

The Impact of Climate Change on the Strategies of the Electricity Industry



Table of contents

Objectives of the Report	3
Contribution of the electricity industry to the climate change issue	4
Business environment for the electricity industry: Changes caused by the climate change issue and actions taken to address them	9
Estimated contribution of the electricity industry in existing CO ₂ emissions scenarios	13
Scope of the role of the electricity industry in the climate change issue	16
References	17

Foreword

This report is the result of a questionnaire survey on the topic of how the climate change issue is affecting the corporate strategies of E7 companies, as well as some of the E7's partners from around the world. We have also compiled and included as much information as possible on the actual and planned actions of each company to address the climate change issue.

Electricity is indispensable to modern life and economic development due to its convenience and efficiency. Electricity also enjoys the benefit of emitting no pollutants at the point of use. These are a few of the many reasons why the share of electricity (i.e. rate of electrification) has been a rising trend. Electricity is unique among the various energies in that there are many ways to reduce CO₂ emissions on the supply side and there is a significant potential for CO₂ emission reductions through the efforts of the electricity companies. Thus, it can be said that increased electricity consumption can be beneficial in controlling emissions, and that the electricity industry plays an extremely important role in addressing the climate change issue.

As a first step, the electricity industry in both Annex I and non-Annex I countries is implementing measures to control the emission of greenhouse gases (GHGs) from domestic power consumption. Each of the electricity companies is making an effort to minimize GHG emissions by selecting from a wide range of options and approaches best suited to their respective circumstances. These include: Improvement of thermal efficiency, switching to fossil fuels that emit less CO₂, promotion of nuclear power and renewable energy generation which does not emit CO₂ during operation, promotion of efficient electricity end-use, and substitution of inefficient energy end-use by electricity. Various kinds of initiatives, including formulation of voluntary agreements with governments are also being introduced to promote the above-mentioned activities.

Furthermore, E7 members and its partners are committed to working with national governments and international organisations to address the climate change issue. For example, the electricity industry is committed to participate in the formulation of the framework pursuant to the Kyoto Protocol as a way of moving forward with the climate change issue. The electricity companies are undertaking pioneering activities such as participation in activities implemented jointly (AIJ) projects, emissions trading in-house or between companies, overseas activities aimed at joint implementation (JI) and the clean development mechanism (CDM), among others.

Activities to develop implementation procedures for the flexibility mechanism of the Kyoto Protocol are being continued at the national government level. The electricity industry in both the Annex I and non-Annex I countries believes that it can cooperatively support these activities at the practical level through initiatives such as greenhouse gas reduction projects and emissions trading. As a first result, the “*Position Paper on CDM and other Flexible Mechanisms – E7 and Its Partners from Around the World*” has been circulated among the stakeholders.

The E7 members aspire to strengthen the relationships with its partners that participated in the preparation of this report and also appeal to other companies worldwide that have not participated this time, to join their efforts in the future. The E7 firmly believes that development of this type of international cooperation activities by the electricity industry will have a great impact on the progression of discussions by various organizations currently involved in the climate debate.

We would like to express our gratitude to each company for kindly presenting the information used to prepare this report.

Notes: E7 is an association of the world’s leading electricity companies. They are, in alphabetical order, EDF (France), Edison International (USA), ENEL (Italy), Hydro-Quebec (Canada), Kansai Electric Power Co. (Japan), Ontario Power Generation (Canada), RWE (Germany), and Tokyo Electric Power Co. (Japan).

Annex I is a group of countries defined by the Framework Convention on Climate Change. Annex I countries take on greenhouse gas mitigation targets, and carry out various measures to achieve them. Most developed countries and economies in transition belong to Annex I.

Non-Annex I is a group of countries which do not belong to Annex I, but are parties to the Climate Convention. These countries are not obliged to take on targets, but cooperate with Annex I countries.

Objectives of the Report

As various stakeholders are furthering the discussions on the climate change issue, the E7 companies acknowledge the importance of the cooperative approach taken by electricity companies around the world, to reduce GHG emissions.

To further promote international cooperation, eight companies from the E7 and six electricity industry companies outside the E7 (CEGCO, EGAT, ESKOM, PLN, SPCC and ZESA) held an international workshop in Bonn, Germany, in October of 1999. The workshop reaffirmed that the participating companies share a common understanding of the electricity industry's important role in addressing the climate change issue.

This report builds upon the common understanding of the workshop. It is a compilation of the results of the questionnaire survey investigating how each electricity company, within its own particular circumstances, takes on the climate change issue as a business issue, as well as on what kinds of actions are being taken. Many electricity industry companies have published reports on their activities, however, this report is probably the first of its kind. It compiles the current state of the electricity industry around the world in an orchestrated manner.

In preparing this report, we became convinced that the electricity industry will further its international cooperation activities. We strongly hope that the publication of this report serves as an excellent opportunity for various organizations involved to further their understanding of the practical approach taken by the electricity industry in addressing this issue.

