

Counter-Policies by Industrial Countries to Tackle Global Warming, from Perspective of the Kyoto Protocol

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Abstract—In accordance with environmental impacts contended in Kyoto Protocol, the study aims to explore the different administrative and non-administrative measurements that industrial countries, such as America, German, Japan, Korea, Holland and British take to face with the increasing Global Warming phenomena. By large, these measurements consist of versatile dimensions, including of education and advocating, economical instruments, research developments and instances, restricted instruments, voluntary contacts, exchangeable permit for carbon-release and public investments. The results of discussion for the study are as follows: both economical impacts as well as reformations for nations that are affected via Kyoto Protocol, and human testifying for variables of global surroundings in the age of Kyoto Protocol.

Keywords—Global Warming, Kyoto Protocol

I. FOREWORD

EVER since the Industrial Revolution, as a result of humans' over-dependence on such fossil fuels as coal, petroleum and natural gas, greenhouse gases (GHGs) such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFCs) have led to the warming effect. Atmospheric motions then extend human's impacts on the earth from the surface of the globe to the atmosphere with dramatically increased GHG concentration, leading to such global warming phenomena as temperature rise, sea level rise and intensified climate change. With the coming of the high-tech era, various countries keep adopting scientific technologies and using alternative energies to tackle anthropogenic climate change and to achieve sustainable development of the globe. The Montreal Protocol, opened for signature in 1987, is the earliest international treaty on environment signed by major industrial countries to protect the ozone layer and the Earth. However, this treaty failed to mitigate global warming, GHG emissions and other problems. Therefore in Kyoto, Japan, on December 1997, the Kyoto Protocol, as supplementary provisions, was constituted during the third session of participating countries of the United Nations Framework Convention on Climate Change (UNFCCC)

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to prevent dramatic climate change from harming humanity and the Earth. At present, there are over 120 signatories of the Protocol. However, they differ in policies in response to the treaty to tackle global warming as they must take into consideration, at the same time of implementing carbon reduction measures, such factors as renewable energy technology improvement, spontaneous incentives for environmental protection, better energy efficiency and the impact of costs of carbon dioxide reduction on their domestic economy. This article discusses counter-policies by various industrial countries to tackle global warming under the Kyoto Protocol, focusing on the US, Germany, Japan, South Korea, the Netherlands, and the UK.

II. LITERACY REVIEW

A. The phenomenon of global warming

Originally a natural phenomenon, greenhouse effect is necessary for organisms on the earth to sustain their life as it helps the earth maintain suitable temperatures. However, dramatic climate change since the second half of the 20th Century is attributed to, from scientists' view, anthropogenic activities. Also in the IPCC Fourth Assessment Report it is explicitly pointed out that anthropogenic activities since 1750 may have caused the warmer climate[1]. Due to large consumption of fossil fuels, excessive deforestation and booming industrial activities, such GHGs as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and chlorofluorocarbons (CFC_s) have witnessed sharp increase in the concentration, which has led to the rise of global average temperature, a phenomenon called global warming[2]. From Diagram 1, quantities of GHGs produced by anthropogenic activities can be observed to rise year by year since 1970.

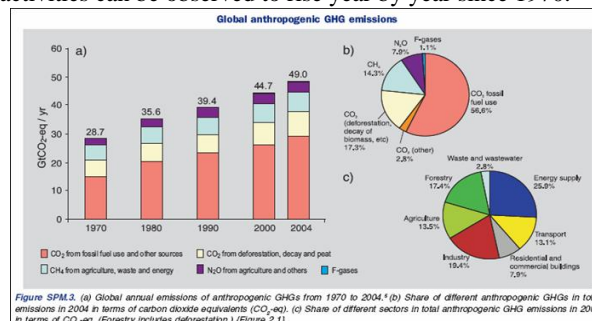


Figure SP.M.3. (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004. (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of carbon dioxide equivalents (CO₂-eq). (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO₂-eq. (Forestry includes deforestation.) (Figure 2.1)

Fig. 1 represents Global Anthropogenic GHG Emission [3]

