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APEC Cooperation and Strategies for the Introduction of Renewable Energy into Developing Countries

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Introduction

The fifth APEC Leaders' Meeting was held in Vancouver, Canada on 25 November 1997. This meeting opened just after the currency and economic crisis in Asia that rapidly swept through many of the region's countries after July of the same year. APEC was strongly criticized in some quarters for its helplessness in response to the economic turmoil among some of its members. Steady economic growth of the member economies was the foundation on which APEC's achievements in the field of trade and investment liberalization had been accumulated, but in many ways the bottom fell out of that foundation after the crisis. The meeting in Vancouver was heavily politicized without concrete progresses in trade and investment liberalization because, for leaders of Asian countries, liberalization was a less important issue and there were too many differences of basic opinions to find much room for consensus. As it turned out, the only really major decision made in this meeting was the approval of the participation in APEC of three new members—Peru, Russia and Vietnam.

Despite a lack of progress on liberalization of trade and investment, after the economic crisis some members tried to focus more attention on one of APEC's other functions—economic and technical cooperation (ECOTECH). Economic and technical cooperation programs have been a part of APEC's agenda for most of the group's history, but progress of liberalization of trade and investment has been perceived by many to be the touchstone of the success or failure of the APEC process. There is now, however, a considerable movement to shift the focus of APEC towards ECOTECH and Malaysia, the host country for the next meeting, has declared that in the Kuala Lumpur meeting in 1998 economic and technical cooperation will be given greater priority over trade and investment liberalization as the main topic of the conference.

However, concerning the expansion and realization of ECOTECH, the present framework of APEC is not adequate for that function. There have been numerous working groups set up to discuss the questions of economic and technical cooperation, but there is no

established body within APEC with its own human and material resources specifically to enhance such cooperation. Thus, while there is a consensus that ECOTECH should be promoted among members of APEC, there has been only limited progress in putting those words into action. Without the necessary resources, how can APEC promote ECOTECH among participants? What is APEC's role in enhancing economic and technical cooperation compared with the traditional means of bilateral overseas development assistance (ODA)? Can APEC become a vehicle for economic and technical cooperation to promote balance economic growth in the region for all members, or will APEC's ECOTECH agenda just produce more discussion than action?

This paper will consider these questions by focusing on the theme of energy and the environment in the APEC region. The demand for reliable sources of energy will increase as the regional economies develop and stable supplies of reliable energy will be a prerequisite for further growth in the region, especially so for the developing countries. However, the increased generation of electricity to meet these demands will put continuous pressures on the environment. The questions of energy and the environment are closely related. They must be considered on more than a single country or bilateral basis because environmental problems easily spread across borders and therefore must be tackled by all countries in the region. Thus, for the enhancement of ECOTECH under APEC and tackling the issues of energy and the environment in the region, APEC as a regional multilateral grouping would be far superior to bilateral ODA.

However, APEC alone may not be sufficient to tackle environmental problems of the present and the future and it seems that APEC must get some "lever" which enables ECOTECH to be achieved based on a completely new concept. In the particular case of energy and the environment, it is necessary to examine the possibilities of linking APEC as a regional forum to more global considerations, especially in the case of global warming.

The Third Conference of the United Nations Framework Convention on Climate Change (UNFCCC) was held in Kyoto, Japan on December 1 to 10, 1997. At that conference,

participants agreed with the introduction of a target for developed countries to reduce the emissions of greenhouse gases (GHGs). More importantly, for the purpose of promoting technology transfer, a new framework was agreed to be introduced called 'clean development mechanism,' which is a kind of 'joint implementation.' Joint implementation is a market-based approach that ideally will allow developed and developing countries to work together on GHG emission targets. APEC could play a constructive role in facilitating joint implementation among its member economies to promote ECOTECH by encouraging technology transfer to increase environmentally friendly energy supplies and, in turn, to help tackle the problem of GHG emissions on a global scale.

