated with these operations. Also the current constructions and future plans for new coal plants which are already in the pipeline for Enel are shown (see coal figures in Table 26). Calculations for person-years necessary for construction and jobs needed for operation and maintenance are performed with employment factor figures from Table 28.

As a consequence of cutting its current (2011) production of coal-fired electricity with 50% by 2020 and with 100% by 2030 and replacing that missing production with the same amount of additional renewable production in Italy, the company would be creating: around 201,000 and 226,000 person-years of work for the construction, manufacturing and installation of plants in the periods 2011-2020 and 2021-2030 respectively, and around 8,400 permanent jobs for the operation and maintenance of the plants by 2030. These figures are shown in Table 34.

Table 34: Job created by Enel as a consequence of the additional renewables capacity envisioned by Greenpeace Italy for the periods 2011-2020 and 2021-2030

	2011-2020			2021-2030			2030
Fuel type	**Capacity change (MW)**	**Construction manufact-uring & installation (person-years)**	**Operation & maintenance (jobs)**	**Capacity change (MW)**	**Construction, manufacturing & Installation (person-years)**	**Operation & maintenance (jobs)**	**Operation & maintenance (total permanent jobs in 2030)**
Coal (existing plants)	-3,400	0	-340	-3,400	0	-340	-680
Coal (current constructions and future plans)	-3,240	-24,948	-324	0	0	0	-324
Wind onshore	5,063	77,963	2,025	5,063	77,963	2,025	4,050
Wind offshore	1,620	46,656	1,134	1,620	46,656	1,134	2,268
Solar photovoltaic	2,492	95,705	997	2,492	95,705	997	1,994
Biomass	137	589	425	137	589	425	850
Wave and tidal	370	3,696	111	370	3,696	111	222
Hydro	66	742	13	66	742	13	26
Solar CSP	41	405	12	41	405	12	24
Geothermal	12	80	9	12	80	9	17
Total	**3,160**	**200,888**	**4,062**	**6,400**	**225,836**	**4,386**	**8,448**

[173] Based on May2012 US Dollar – Euro conversion, XE Currency Converter, www.xe.com.

5.3. Emissions, waste, and the impact on public health of Enel's hypothetical future fossil fuel and nuclear power production

5.3.1. Carbon and climate

Total emissions in Italy amounted to 34.4 million tons of CO_2, or 34.5 million tons of CO2 equivalent in 2010.[174] Having generated a total of 81,180 GWh[175], the Italian emission-production ratio amounted to 425 kg CO_2/MWh[176].

However, when Greenpeace's suggestions of decommissioning all Italian coal-fired power plants are followed by Enel, the current emissions from these coal-fired plants, which today accumulate to approximately 27,735,000 t CO2/year (see Table 13) will be eliminated completely. Also, the plants at Porto Tolle and Rossano, which are now Enel's newly planned coal-fired power plants, will not produce any carbon dioxide. Enel has not yet produced an environmental impact assessment for the planned Porte Tolle CCS plant. Nevertheless, it is has been predicted that at a minimum the Porto Tolle coal-fired power plant will still emit 0.77 tons of CO_2 per MWh, which is about the same as the currently nearly closed oil-fired power plant at Porto Tolle.[177] Other sources predict an annual production of 1 million tons of CO_2.[178]
Again, by not constructing new coal-fired power plants, with or without CCS, large amounts of CO_2 are not produced.

5.3.2. Impact on public health and costs of emissions to air

Not only CO_2 emissions, but also emissions of pollutants such as NOx, SOx, and ozone will decrease dramatically if Enel switches production according to Greenpeace's suggestions. For example, the theoretical amount of premature deaths due to Enel's Italian coal-fired plants was 366 in 2010 (see Table 13), while costs carried by society (for crop damage, increased health expenses, loss of human productivity, etc.) amounted to nearly EUR 1.8 billion per year. These costs will decrease linearly until they are reduced to 0 by 2030.

Also, by avoiding investing in new coal-fired power plants such as Porto Tolle and Rossano, another 3,240 MW of coal-fired plants will not be emitting the pollutants as they are calculated in Table **29** above.

[174] Enel Environmental Report 2010, p. 151.
[175] Enel Environmental Report 2010, p. 149.
[176] Enel Environmental Report 2010, p.161.
[177] The Financial Times, 31 July 2008, *Italy's Enel opens new coal-fired power plant.* Website viewed 29 February 2012. http://www.ft.com/intl/cms/s/0/b0c5c612-5e5f-11dd-b354-000077b07658.html#axzz1nn7zVPCY.
[178] Website The Engineer, 19 May 2011, *Enel "astonished" by clean-coal project ruling*. Viewed 26 February 2012. http://www.theengineer.co.uk/channels/process-engineering/enel-astonished-by-clean-coal-project-ruling/1008719.article#ixzz1PLoUXudM.