The phenomenon of global warming cannot be completely attributed to anthropogenic activities as solar activities, volcanic activities and other natural or non- anthropogenic factors may also be blamed. The majority of anthropogenic GHG emissions are carbon dioxide, methane and nitrous oxide. For carbon dioxide, combusting fossil fuels, disafforestation and burning biomass such as wood are major sources. As a result of such anthropogenic emissions, its concentration has risen from 280ppm, as of 1750, to 379ppm, as of 2005, while methane, mainly produced by agricultural activities and burning fossil fuels, has also witnessed an increase from 715ppb to 1774ppb[4]. As data shown and common agreement reached within the scientific community, anthropogenic factors shall be blamed for intensified global warming

TABLE I
INCREASE IN DIGITS OF ANTHROPOGENIC GHG EMISSIONS IN PERIOD
1750-2008[5]-[7]

	Carbon dioxide	Methane	Nitrous oxide
Major source(s)	Combusting fossil fuels, disafforestation and burning wood	Burning fossil fuels and decomposition of biomass such as excrement from livestock husbandry	Burning solid wastes and chemical fuels and agricultural activities, with 53.6-67.5% of total from soil
Natural fluctuation range	180-330ppm	320-790ppb	
Year 1750	280ppm	715ppb	270ppb
Year 2005	379ppm	1774ppb	319ppb
Year 2008	385ppm	1797ppb	321.8ppb

GHGs produced by anthropogenic activities that consume large amount of fossil fuels not only lead to global temperature rise and intensified climate change, but also result in sea level rise and extreme changes in precipitation and even change the climate in some regions, bringing about such extreme weather events as flood, drought, typhoon, tornado and heat wave. Regional climate change increases the amount of rainfall and evaporation, affecting forests, agricultural productivity, river flux and water supply capacity, leading to species extinction and outbreak of diseases, and consequently threatening human being's living environment, health and even other ecosystems. Listed below are major indexes for assessing global warming[8]:

- 1) Shrinking glacier area: In the Kerguelen Island on the South Indian Ocean, the Cook glacier has been reduced by one-fifth of area. Some of the various Himalayan glaciers, which serve as water source for 1.3 billion people, retreat as much as 70 meters annually. Snow atop the Mount Kilimanjaro, the highest in Africa, has been melting gradually. Ice sheet in the Greenland is losing. The Arctic glacier and ice cap are melting rapidly, producing large blocks of drift ice which pose a threat to open-sea drilling platforms, while the shrinking glacier area also greatly affects Arctic ecosystems.
- 2) Rise of the average global sea level: Along with global warming, surface glaciers melt under the rising temperature, leading to sea level rise globally year by year. As predicted by IPCC, the sea level will rise by 18 to 59cm by 2100. Many other related researchers have also carried out such kind of estimation, with the following four factors that must be taken into consideration: the situation of thermal expansion of sea water, condition of melting mountain glaciers, situation of thawing Greenland glacier and condition of collapsing Antarctic continental glacier. Although there are slightly different results in calculating, all scholars agree with a continuously rising sea level in the future, with the margin of rise closely related to that of global warming, while the magnitude of global warming vitally linked to the degree of atmospheric greenhouse effect.
- 3) The swift of seasons: In response to the rising temperatures, part of organisms change their habitat or move to colder places, with a change in the temperature-related northing distance compared to the same period in the past. Take birds and fishes for example, from 1989 to 2006, 105 species of birds in France moved 91km in average further to the north, while the average temperature for the same period moved northward for about 273km, three times of that distance. In the North Sea, 21 out of 36 categories of fish have been moving north from 1962 to 2001 to look for colder seawater.
- 4) Ocean acidification: As carbon dioxide is soluble in water, the PH value at water surface decreases when too much carbon dioxide is absorbed by oceans. Higher acidity will do harm to aquatic organisms. Death of such lives not only leads to the imbalance of ecosystem and coral bleaching, but also severely impacts ecological diversity and fishery industry in oceans.
- 5) Warming up Antarctic Peninsula: Since 1960s, temperature here has risen by over two degrees Celsius, several times in speed as much as global warming. Ice and snow have begun to melt under the rise of temperatures at ice land in western Antarctica [9].
- 6) Melting permafrost: As permafrost melts, warmed up soils will emit gases. In northern Siberia, methane, a poisonous GHG, is measured to soar in emission in various lakes.
- 7) Changing precipitation: There in the warming up atmosphere is large amount of vapor, which produces intensive abnormal precipitation with obvious rainfall or snowfall increase in some areas across the world, accompanied by droughts due to overheating in some other areas, presenting opposing weather changes.
In response to the climate change and continuous natural disasters over the past decades, scientists and related researchers have been carrying out observations on global