The objectives of this report are to demonstrate:

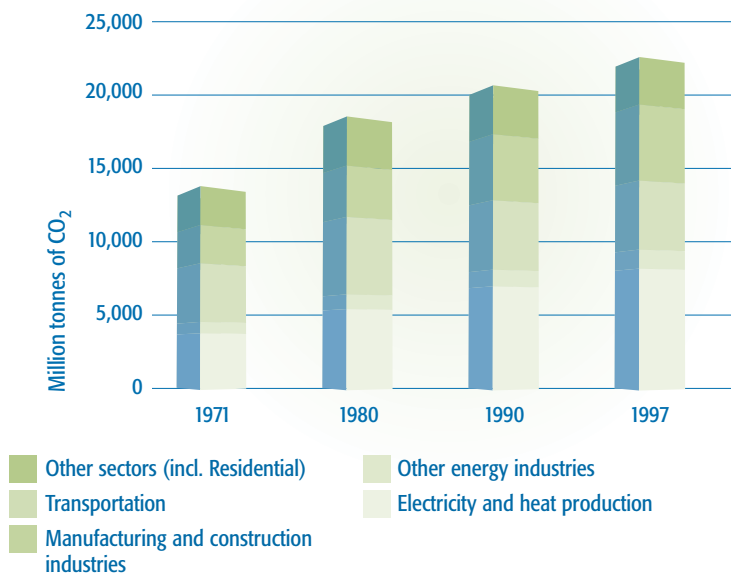
- The role of electricity as an important means to reduce GHG
- Cooperation among companies in the electricity sector worldwide such as the E7 and its partners as an effective, practical approach to reducing GHG emissions.

Contribution of electricity industry to climate change issue

Trend of emissions from electricity consumption in relation to world GHG emissions

Worldwide CO₂ emissions from 1971 to 1997 have grown by about 68%. Since 1990, it has risen by about 8% (Fig.1-1). Emissions from electricity consumption, represented roughly by emissions from “electricity and heat production” consisted of about 27% of the world’s total in 1971. Since then, it has risen gradually to 29% in 1980, 30% in 1990, and to 32% in 1997. It can be seen that the change in emissions from electricity consumption significantly affect world emissions.

Fig.1-1
Sectoral CO₂ emissions of the world (Data source: IEA, 1999, CO₂ Emissions from Fuel Combustion 1971-1997; IEA, Energy Balances of OECD Countries; IEA Energy Balances of Non-OECD Countries)



Regarding “electricity and heat production” in Fig.1-1, it should be noted that the bulk of CO₂ emissions is due to meeting customer electricity and heat demands in the commercial and residential sectors, as well as in the manufacturing sector.

Key figures pertaining to CO₂ emissions from the electricity industry are as shown on Table 1-1. From the table, it can be seen that the world GDP, final energy consumption, and CO₂ emissions have grown 2.1, 1.8, and 1.7 times during the period from 1971 to 1997, respectively. Thus, the increase in CO₂ emissions was smaller than the increase in final energy consumption. One of the reasons for this, is that there has been a fall of about 25% in CO₂ emission intensity (i.e. CO₂ emissions per kWh of electricity generated) in the electricity supply sector during the period. Furthermore, convenience and efficiency of electricity became widely recognized resulting in an increased rate of electrification of about 1.6 times. This means that the share of electricity in final energy consumption has increased.

The reason for this dramatic decline in CO₂ emission intensity lies in the diversity of emissions reduction measures that the electricity industry can take in generating electricity, a secondary form of energy. The electricity industry can take advantage of this and contribute significantly to a worldwide reduction of CO₂ emissions through efforts to improve energy efficiency, as well as promoting generation methods which do not emit CO₂, such as nuclear, hydropower, and other renewable energies.

Industry to the climate

Table.1-1. Reference data on CO₂ emissions from electricity consumption (Worldwide)

	1971	1980	1990	1997	ref:
Real GDP [1990 US dollars]	12,054	16,487	21,612	25,270	1)
Total final energy consumption [million tons oil equivalent]	3,789	4,768	5,541	6,661	2), 3)
CO ₂ emissions (all sectors) [Mt- CO ₂]	13,707	18,246	21,246	22,981	1), 2), 3)
Electricity generation [TWh]	5,264	8,315	11,825	13,949	2), 3)
CO ₂ emissions (electricity and heat) [Mt- CO ₂]	3,745	5,390	6,390	8,129	1), 2), 3)
CO ₂ emission intensity ¹ [kg-CO ₂ /kWh]	0.71	0.65	0.54	0.53	1), 2), 3)
Electrification rate ² [%]	10.1	11.9	15.5	17.0	4)

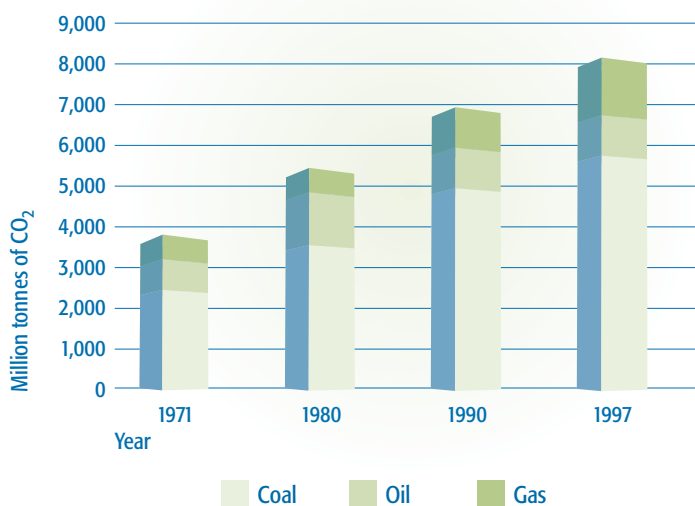
Notes: 1. Calculated as total CO₂ emissions/total electricity generated.
2. Based on final energy consumption.