One characteristic of APEC—the coexistence of developed countries and developing countries—would be helpful to prevent GHG emissions through technology transfer, particularly for renewable energy to meet electricity demand as the economies of the region develop. However, it will be argued that in order to make these possibilities into reality and enhance ECOTECH for energy and the environment under the APEC framework, the connection with other international cooperation frameworks, such as the UNFCCC, is indispensable.

In section 1 we discuss the present situation of APEC cooperation for energy and the environment. While there has been some progress in developing a standardized source of information on energy supply and demand in the region, there is still much room for a facilitating role for APEC in promoting economic and technical cooperation that would benefit both developed and developing countries in terms of economically efficient energy supply and reduced GHG emissions to alleviate the problem of global warming. To-date APEC has been somewhat successful in establishing a forum—the Energy Working Group (EWG)—to discuss energy issues in APEC and collect information on energy markets in the region. The EWG as also encouraged the participation of independent power producers (IPPs), which have been able to provide electricity in many cases when governments have been unable to do so. However, there are two issues that need to be addressed. Once is that the absolute

scale of IPP production is not that great and therefore progress has been limited. The second, and in terms of environmental concerns the more pertinent, is that IPPs tend to choose fossil fuels as their prime energy source because of the low price. Small-scale IPP plants are not efficient and cause more emissions of carbon dioxide per KWh than other forms of generation, including even large-scale thermal plants.

Section 2 will discuss the potential of renewable energy. While renewable energy has been considered very expensive in the past, its cost-benefit is becoming more appealing because of increased demand in remote areas, improved technology and rising awareness of environmental concerns. It will be argued that the level of development and geographical attributes of some countries of Asia may actually be more suitable for renewable energy projects than some traditional forms of power generation.

Based on the analysis of sections 1 and 2, section 3 will consider future cooperation for energy and the environment in APEC and argue that joint implementation is a productive way to promote technology transfer and reduce greenhouse gas emissions. This would benefit both the countries of APEC and the world at large, but only if this issue is considered with regards to its global implications and the connection with international organizations like the UN. In the conclusion we propose that APEC, in particular the EWG, could build on its experience to support joint implementation projects in the region. At the same time, APEC has the potential to play a constructive role in the UNFCCC framework to tackle the important issue of global warming.

1. Present Situation of APEC Cooperation for Energy and the Environment

1.1 FEEEP

Most of the attention given to APEC has been the promotion of trade and investment liberalization; environmental and technical cooperation did not stand out as a main issue in the APEC framework in the initial stages. However, after the 1992 United Nations Conference

on Environment and Development (UNCED) in Brazil—the so-called Rio conference—cooperation for energy and the environment in the APEC region began to be discussed. During the first APEC Leaders' Meeting in Seattle in 1993, Japanese Prime Minister Hosokawa proposed the "3Es' Initiative," which stands for economic growth, energy security and environmental protection. The 3Es' Initiative was an APEC-styled sustainable development, which gave a little more priority to economic growth compared with the standard definition of sustainable development.[1]

At the APEC Cabinet Members' meeting held in Manila on November 22 and 23, 1996, the joint declaration stated that the cabinet members welcomed the call for a demonstration of initiative by the ministers in regard to the APEC Economic Committee's food, economic growth, energy, environment and population (FEEEP) issue. The characteristic of this new concept of FEEEP was that each issue was not to be treated separately, but rather emphasis was placed on the overall relationship of the elements comprising FEEEP. In that sense, the concept of FEEEP looks similar to 'sustainable development.' However, like the 3Es' initiative, FEEEP gives more priority to economic growth. Therefore, the cooperation envisioned under FEEEP would be a more market-oriented one in which economically efficient and cost-effective ways would be sought.[2]

1.2 Energy Working Group (EWG)

The most concrete program for cooperation on energy issues in APEC to date is the APEC Energy Working Group (EWG), formally known as the Working Group on Regional Energy Cooperation, which was established in 1990. Annual meetings of APEC Energy

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[1] Although definitions vary, the use of the term 'sustainable development' usually gives equal priority to economic development, protecting and restoring the environment and improving people's livelihoods.