warming. Objective data shows that situation of global warming at present is becoming much severer than that of before, the Industrial Revolution Era, arousing the world of the common sense of protecting the globe from environmental change. In order to prevent anthropogenic GHG emissions from continuing to interfere with the atmosphere and ecosystems, the UN passed the UNFCCC on May 9, 1992[10], aiming to implement regulations and controls concerning global warming. Other international treaties are the Montreal Protocol[11], Basel Convention[12], Kyoto Protocol[13], Hyogo Framework for Action[14], Copenhagen Accord[15]and so on. Although they share the same goal of reducing impacts of global warming on the humanity, they differ in process and measures to achieve. The Kyoto Protocol aims to stabilize GHG concentrations in the atmosphere at an appropriate level, by which it is distinguished from the Basel Convention, which focuses on the control of the trans-boundary movements of hazardous wastes, and the Hyogo Framework for Action that fights against natural disasters caused by extreme weathers. In consideration of the expiration of Kyoto Protocol in 2012 and to prevent negotiation from breaking down caused by disagreements between signatories, the successive Copenhagen Accord will give all countries enough time to discuss and decide the entry of the treaty. It has become the synonym of a new international climate treaty.

B. Soothing the warming - The Kyoto Protocol

As greenhouse gas emitted by mankind activities is alerting governments worldwide that the accelerating and severe issue of global warming is building an overwhelming threat to both mankind and the ecosystems. Furthermore, resources of the earth is not limitless, therefore massive energy consumption will force mankind to face the uncertainty of resources while maintaining the sustainable development of earth. At the same time, drastic weather change could mean hazard to both human life and security of property, therefore full commitment to reducing greenhouse gases is paramount: to reduce global warming, we should adjust our way of living and the way our society functions.

1) Origin of Kyoto Protocol: As governments worldwide are fully aware of the fact that human factors are key to the alarming growth of greenhouse gas concentration in the atmosphere, which causes increasing temperature, rising sea level, and a large number of species on the brink of extinction all over the world. Based on the common agreement, in the Earth Summit 1992, the United Nations approved the United Nations Framework Convention on Climate Change, (UNFCCC), which became effective on March 21, 1994. The convention aimed to reducing greenhouse gas emission as a way lower its concentration in the atmosphere; at the same time, the newly approved convention was built as an approach to minimize the adversary impact created by both global warming and climate change[16]. Only the convention fails to specifically assign responsibilities and enforcement systems to the signing nations; in brief, it does not legally bind anyone. However, UNFCCC specified that in

subsequent protocols, compulsory limitations of emission levels may be set. The United Nations took one step further to formulate management strategies on reducing global greenhouse gas emissions. In December 1997, UNFCCC COP 3 was held in Kyoto Japan, where the Kyoto Protocol was signed to forcibly limit greenhouse gas emission [17], where industrialized nations became accountable for effective reduction of greenhouse gas emission by waging technology R&D, economic incentives among other strategies as efforts to meet the objective [18].

2) Contents of the Kyoto Protocol

According to the common agreement reached by its signing member nations after negotiation, in the Kyoto Protocol, the year 1990 is set as reference for greenhouse gas emission, and the signing nations were pledged to, between 2008 and 2012, reduce the average greenhouse gas emission in industrialized nations by 5.2% of the reference year. The key contents are as follows:

- i. Total volume control: The industrialized nations are committed to cutting total greenhouse gas emission by 5.2%, a 30% drop compared to the natural growth of emission by human factors.
- ii. Accomplishment period: The reduction would be computed based on the average emission between 2008~2012.
- iii. Gases under control: Reduction of CO², CH₄, N₂O gases would be taken based on the level reached in 1990 as reference. HFCs, PFCs, SF₆ gases would be taken based on the level reached in 1990 or 1995 as reference.
- iv. Emission computing: Year 1990 is set as the year of reference for net emission, which is calculated by man-made emission minus absorption. Net emissions by forestation, plantation and felling after 1990 can be deducted with man-made emissions.
- v. Reduction timetable and target value: To be implemented on the 39 member nations signing UNFCCC [19], where the 6 man-made greenhouse gases are converted into corresponding volumes of carbon dioxide and by applying a differential target reduction, in which 8% is designated to each of the EU member nations and Eastern Europe nations, 7% for the U.S., 6% for Japan, Canada, Hungary and Poland. The reduction period is from 2008 to 2012, of which the average emission during the 5 years will be accounted. However, the protocol allows a growth of 10%, 8%, 1% to Iceland, Australia and Norway respectively, while Russia may remain at its emission rate of 1990[20]. Developing nations were not designated any obligations in terms of emission reduction, as they are allowed to set their own reduction target voluntarily.
- vi. Proposal of Kyoto mechanisms: Including Clean Development Mechanism (CDM)[21], Emission Trade (ET) and Joint Implementation (JI)[22]. For the signing nations to meet the target of greenhouse gases reduction, the Kyoto Protocol allows the 4 implementation methods given as follows[23]:
 - (i.) Emission Trading: Two developed nations can trade emission quota, whereby a nation that cannot meet their quota for greenhouse gases emission may, through monetary transactions, buy in quota from

another nation that has successfully reached its target. Such a deal is known as green development mechanism, of which its objective is to encourage both developed and developing nations to cooperate in reducing greenhouse gas emission.

- (ii.) Net emission: Net emission is the volume of carbon dioxide produced in a nation after deducting the amount of carbon dioxide taken in by the forest. Used for calculating greenhouse gases emission.
- (iii.) Green Development Mechanism: Green Development Mechanism is allowed as an approach to assure both developed and developing nations are committed to working together to reduce greenhouse gases emission.
- (iv.) Grouping: This is an approach that takes a number of EU member nations as one, in which some are required to reduce emission while others to increase emission, while reducing their overall greenhouse gases emission.

When the Kyoto Protocol was officially implemented in 2005, to decrease greenhouse gases emission worldwide, a rigid target was designated to the signing nations to be reached within a certain time period. This implementation will largely affect both energy appropriation and industrial structure of the nation, which would in turn cause an impact on international economic development and competitiveness in the world market. Therefore, how to minimize energy consumption and lower cost of carbon dioxide emission without affecting economic development is a difficult issue. Since most developed nations' CO₂ emission increased as their economy boomed, they were reluctant to sign the Kyoto Protocol at first; they are subject to a much higher unit cost waged on carbon dioxide reduction than that of developing nations, the effort put into reducing CO₂ would impact domestic industries and the economy. To deal with the targets set in the Tokyo Protocol, each and every industrialized nation is releasing its own measures.

C. Measures released by the main industrialized nations

To meet the targets set by the Kyoto Protocol, industrialized nations must designate reduction targets and ratios to different manufacturing divisions within the country. Most nations would focus on their key manufacturing industries with high energy consumption and high carbon dioxide emission. The countermeasures involve administrative measures, which encourage manufacturers to improve voluntarily by offering economic benefits; at the same time, new legislatures were introduced for rational and new standards governing the use of energy; objective criteria are in place to categorize targets for greenhouse gases emission along with various control standards for successful management. These control measures can reveal the methods adopted by industrialized nations and their improvement progress. Table 2 shows the measures of major industrialized nations have taken for their domestic industries on carbon dioxide reduction and energy conservation:

TABLE II
MEASURES WAGED BY INDUSTRIALIZED NATIONS ON DOMESTIC INDUSTRIES
IN TERMS OF CARBON DIOXIDE REDUCTION AND ENERGY CONSERVATION
[24]-[25]