Ref. 1) IEA, CO₂ Emissions from Fuel Combustion 1971-1997
2) IEA, Energy Balances of OECD Countries
3) IEA, Energy Balances of non-OECD Countries
4) Estimate by the Institute of Energy Economics Japan

Data on CO₂ emissions from electricity consumption, according to fuel type and region

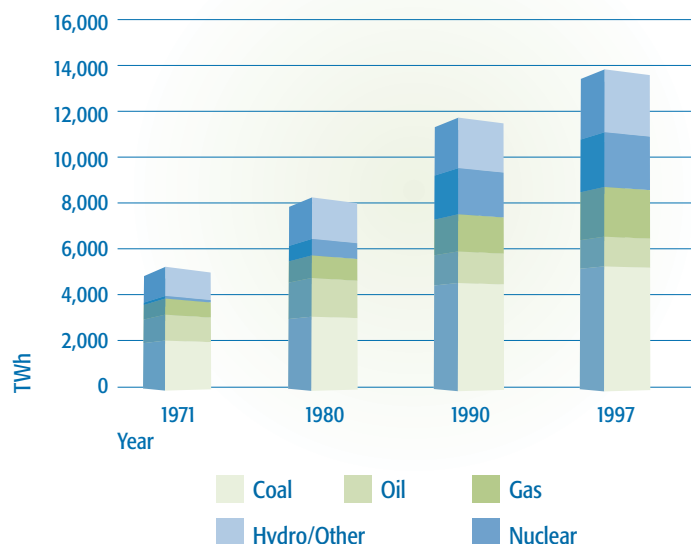
Worldwide CO₂ emissions from electricity consumption are as shown in Fig.1-2. It can be seen that overall emissions have grown almost twofold from 1971 to 1997 (15% from 1990 to 1997), and most of the increase can be attributed to the growth in demand for electricity (2.6 times between 1971 and 1977) which resulted in increased power generation from coal and gas (in addition to increased hydro and nuclear generation which provides CO₂-free Emissions). In particular, most of the total emission has been due to the combustion of coal (64% in 1971, 65% in 1980, 70% in 1990, 72% in 1997). This can be attributed to the fact that coal is widely used due to its economical and stable supply.

Fig.1-2
Worldwide CO₂ emissions from electricity consumption according to fuel type (Data source: IEA, 1999, CO₂ Emissions from Fuel Combustion 1971-1997; IEA, Energy Balances of OECD Countries; IEA Energy Balances of Non-OECD Countries)



Worldwide electricity generation according to energy source is shown in Fig. 1-3. The majority comes from thermal generation, but its share is gradually decreasing, from 74% in 1971 to 70% in 1970, 64% in 1990 and 63% in 1997.

Fig.1-3
World electricity generation according to energy source (Data source: IEA, 1999, CO₂ Emissions from Fuel Combustion 1971-1997; IEA, Energy Balances of OECD Countries; IEA Energy Balances of Non-OECD Countries)



CO₂ emissions from the electricity industry of Annex I and Non-Annex I countries in 1997 are as shown in Fig.1-4. It can be seen that bulk of the emissions of both Annex I and Non-Annex I countries are due to coal combustion. Electricity generation of Annex I and Non-Annex I countries according to energy source is as shown in Fig. 1-5, which demonstrates that coal occupies a large share of electricity generation in both Annex I and Non-Annex I countries. It is also demonstrated that while Annex I countries have a larger share of nuclear generation, non-Annex I countries depend more on hydropower.

Regarding Annex I and Non-Annex I countries, electricity generation and CO₂ emission intensity of electricity are as shown in Table 1-2. CO₂ emission intensity of electricity generated in Non-Annex I countries is higher compared with those of Annex I countries. Some of this difference may come from the low efficiency of generation and the lower use of nuclear power in non-Annex I countries.

From these analyses, it can be concluded that CO₂ emission intensity can be reduced by measures such as switching to low CO₂-emitting fuel (as shown in Fig.1-6), and increase in thermal efficiency. In particular, CO₂ emission

reductions on a worldwide scale can be achieved more efficiently by carrying out such measures in non-Annex I countries, since CO₂ emission intensity in these countries is relatively high,

and a rapid growth in electricity consumption can be anticipated. Therefore, cooperation between Annex I countries and Non-Annex I countries can help accelerate such measures.

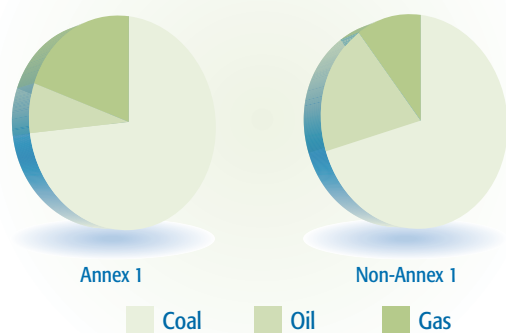
Table 1-2. CO₂ emissions per electricity generated

	Annex I	Non-Annex I	Ref.
CO ₂ emissions [Mt- CO ₂ : same as Table 1-1]	4,576	2,777	1)
Electricity generation [TWh]	9,385	4,564	2)
CO ₂ emissions intensity ¹ [kg-CO ₂ /kWh]	0.49	0.61	1), 2)

Note: 1. Calculated as total CO₂ emissions in the region/total electricity generated in the region.