[2] See Shigeru Itoga, eds., *APEC: Cooperation for Sustainable Development*, I.D.E. Symposium Proceedings No. 18, Institute of Developing Economies Tokyo, January 1998.

Ministers, sponsored by the EWG, have been held since 1996. The EWG is one of ten sectoral working groups under the APEC process and is "shepherded" or managed by Australia. Meetings are co-chaired by Australia and by the member economy hosting the meeting. The Australian government's Energy Division of the Department of Primary Industries and Energy provides the Secretariat for the EWG.[3]

Meetings of the EWG have been held approximately every six months and the Group has so far met fifteen times, with the last meeting being held in Mexico in March 1998. Meetings are attended by representatives from each member economy, observers from the Energy Forum of the Pacific Economic Cooperation Council (PECC) and the South Pacific Forum, and EWG's current guest participants (Colombia, India, Mongolia and Pakistan).

The current work program of the EWG is based on the EWG's Action Program, which forms part of the Osaka Action Agenda, and on the decisions of APEC Leaders, Trade Ministers and Energy Ministers. The first meeting of APEC Energy Ministers was held in Sydney, Australia in August 1996. The second meeting was held in Edmonton, Canada in August 1997 and the third meeting is to be held in Okinawa, Japan in October 1998.

The stated objective of the EWG is to maximize the energy sector's contribution to the region's economic and social well being. The activities of the EWG for that purpose are to contribute to decision making through frank and open discussion of national energy policies and planning priorities, share basic resource demand and supply outlook data, and consider the regional policy implications and responses to a wide range of energy related issues.

The strategies used to achieve the above objective include:

(1) considering and pursuing energy policies which reduce or remove market distortions, mitigate the adverse environmental effects of energy production and use in order to promote efficient consumption and production, and to enhance energy security;

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[3] The explanation about APEC EWG in this paper is based on the information acquired from APEC EWG Website. URL is *http://www.dpie.gov.au/resources.energy/energy/apec/apec_energy.html*.

(2) involving the business sector in the activities of the Working Group;

(3) exchanging information, including energy statistics and supply/demand outlook data and disseminating that information to the region's business and public sectors;

(4) developing cooperative activities, such as conferences, seminars, workshops and training programs which promote energy conservation and efficiency, result in the sharing of energy R&D, reduce adverse environmental impacts, facilitate the transfer of efficient and environmentally sound energy technology, and develop human resource skills; and

(5) developing cooperative arrangements with other international organizations, including drawing on their expertise, avoiding duplication, and increasing the speed of the introduction of efficient and environmentally sound technologies and practices, through cost-sharing and other cooperative activities.

The EWG is assisted by five Expert Groups, each of which concentrates from an energy perspective on a specific theme of strategic importance to the economies of the region including, for example:

- energy supply and demand
- energy and the environment
- energy efficiency and conservation
- energy research and development
- and technology transfer exploration and development

The ***Expert Group on Energy Data & Outlook*** is responsible for progressing work under the Energy Supply and Demand theme. The work of the expert group has concentrated on establishing a consistent framework for energy data reporting and forecasting in the APEC region. The Group publishes an annual energy data time series with a common data format for

the region.[4]

The Group is also responsible for the oversight of the Asia Pacific Energy Research Center (APERC). The major role of the APERC is to prepare and publish a comprehensive APEC regional energy outlook to 2010, which is expected to be published in early 1998, and to undertake research projects which, together with the energy outlook, address medium- to long-term issues associated with addressing the risks and impacts of potential disruption to energy supply and demand, along with issues concerning the environmental consequences of energy use.

The role of the ***Expert Group on Clean Fossil Energy*** is to concurrently enhance economic development and mitigate at the local, regional and/or global level all environmental impacts related to the production, preparation, transport, storage and use of fossil fuels and their derivatives.

The ***Expert Group on Energy Efficiency & Conservation*** is responsible for progressing work under the Energy Efficiency and Conservation theme. The work of the group has centered on encouraging the adoption of policies and programs that promote energy conservation and the application of energy-efficient technologies.