	Administrative measures	Non-administrative measures
U.S.	<ol style="list-style-type: none"> 1. FCCC framework 2. Clean Air Law 3. Pollution Control Law 1990 4. FCCC Campaign 5. Energy Act 	<ol style="list-style-type: none"> 1. Financing Program for Industries 2. Environmental Accounting Program 3. Energy Star v.s. Green Light 4. Climate, Waste Wisdom 5. Industrial Incentive Schemes
Japan	<ol style="list-style-type: none"> 1. Energy Saving Law 2. Recyclable Energy Ratio System 	<ol style="list-style-type: none"> 1. Low-interest-rate preferential loans 2. Tax reduction /exemption, accelerated depreciation and preferential measures 3. Assistance program for development of energy-saving technologies 4. Incentive measures on recyclable resources 5. Culturing ESCO businesses 6. Development of high-performance industries 7. Environmental action plans
Korea	<ol style="list-style-type: none"> 1. Administrative measures by product 2. Administrative measures by activity 3. Energy Use Plans 	<ol style="list-style-type: none"> 1. Incentive measures for technology R&D 2. Incentive measures for controlled emission 3. Foundation for Rational Use of Energy 4. Voluntary agreements 5. Culturing ESCO businesses 6. Energy auditing plans
Germany	<ol style="list-style-type: none"> 1. Environmental auditing acts 2. Federal investment control acts 3. Regulations for use of waste heat 4. Development of co-generation 5. Recyclable energy laws 	<ol style="list-style-type: none"> 1. Reform of ecological taxation 2. Reduction of subsidy for hard charcoal 3. A study on optimized carbon dioxide reduction plan 4. A study on special control tools 5. Levy of energy tax
Netherlands	<ol style="list-style-type: none"> 1. Implementation of climate policy plans 	<ol style="list-style-type: none"> 2. Levy of energy tax 3. Long-term agreements
U.K.	<ol style="list-style-type: none"> 1. Emission trading proposal 2. Climate change agreement 3. Low-carbon transformation plan 	<ol style="list-style-type: none"> 1. Climate change tax 2. Carbon trusteeship

EU	1. Joint executive systems	1. Levy of energy tax & major ratio of environmental tax 2. Use of brown, green and white certificates 3. Allowance to recyclable energy industries
Brazil		1. 80% of new cars on ethanol gasoline
Denmark		1. Levy of carbon dioxide tax 2. Tax rates per energy concentration
Russia		1. Servicing & rebuilding of heat piping 2. Forestation 3. Preserving and treating solid daily-living wastes
China	1. Recyclable energy law 2. Establishment of state agencies on climate change coordination 3. State strategies against climate change 4. Provisional Management Code for Cleaner Development System in China	1. Implementation of CDM system with Japanese steel industries 2. Establishment of scientific research on climate change 3. Upgrading of energy use performance

Table II suggests that most of the nations that have signed the Kyoto Protocol for global warming have taken corresponding measures to avoid impacts on their domestic manufacturing industries, including administrative and non-administrative control measures (such as economic incentive and voluntary policies). Furthermore, from Table 2, we can observe that European nations and the U.S. tend to favor taxes, enforce industry environmentalism, and offer environmental funds among other economic incentives. In Asia, exemptions and preferential treatments top the list of measures, along with allowances to R&D. The different approaches opted by governments in the East and West may be determined by the different types of manufacturing industries. Despite the different policies implemented by the governments with respect to global warming, the same may be roughly seen as follows [26]:

1) Education and campaign: This policy stands out as it shows how the authorities wage to gather information on climate change policies and divulging information on the issue. As a government is meant to, prior to materializing relevant policies, make sure that all information are distributed to and discussed with specific groups assuring wider

acknowledgment and acceptance, which would facilitate the implementation of the policies.

2) Financial means: Financial means are provided for incentives on improving and expanding advanced technologies, such means include:

i. Allowance: Low-interest-rate loans, guaranteed low purchase price and subsidies for recyclable energy or development of technologies for improved environment.

ii. Exempted tax: Lowering or exemption of fuel tax, reduction or lowering of income tax among other approaches to encourage development of recyclable energy, alternative energy and energy conservation.

iii. Pricing subsidies: This is a policy opted for on technologies available in the market and, by means of short-period of subsidies, it is expected to see boosted competitiveness in meeting the target of reduced greenhouse gases in a short term.