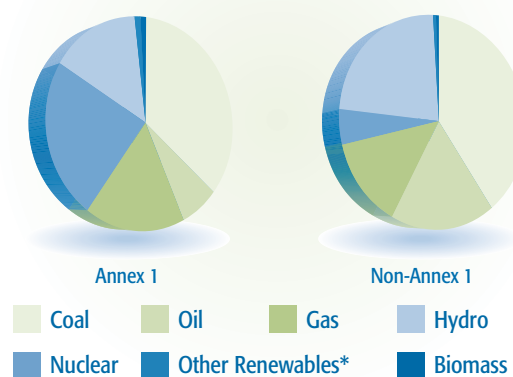
Ref. 1) IEA, CO₂ Emissions from Fuel Combustion 1971-1997
2) IEA, Energy Balances of OECD Countries; IEA Energy Balances of Non-OECD Countries

Fig.1-4
CO₂ emissions from electricity consumption according to region (1997, million tonnes of CO₂) (Data source: IEA, 1999, CO₂ Emissions from Fuel Combustion 1971-1997)



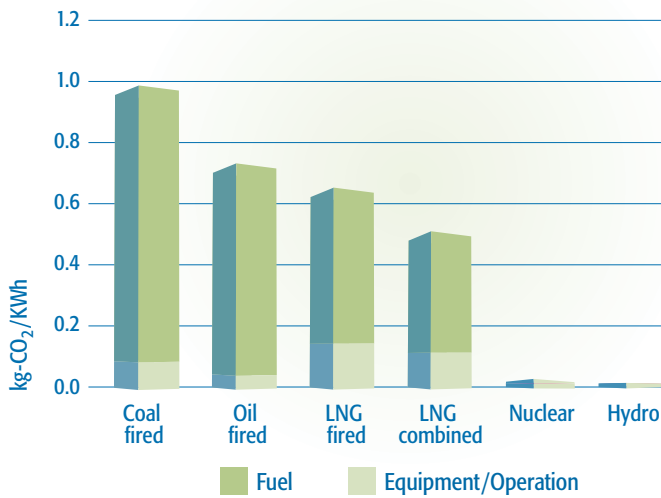
Note: Based on the total CO₂ emissions for all processes from energy extraction to the plant construction, fuel transportation and refining, and plant operation and maintenance.

Fig. 1-5
Electricity generation by source, according to region (1997, in TWh) (Data source: IEA, Energy Balances of OECD Countries; IEA Energy Balances of Non-OECD Countries)



* Other Renewables: solar, geothermal, wind, etc.

Fig. 1-6
CO₂ emission intensity by power source (Reference data based on the assumption that the plants are sited in Japan)* (Data source: the Report of the Central Research Institute of Electric Power Industry)



* Combined Cycle Gas Turbine (CCGT) plants in construction in Europe with net efficiency of 56% and supplied by natural gas transported by gasduct have emissions due to gas combustion of 360 g/kWh and for equipment/operation in the order of 30 g/kWh (Vattenfall's Life-Cycle Study).

The role of the electricity industry in climate change

Electricity occupies a unique position among energies, in that overall efficiency can be improved not only through supplier efforts, but also through efficient utilization by the consumers. Thus, it can be said that there are four ways for the electricity industry to contribute to CO₂ emission reductions, as shown below.

- Introduction of less CO₂-intensive generation
- Improvement in efficiency of fossil fuel generation plants
- Improved efficiency in the use of electricity
- Increased electrification.

These measures are carried out by the electricity industry. The degree of implementation, however, varies from company to company. Thus, it becomes increasingly necessary that the electricity industry, in various regions, make a concerted effort with mutual cooperation to reduce CO₂ emissions. In particular, cooperation between electric utility companies of Annex I and non-Annex I countries can be effective in reducing CO₂ emissions globally. How each industry member can be involved in the issue, however, depends much on external circumstances such as electricity demand and the policies of each country/region. Therefore, attention must be paid to the judgment of each of the industry members. Although reduction of CO₂ emission intensity requires effort on the side of the electricity companies, it should also be noted that efforts by the customers will also be called for in order to achieve a more efficient use of energy.

Business environment for the electricity industry: Changes caused by the climate change issue and actions taken for them

A questionnaire survey was conducted from December 1999 to April 2000, to find out what the electricity industry views as effects of the climate change issue, as well as actions taken by the industry. The respondents were the eight member companies of the E7 and six non-E7 companies, as shown in table 2-1.

The main categories of the questionnaire are as follows:

- a) Policies, regulations, and voluntary measures aimed at climate mitigation
- b) Measures to reduce CO₂ emissions
- c) Information disclosure and activities taken toward policy-making institutions
- d) Other activities.