The ***Expert Group on New & Renewable Energy Technologies*** is responsible for developing the Energy Research, Development and Technology Transfer theme. The work of the Expert Group has focused on maximizing the degree of new and renewable technology assimilation by member economies by increasing their ability to assess, operate, maintain and adapt both existing and new technologies.

The ***Expert Group on Minerals & Energy Exploration and Development*** is responsible for developing the Energy Exploration and Development theme. The group seeks to promote issues related to minerals and energy exploration within APEC, including gathering and distributing information on minerals and energy exploration, and development and market

[4] The first of these publications was *APEC Energy Statistics 1995*, published in October 1997.

demand.

An Ad Hoc Business Forum has also been formed to provide business input into the EWG's work and an Electricity Regulators' Forum allows input from regulators involved in the power sector. The EWG implements a program of projects and cooperative activities. Some of its current important activities include the Power Infrastructure Initiative, the Natural Gas Initiative, Cooperation in Energy Standards, a regional outlook for energy in APEC to 2010 and an expanded program of work on energy efficiency.

As indicate by the above, the EWG has developed into a forum that is actively involved in a wide array of energy issues in the APEC region. To date, it is safe to say that the EWG has been successful in three ways. First, it has enabled government leaders, other public officials, industry specialists and business executives to exchange views and search for avenues of cooperation in the region. Second, in connection with the first, the EWG has become very effective in gathering, analyzing and distributing information on energy issues in the APEC member countries. It has been able to provide information services like conferences, seminars, workshops and training programs. At the Senior Officials' Meeting in Sapporo in July 1995, for example, the EWG submitted a report, the recommendation of which was to improve access to technology, training, services, and investment opportunities for reducing the environmental impacts of energy production, delivery and consumption in the APEC countries.[5] Third, the EWG has been active in promoting the investment of Independent Power Producers (IPPs) into this sector. To increase the number of IPPs, the EWG commissioned two reports, *Regional Cooperation for Power Infrastructure* and *Manual Best Practice Principles for Independent Power Producers*. In the EWG's Ad Hoc Business Forum, the business sector can get basic information about the electricity markets of APEC member economies in such areas as electricity regulatory arrangements, tariff pricing policy methodologies and IPP power purchase arrangements. Such kind of

[5] See Ippei Yamazawa and Akira Hirata, eds., *APEC: Cooperation from Diversity*, I.D.E. Symposium Proceedings No. 16, Institute of Developing Economies Tokyo, February 1996.

information service has been useful for reducing investment risks for IPPs and some projects have been encouraged as a result of this information.

Despite these successes of encouraging business participation and providing information services, for the most part the EWG has not made much progress beyond the information dissemination function. On the one hand, the results of the EWG's activities have been limited in terms of increased investment and technology transfer in APEC. While the EWG has encouraged market forces to work in the energy area, there have been limitations and there is more room for an active push for further progress.

On the other hand, and certainly the most serious issue of concern here is that IPPs often rely on technologies that greatly increase pollution in the electricity generation process. IPPs have been able to provide electricity in many cases when governments have been unable to do so, but IPPs tend to choose fossil fuels as their prime energy source because of the low price. Small-scale IPP plants are not efficient and cause more emissions of carbon dioxide per KWh than other forms of generation, including even large-scale thermal plants.

As indicated above, one principle of APEC cooperation is letting market forces work by enhancing business involvement in the APEC process. Considering the present situation of economic growth in Asian member economies, these limited activities cannot play an adequate role in solving both energy and environmental problems.

APEC has no funds of its own to promote economic cooperation among member economies. The developed member economies prefer bilateral ODA to APEC's ECOTECH when allocating their budgets. One of the reasons for this preference is that the present APEC framework does not provide much incentives for donor governments to allocate resources to enhance APEC's function. APEC in general, and the EWG in particular, has really only been able to function as a source of information in terms of energy and environmental issues.