6. Conclusions and Implications

The research results outlined in this report results lead to the following answers to the research questions. These conclusions have important implications for policy makers, energy companies, civil society and all those interested in the public debate the future of our system of energy supply.

Today, Enel is a major, international energy company, which generated 290,200 GWh[179] in 2010, of which 73,100 GWh (25%) was produced by coal-fired plants. In Italy, the company produced 81,569 GWh, while 34% or 27,798 GWh of electricity was produced by coal-fired plants[180]. The company employed 78,145 people in 2010[181]; 37,383 of these employees worked in Italy.

After conducting a literature review on calculating the health impact of industrial facilities, SOMO chose to use a methodology that was created for the European Environment Agency of the European Union. The EEA is a reliable source of information which advises the European Commission, the European Parliament, the European Council, as well as EU member countries, on environmental issues.[182] Among the various scientific methods available to calculate health impact from air pollution, the methodology applied by the EEA is perceived to be reliable and non-controversial and therefore served as a basis for SOMO to calculate health impacts from Enel's power plants in Italy. While using data from the European Pollutant Transfer and Release Register, where emissions data from 28,000 European industrial facilities can be found. Enel's coal-fired power plants emitted 27,735,000 tons of CO_2 in 2010[183], and many tons of pollutants such as nitrogen oxides, sulphur acids, particulate matter, and ozone; which, according to our calculations, should have led to 366 premature deaths[184] in Italy. Total annual costs for the Italian society – due to crop damage, health damage, and CO_2 emissions – are estimated to amount to € 1,772 million.[185]

Tomorrow's operations are described by the company itself: in Italy, Enel is planning to increase its coal capacity from a current 6,804 MW to 10,044 MW.[186] To calculate future employment for this new coal capacity, SOMO has used numbers that were proposed by Greenpeace. These employment factors were developed for the Energy [R]Evolution report, by Greenpeace and the European Renewable Energy Council.[187] Based on these employment factors, Enel's plans to build 3,240 MW[188] of new coal-fired power plants in Italy would create approximately 25,000 person-years of work for the construction, manufacturing and installation of the plants. If Enel were to complete construction, the 3,240 MW of coal-fired capacity would require 324 jobs to operate and maintain.

[179] See table 9.
[180] See table 11.
[181] See table 12.
[182] Source: website EEA. http://www.eea.europa.eu/about-us Viewed 30 April 2012.
[183] See table 13.
[184] See table 13.
[185] See table 13.
[186] See table 26.
[187] Greenpeace International and European Renewable Energy Council, "Energy [R]evolution – A sustainable world energy outlook", June 2010, p. 138, http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf.
[188] See table 26.

The retiring of 3,900 MW[189] of oil and gas-fired capacity in Italy will lead to a loss of 195 jobs (as Porto Tolle and Rossano Calabro will be converted to coal-fired plants). By increasing coal capacity, the future coal-fired plants are expected to cause an additional annual 163 premature deaths[190].

Greenpeace Italy proposes an alternative energy future for Enel. Enel should not only avoid any potential nuclear operations, it should also abandon the path of coal. Greenpeace's proposal is to close all Italian coal-fired plants between now and 2030, and not to construct any new coal-fired facilities. Instead, the coal-fired production should be replaced by renewable energy. In order to do so, SOMO has calculated how much renewables capacity would have to be constructed, how high investment costs will be, and how much employment will be created. These calculations are based on variables provided by Greenpeace: capacity factors of power plants were given by Greenpeace Italy. Expected investments costs per MW renewables and future employment numbers were taken from the Energy [R]Evolution report.[191]

It was thus calculated that replacing 10,044 MW of coal capacity by renewables will require an installed capacity of 19,600 MW[192] of renewables. This will create 8,448 permanent jobs by 2030 (job loss due to abandoning coal has been integrated in this calculation).[193] During the construction periods of 2011-2020 and 2021-2030, a respective 200,888 and 225,836 person-years will be created. Premature deaths due to air pollution by coal-fired plants will be avoided entirely. The investments costs for Enel are expected to amount to $ 25,190 million.[194]

[189] See table 26.
[190] See table 29.
[191] Based on Greenpeace International and European Renewable Energy Council, "Energy [R]evolution – A sustainable world energy outlook", pp. 54-57., June 2010, http://www.greenpeace.org/international/Global/international/publications/climate/2010/fullreport.pdf.
[192] See table 31.
[193] See table 34.
[194] See table 33.

Appendix 1: Source-receptor relationships

The following source-receptor relationships were calculated for the 2011 EEA report “Revealing the costs of air pollution from industrial facilities in Europe”.