Table 2-1. Respondents of the questionnaire survey

Name of utility	Country	Abbr.
E7 members		
EDF	France	EDF
Edison International	USA	EIX
ENEL	Italy	ENEL
Hydro-Quebec	Canada	HQ
Kansai Electric Power Co.	Japan	KANSAI
Ontario Power Generation	Canada	OPG
RWE	Germany	RWE
Tokyo Electric Power Co.	Japan	TEPCO
Non-E7		
Central Electricity Generation Co.	Jordan	CEGCO
EGAT	Thailand	EGAT
ESKOM	South Africa	ESCOM
PLN	Indonesia	PLN
State Power Corporation of China	China	SPCC
Zimbabwe Electricity Supply Authority	Zimbabwe	ZESA

Detailed answers by each company are given in the Annex to this paper. A summary of the companies' responses by each of the categories identified above is provided in the following section.

Policies, regulations and voluntary measures aimed at climate mitigation

Examples of policies, regulations and voluntary measures for climate change related to the electricity industry include the following measures:

- Carbon tax
- Obligatory allocation of electric supply from renewable energy plants
- Voluntary agreements.

Carbon taxes have been introduced in some European countries. The effect of such taxes on CO₂ emission reductions, however, remains unproven to date. As a result of carbon taxes, electricity companies may experience increased fuel expenditures, which necessitate a reformulation of generation mix.

Some countries allocate their electricity industries a mandatory quota for purchasing electricity generated from renewable energy. Since investment costs of renewable generation at present remain expensive compared to fossil fuel generation, excessive introduction of such energies can result in increased overall generation costs. Other possible regulatory measures on the electricity industry include CO₂ emission limits.

Some countries employ a more voluntary approach, where the electricity industry proposes and negotiates its own CO₂ emissions reduction target and implements measures through a voluntary agreement. In this way, the industry can pursue measures according to its strategies in the most cost-effective manner. This method can also be said as being the most responsive to market demands.

Measures to reduce CO₂ emissions

Measures taken by the electricity industry to reduce CO₂ emissions can be classified into three categories: Supply-side measures, demand-side measures, and Kyoto mechanisms.

Supply-side measures

The electricity industry undertakes CO₂ emissions reduction measures in the generation, transmission and distribution phases, according to their circumstances and energy mix. Examples of such supply-side measures include the following:

- Choosing generation methods which emit less CO₂
 - Promotion of nuclear power
 - Promotion of combined cycle generation
 - Fuel switching to less carbon-intensive fuels
 - Promotion of hydropower
 - Development of other renewable energies.
- Increase in efficiency
 - Increased thermal efficiency of existing plants
 - Increased capacity factor of baseload nuclear plants
 - Reduction of energy losses in transmission, distribution and transformation.

Demand-side measures

With the help of customers, the electricity industry can undertake CO₂ emissions reduction measures on the demand side as well. Examples of such demand-side measures include the following:

- Increase in efficiency of consumer appliances
- Promotion of efficient electrotechnologies in the industry and heat pumps for building heating by replacing technologies that are based on the combustion process (e.g. fossil fuel boilers and ovens)

- Energy conservation through an efficient tariff system
- Consulting and information provision to customers for energy-conserving/high efficiency appliances
- Development of electric transportation (passenger and freight vehicles, motorcycles, scooters, etc.).

Kyoto mechanisms

The framework of the Kyoto mechanisms (CDM, JI, emissions trading) is being negotiated, aiming to take decisions at COP6. The electricity industry considers the Kyoto mechanisms to be of substantial merit, since they enable the industry to utilize the market mechanism in an efficient manner. Examples of utility actions are as follows:

- Supporting Kyoto mechanisms
- Participation in AIJ projects
- Implementation of experimental/preparatory activities on Kyoto mechanisms
- Local initiatives on emissions trading (trading between utilities, in-house trading, contribution to simulation efforts).

Information disclosure and activities taken toward policy-making institutions

As demonstrated, CO₂ emissions from electricity consumption occupy a large share in the overall anthropogenic CO₂ emissions of the world. Thus, electricity companies are developing, or have developed, climate change strategies, are totaling their CO₂ emissions, and may publicize this information. This may be carried out in the following manner:

- Publication of corporate environmental reports
- Publication of GHG emissions data
- Reporting GHG emissions data to public authorities.

Since the management of electricity companies will be influenced by political decisions on climate issues, the electricity industry has a

strong interest in such policy-making processes. Actions taken by the electricity industry towards the policy-making institutions are as follows:

- Participation either directly or indirectly, through electricity or other related associations, in international and domestic climate negotiations
- Participation in national programs as a sponsor
- Leading by example using a voluntary approach to reducing GHG.

Development of technology and administrative reinforcement

Other examples of action taken by the electricity industry include the following:

- Development of technologies to sequester/fix CO₂ emissions from thermal power plants
- Emissions reduction of non- CO₂ GHGs (e.g. SF₆)
- Investment in the development of new technologies such as superconductive materials

In addition, many utilities are taking comprehensive approaches by tackling the issue of climate change as follows:

- Strengthening organizations and the training of their staff
- Establishment of departments with dedicated staff to specialize in this issue
- Holding meetings on this topic at the top management level
- Holding in-house workshops.