3) R&D and demonstration: Traditional intervention adopted by the government. In the early stage of technology development, for uncertain number of years of recycling, the outcome of the research does not guarantee protection of intellectual properties. Therefore R&D incentives invested by private sectors is very low. The presence of the government is to facilitate investments in need.

4) Control means: Mostly applied in setting forcible criteria for energy efficiency or compulsory standards, this is an effective approach when it comes to setting combined energy criteria for development of recyclable energy.

5) Voluntary agreements: Available in hard voluntary agreements and soft voluntary agreements; the former comes with legal issues for those who fail to honor commitments; the latter is to be executed in a voluntary manner on the reduction of greenhouse gases emission.

6) Emission permits for trading: Aiming to reduce pollution emission, also known as limited trading system.

7) Public investment: This political means includes investment in infrastructure and government purchase waged for sustainable economy.

D. Kyoto Protocol and economic conflicts

To many industrialized nations, signing the Kyoto Protocol may mean, after successful reduction of carbon dioxide, the domestic economy would be exposed to adversary impacts. Manufacturing industries only had to shoulder fixed cost for raw materials, machinery and ground for manufacturing plants; by dealing with global warming, we human tend to become increasingly aware of the deteriorating environment caused by human activities. Therefore most countries are launching new policies to raise awareness within industries of the costs they are to assume, and contribute to improving the environment. The Kyoto Protocol will cause industries to assume more external costs, and the global economy is to see its cost building up. International competitiveness is an issue that varies from nation to nation and each would assume a different cost. In the short term, the heavy economic cost signing the Kyoto Protocol means is definitely to create adversary impacts to all nations; at the same time, the international community would blame the issue and eventually, in the future, the international market

would see a green barrier [27]. Besides, Kyoto Protocol going in to effect would estimate to an average investment of some US\$180,000,000,000 per year starting 2008, at roughly 0.5% of the gross product of the world. In the long run, alleviating greenhouse gases emission may allow global sustainability. Should the manufacturing industry improve in environmental technology and win out in the competitive international market, its victory in releasing products to the market would be guaranteed.

III. CONCLUSIONS

Kyoto Protocol limited carbon emissions in signatory countries, this not only derived carbon economy but meant to restrict the growth of energy use. Since the efficiency of energy use could affect carbon emissions, each signatory country needed to relocate the energy distribution, develop new energy policy and adjust energy-related industrial structure, meanwhile, bring the development of new energy and low-polluted technology.

However, the carbon emissions will impact the traditional high energy-related industries such as steel, petrochemical and water industries since in era of low-carbon, there is a possibility that countries will take carbon-emission as standards for imported goods trade sanctions, countries also need to actively seek transformations of industries.

Due to above reasons, the development of renewable energy technologies such as solar thermal technology, solar technology, wind power technology and other related renewable energy technology has become a world trend, coupled with national policies and supporting measures for promoting technological research and development, support for green energy industry will become an important future trend of economic development of countries.

From the view of environmental point, in order to reach the objective of carbon reduction, countries need effective Environmental Management to meet the emission control. The Environmental Management Group (ISO/TC207) of International Standards Organization, ISO has developed ISO14000 environmental management series which includes more than 20 international standards, since September 1996, it has announced a number of relevant standards in terms of environmental management system, the environment auditing and environmental aspects of product standards. Although ISO14000 belongs to voluntary management standards, products that can meet ISO14000 requirements will attract more consumers in the international trade market.

Kyoto Protocol will expire in 2012, but the green trend of the future cannot be stopped. For the increasing depletion of resources, countries have taken reduction of energy consumption and production of green energy as future goals. Although Kyoto Protocol emission limits limited development of new products, it has led a new green industry. The government and companies need a broader perspective to examine the past behaviors, in addition to set the pursuit of national or industry interests as the ultimate goal, also need to take the overall environmental balance of domestic into

account. The self-restraint of all countries will help ease the phenomenon of global warming.

However, it is noteworthy that Copenhagen agreement (Copenhagen Accord) which was seen as the index of future of global warming trend after the Kyoto Protocol, does not determine the country's emission reduction targets. After the loss of binding in the Kyoto Protocol, there are many questions needed to be further observed such as national attention for environmental issues and which standard should countries follow in order to reduce carbon emissions.

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