Table 35: Effect of emission of 1 t of each pollutant from each country on population weighted concentration of $PM_{2.5}$ across Europe

Country	$PM_{2.5}$	NO_X	SO_2
Albania	3.9151E+02	5.8082E+01	8.2488E+01
Austria	5.8772E+02	2.2591E+02	1.8662E+02
Bosnia and Herzegovina	3.5199E+02	1.1425E+02	9.9051E+01
Belgium	8.5339E+02	1.6853E+02	2.1207E+02
Bulgaria	3.8085E+02	1.0154E+02	7.9346E+01
Belarus	2.2580E+02	9.7429E+01	1.1698E+02
Switzerland	7.3239E+02	3.5889E+02	2.6298E+02
Cyprus	2.5548E+02	9.8007E+00	2.7207E+01
Czech Republic	4.1200E+02	1.6107E+02	1.6297E+02
Germany	8.8171E+02	2.6561E+02	2.3820E+02
Denmark	2.1593E+02	7.1436E+01	9.0450E+01
Estonia	1.4089E+02	3.2905E+01	8.2895E+01
Spain	3.8324E+02	5.5669E+01	1.0219E+02
Finland	1.4099E+02	2.4983E+01	5.7584E+01
France	6.0059E+02	1.8773E+02	1.8401E+02
United Kingdom	4.8684E+02	1.0308E+02	1.5082E+02
Greece	3.5998E+02	2.2957E+01	5.8540E+01
Croatia	5.3045E+02	1.5928E+02	1.3954E+02
Hungary	5.8052E+02	2.1239E+02	1.5878E+02
Ireland	3.0100E+02	7.1488E+01	1.1304E+02
Italy	7.0369E+02	1.5666E+02	1.5384E+02
Lithuania	1.9183E+02	8.1914E+01	9.7355E+01
Luxembourg	6.3598E+02	2.3283E+02	1.9175E+02
Latvia	1.9150E+02	5.2563E+01	8.7021E+01
Moldova	4.2904E+02	1.3034E+02	1.2050E+02
Macedonia	2.3254E+02	5.9562E+01	6.3020E+01
Malta	3.1282E+02	7.0875E+00	
Netherlands	7.8787E+02	1.5920E+02	2.4723E+02
Norway	1.5740E+02	3.2299E+01	4.7047E+01
Poland	4.0410E+02	1.2328E+02	1.4186E+02
Portugal	4.7380E+02	2.2621E+01	6.8326E+01
Romania	4.1235E+02	1.6450E+02	1.1866E+02
Sweden	2.2151E+02	3.9651E+01	6.0636E+01
Slovenia	4.3189E+02	1.8557E+02	1.5780E+02
Slovakia	4.0689E+02	1.8749E+02	1.5482E+02

Turkey	3.7775E+02	2.7340E+01	5.9347E+01
Ukraine	4.1453E+02	1.0216E+02	1.3098E+02

Table 36: Effect of emission of 1 t of each pollutant from each country on population weighted SOMO 35 concentration across Europe

	NO_X	SO_2
Albania	8.8167E+04	-3.4164E+03
Austria	7.8029E+04	-1.2443E+04
Bosnia and Herzegovina	1.0376E+05	-3.5514E+03
Belgium	-6.6578E+04	-5.6995E+03
Bulgaria	9.2314E+04	-7.0708E+02
Belarus	4.8965E+04	-4.4867E+03
Switzerland	9.0287E+04	-1.8906E+04
Cyprus	5.5981E+04	-1.4830E+03
Czech Republic	5.5582E+04	-7.9477E+03
Germany	3.4242E+04	-1.2346E+04
Denmark	6.9511E+03	-1.0464E+04
Estonia	3.0064E+04	-4.2567E+03
Spain	5.9470E+04	-1.0853E+04
Finland	1.7214E+04	-6.2519E+03
France	9.2518E+04	-1.1662E+04
United Kingdom	-3.4462E+04	-9.9640E+03
Greece	4.3628E+04	-1.6494E+03
Croatia	1.1231E+05	-7.5827E+03
Hungary	1.1316E+05	-4.4170E+03
Ireland	4.8069E+04	-1.5386E+04
Italy	5.4142E+04	-9.4963E+03
Lithuania	6.6340E+04	-6.2456E+03
Luxembourg	1.5503E+04	-9.0853E+03
Latvia	4.5998E+04	-5.8752E+03
Moldova	9.0858E+04	-3.1587E+03
Macedonia	6.4754E+04	-2.0287E+03
Malta	1.2860E+04	
Netherlands	-7.0151E+04	-5.4803E+03
Norway	5.2553E+04	-1.4571E+04
Poland	3.9462E+04	-3.6812E+03
Portugal	6.3186E+03	-5.6914E+03
Romania	1.0215E+05	-2.0537E+03
Sweden	3.1619E+04	-1.1205E+04
Slovenia	8.6406E+04	-1.1863E+04
Slovakia	1.0862E+05	-5.3033E+03
Turkey	6.1512E+04	-8.7392E+02
Ukraine	4.5440E+04	-3.0269E+03