Estimated contribution of the electricity industry in existing CO₂ emission scenarios

Of the CO₂ emission scenarios that take into consideration actions mentioned in table 2.1 (page 9) and the Annex, three scenarios that are well known throughout the world are discussed below.

- a) World Energy Council (WEC) scenarios (1998).
- b) Intergovernmental Panel on Climate Change (IPCC) IS92 scenarios (1992).
- c) Annual Energy Outlook 2000 (1999) by the U.S. Department of Energy (DOE) Energy Information Administration (EIA).

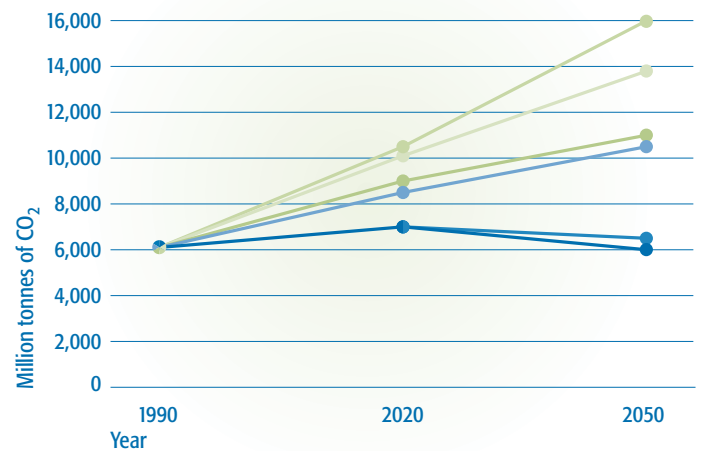
CO₂ emissions forecasted by the five WEC scenarios are shown in Fig.3-1. In the year 2020, all of the scenarios show an increase in emissions from their 1990 levels. As for the year 2050, only emission scenarios C1 and C2, both ecology-oriented scenarios, will fall below their 1990 levels.

The share of nuclear power in primary energy supply for each of the scenarios of Fig.3-1 is shown in Fig.3-2. The share of nuclear power in primary energy supply differs widely among the scenarios. Under the C2 scenario, which pursues introduction of carbon-free nuclear energy, it is forecasted that emissions in 2050 can be reduced to below 1990 levels.

All scenarios predict an increase in the share of renewable energy in primary energy supply, even though the level of introduction varies among the scenarios, as shown in Fig3-3. Under the C1 scenario, which assumes the highest degree of introduction, emissions in 2050 are reduced to below 1990 levels.

Thus, the WEC scenarios indicate that increased introduction of less carbon-intensive energies such as nuclear power or renewable energy can be an effective measure for CO₂ emissions limitation.

Fig. 3-1
CO₂ emissions forecasted by the WEC scenarios
(Data source: WEC, 1998, Global Energy Perspectives)



Scenarios

High Growth

- Fossil-dependent
- Clean use of coal
- Biomass and nuclear

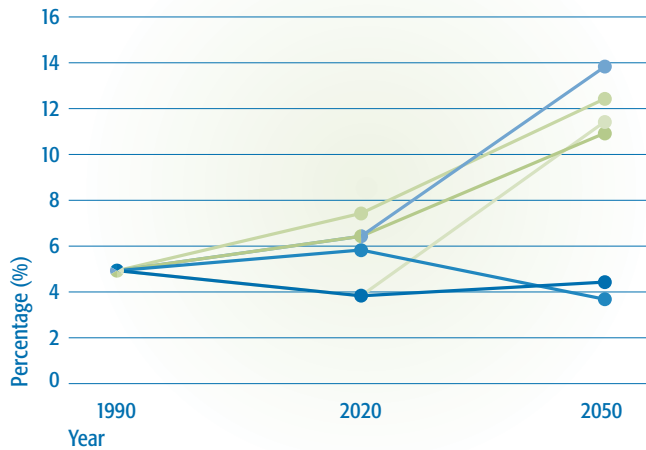
Middle Growth

Ecology-oriented

- Non-nuclear (increased use of renewable energy)
- Increased use of nuclear power

Fig.3-2

Forecasted share of nuclear power in primary energy supply (WEC) (Data source: WEC, 1998, Global Energy Perspectives)



Scenarios

High Growth

- Fossil-dependent
- Clean use of coal
- Biomass and nuclear

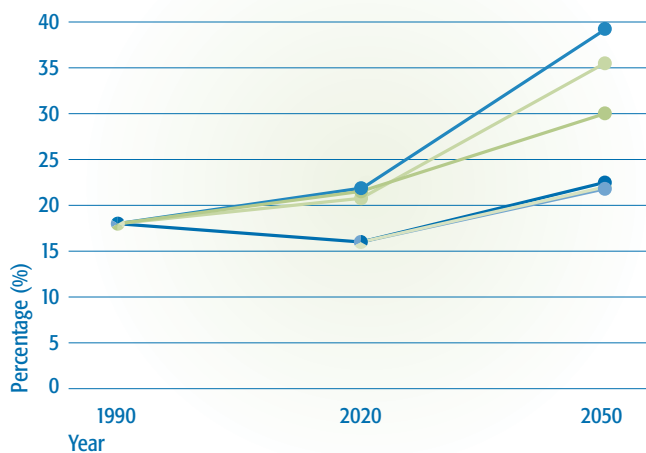
Middle Growth

Ecology-oriented

- Non-nuclear (increased use of renewable energy)
- Increased use of nuclear power

Fig.3-3

Forecasted share of renewable energy in primary energy supply (WEC) (Data source: WEC, 1998, Global Energy Perspectives)



Scenarios

High Growth

- Fossil-dependent
- Clean use of coal
- Biomass and nuclear

Middle Growth

Ecology-oriented

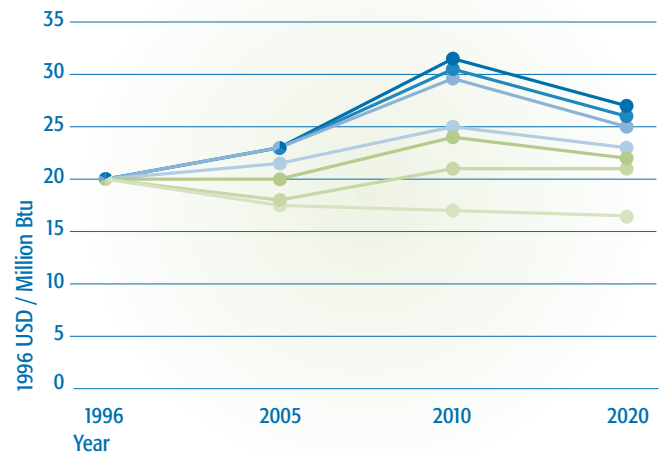
- Non-nuclear (increased use of renewable energy)
- Increased use of nuclear power

All six IS92 scenarios developed by the IPCC, predict a continued increase in emissions. However, according to the scenarios which assume an increased introduction of solar energy and nuclear power, it is indicated that these measures can control CO₂ emissions.

The Annual Energy Outlook analyzes the effect of emission reductions on U.S. electricity prices. The results of the Outlook are shown in Fig.3-4. Compliance with strict emissions reduction targets necessitate substantial increases in electricity prices compared to the reference case. This can be attributed to the additional cost of emission reductions.

Fig.3-4

Forecast of electricity prices (Data source: US DOE/EIA, 1999, Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity)



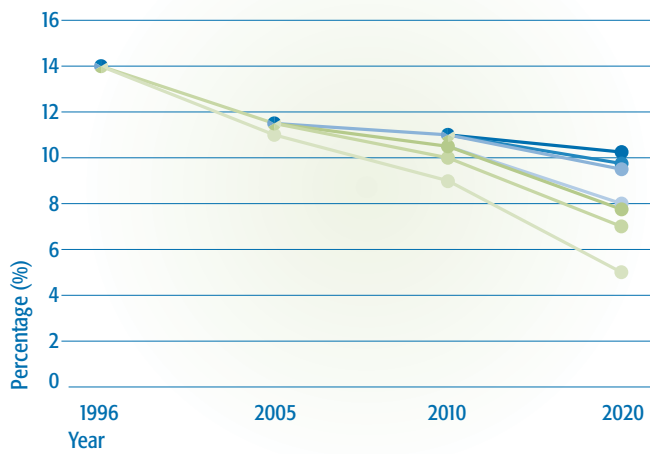
The following scenarios are discussed

CO₂ emissions in 2010 compared with 1990 levels

- (Reference case)
- + 24%
- + 14%
- + 9%
- stabilization (0%)
- 3%
- 7%

According to the forecasts, the share of nuclear generation in the electricity supply will increase as emissions reduction targets for 2010 become stricter. This can be attributed to the projection that the lifetime of nuclear power plants will be prolonged. DOE scenarios indicate that contribution from nuclear power plants could be key to meeting a strict emissions reduction target (Fig.3-5).

Fig. 3-5
Share of nuclear power in total electricity generated
 (Data source: US DOE/EIA, 1999, Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity)



The following scenarios are discussed
CO₂ emissions in 2010 compared with 1990 levels

- (Reference case)
- + 24%
- + 14%
- + 9%
- stabilization (0%)
- - 3%
- - 7%

The three CO₂ emission scenarios show that even with maximum effort, CO₂ emissions would be only slightly reduced from 1990 levels. Achievement of GHG emissions reduction targets under the Kyoto Protocol will, without doubt, be extremely difficult. Therefore, in order to be compliant with the emission targets, utilization of Kyoto mechanisms will be required, as well as individual reduction measures in each country. Consequently, the importance of cooperation between electricity companies will increase.

The electricity industry is rising to the challenge. The electricity companies are taking action and utilizing measures suitable to their respective circumstances as well as making a concerted effort to mitigate climate change. In this way, the utilities contribute as key players to achieving the targets.

Scope for the role of electricity industry in the climate change issue

As shown in the results of the industry questionnaire survey, electricity of both Annex I and non-Annex I parties view climate mitigation measures as an important aspect of their corporate strategies. The respondents also believe that the electricity industry of their respective countries' private sectors possess the necessary capacity and human resources to effectively address the issue in a voluntary and efficient manner.

The electricity industry also believes that by creating a framework to effectively utilize the market mechanism for GHG reduction, climate change can be addressed without the addition of regulation or the strengthening of existing regulation. Furthermore, detailed guidelines related to the mechanisms that are technically and operationally efficient can be formulated through international cooperation between electricity companies. An example of this is the "*Position Paper on CDM and other Flexible Mechanisms—E7 and Its Partners from Around the World*".

The electricity industry believes inter-company collaboration of this nature, on a practical level, can be an effective way to seek consensus on a topic, for which agreement through political negotiation would be hard to reach otherwise. Factors such as differences in regulatory framework and fuel availability of different countries will affect the operations and fuel mix of electricity companies worldwide. While the companies are making a concerted effort,

due to differences in backgrounds, there is diversity in the manner of involvement. This is apparent in the commitment of the companies to reduce GHG emissions. Examples referred to are as follows:

- Promotion of a fuel mix centering on nuclear energy
- Switch to a less carbon-intensive fossil fuel (switch to natural gas from coal and oil)
- Improvement of the efficiency of thermal power plants
- Promotion of hydropower
- Promotion of increased utilization of other renewable energies

Thus, each electricity company selects from a wide range of choices, the methods best suited to their circumstances. The importance of cooperation between electricity companies to achieve emissions reduction targets is also recognized. It can be said that the questionnaire survey confirmed the industry's commitment to contribute to the solution of the climate change issue in a voluntary and proactive manner.

Annex – The effect of climate change issues on the electric utility industry and their

Category	Topic	
A) Policies and regulatory measures		<ul style="list-style-type: none"> • Carbon/energy tax (on-going) • Supply quota from new renewable energy plants (on-going) • Mandatory implementation of demand side measures by distributors (on-going) • Phase-out plan for nuclear generation plants by governments (on-going) • Explicit industry responsibility to carry out climate mitigation measures, as stipulated by law (on-going) • Amendment of law to strengthen provisions of rational energy use in factories (implemented) • Movement toward legislation by MPs on increased introduction of renewable energy (on-going)
B) CO ₂ mitigation measures	<i>Supply-side</i>	<ul style="list-style-type: none"> • Promotion of nuclear power generation • Promotion of combined cycle generation • Increased thermal efficiency of existing plants (including repowering) • Measures related to existing coal plants • Increased use of Natural Gas • Reduction of environmental effects through the use of petroleum additives • Investment in the Clean Energy Initiative • Establishment of an affiliate company on small-scale renewable plants (implemented) • Development/upgrade of hydropower • Development of renewable energies other than hydropower • Use of non-fossil fuel • Increase of in-house energy efficiency • Reduction of transmission, distribution, and transformation losses
	<i>Demand-side</i>	<ul style="list-style-type: none"> • Increase in efficiency of consumer appliances • Introduction of digital metering to all customers (on-going) • Development of high-efficiency electric appliances • Promotion of demand-side management (DSM) • Energy conservation through an efficient tariff system • Consulting and information provision to customers on energy-conserving/high efficiency appliances • Research on efficient energy use • Cooperation with local communities on energy conservation/recycling activities • Development of electric transport (passenger and freight vehicles, motorcycles, scooters, etc.)

*Unable to integrate comments from ESKOM.

Annex (cont.) – The effect of climate change issues on the electric utility industry and

Category	Topic	
C) CO ₂ emission mitigation measures	<i>Kyoto mechanisms</i>	<ul style="list-style-type: none"> • Possibility of reduced generation cost by acquisition of emissions reduction credits (estimation) • Possibility of competitive advantage of imported electricity due to acquisition of emissions reduction credits (estimation) • Supports Kyoto mechanisms (included as members of industry organizations) • Gaining experience on early action important for flexibility mechanisms • Welcomes/interested in implementation of CDM projects • Participation in AIJ projects (implemented or/and on-going) • Implementation of experimental/preparatory activities on the Kyoto mechanisms (on-going) • CO₂ emissions trading between utilities (implemented) • (Anticipated) acquisition of CO₂ emissions reduction credits • In-house emissions trading (planned) • Contribution to emissions trading simulation efforts (implemented) • Dedicated staff for utilization of the Kyoto mechanisms (on-going) • Participation in international CDM workshops (implemented)
	<i>Voluntary agreements</i>	<ul style="list-style-type: none"> • Formulation of voluntary agreements (with the government) (implemented) • Formulation of partnerships (with national and regional government) (implemented) • Establishment of emissions targets, as denoted by emission intensity (implemented) • Stabilization of CO₂ emission at 1990 level • Quantitative reduction target of CO₂ emissions
D) Information Disclosure		<ul style="list-style-type: none"> • Publication of corporate environmental reports (on-going) • Publication of GHG emission data and reporting to public authorities (on-going) • Participation in international and domestic climate negotiations (implemented) • Dispatching of staff to the UNFCCC and subsequent negotiations (implemented) • Participation in national programs as a sponsor (implemented)
E) Others		<ul style="list-style-type: none"> • Development of carbon sequestration/fixation technologies • Emission reductions of non- CO₂ GHGs • Investment in development of superconductive materials • Transfer of know-how on energy efficiency improvement and environmental technology to the staff • Implementation of survey of CO₂ emissions inventory from generation plants • Establishment of a company-wide conference on environmental issues (implemented) • Establishment of a dedicated organization on climate issues (or environmental issues in general) (implemented) • Holding in-house workshops on climate change (on-going)

*Unable to integrate comments from ESKOM.

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