In terms of energy and the environment, APEC's economic and technical cooperation can only become successful if APEC can encourage an increase of energy supply and steps to address environmental problems simultaneously. One solution would be to build on the work

of the EWG to promote the use of renewable energy in the APEC countries while continuing a market based strategy that would give incentives to both government and business to use renewable energy sources to meet electricity demand in the region.

2 Potential of Renewable Energy in the APEC Region

2.1 Energy Supply and Demand in the APEC Region

Table 1 shows that APEC countries collectively consumed 196 quadrillion British thermal units (Btu) of energy (52% of the world's total) and generated over 3.2 billion metric tons of energy-related carbon emissions (54% of the world's total) in 1996. In spite of the economic turmoil that began in the middle of 1997, Asian member economies, exclusive of Thailand, achieved steady economic growth in 1997. It is expected that the Asian economies will slow in 1998, with even minus growth rates for Indonesia, South Korea and Thailand. However, in the long term Asian economies are expected to continue their robust economic growth, which means an increase of energy consumption and carbon emissions in the future.

Table 1. GDP Growth, Energy Consumption and Carbon Emissions for APEC Economies

Member	GDP (1997) (1990 $US bn)	Real GDP Growth (1997)	Total Energy Consumption (quadrillion Btu)	Carbon Emissions (million metric tons)
Australia	357.2	2.9%	4.08	79
Brunei	N/A.	N/A.	0.06	1
Canada	650.3	3.7%	12.20	141
Chile	49.0	6.5%	0.79	11
China	802.0	8.8%	37.04	805
Hong Kong	107.9	5.4%	0.61	11
Indonesia	185.4	5.0%	3.51	61
Japan	3,346.3	0.9%	21.37	291
Malaysia	75.0	6.8%	1.66	26
Mexico	318.1	7.0%	5.62	86
New Zealand	50.9	2.3%	0.88	10
Papua New Guinea	N/A	N/A	0.04	1

Philippines	54.5	4.7%	0.98	15
Singapore	65.2	7.6%	1.22	22
South Korea	408.9	4.9%	7.16	113
Taiwan	248.1	6.3%	3.11	51
Thailand	136.1	-0.5%	2.33	44
United States	6,726.4	3.7%	93.36	1,466
Total	13,581.3	3.1%	196.04	3,233

Note: GDP and GDP Growth Rates are estimated by the Energy Information Agency, Department of Energy, USA. GDP totals exclude Brunei and Papua New Guinea.

Source: EIA, Internet Homepage. URL is *http://www.eia.doe.gov*

In addition to the projected economic growth in the region, the shift of economic structure from primary industry to more advanced industry is increasing the demand for electricity in the Asian region. The International Energy Agency (IEA) projects that electricity demand in the APEC member economies will increase by over 50 percent by 2010 compared with 1992 levels, while demand in developing member economies could increase by up to 268% over the same time period.[6] As Table 2 indicates, demand for stable electricity supplies will increase tremendously as the economies in the region continue to develop.

Table 2. APEC Electricity Generation Capacity to 2010

Member	Generation Capacity (GW)		Annual Growth Rate
	1995	2010	
Australia	38.7	50.5	1.7%
Brunei	0.5	5.1	13.8%
Canada	109.0	131.0	1.0%
Chile	5.5	12.0	4.4%
China	214.0	530.0	6.2%
Hong Kong	8.6	13.0	2.8%
Indonesia	13.2	51.5	8.9%
Japan	201.8	322.2	3.2%
South Korea	32.2	71.0	5.4%
Malaysia	9.2	23.0	6.3%
Mexico	26.6	55.5	4.2%
New Zealand	7.7	10.7	2.2%
Papua New Guinea	N/A	N/A	N/A.

[6] See Apogee Research International, *Environmentally Sound Infrastructure in APEC Electricity Sectors: A Report to the APEC Energy Working Group*, August 1997.

Philippines	8.6	29.9	8.1%
Singapore	4.7	9.0	4.1%
Taiwan	21.9	61.7	7.1%
Thailand	17.9	61.2	8.5%
United States	3,362	4,209	1.5%

Source: Apogee Research International, *Environmentally Sound Infrastructure in APEC Electricity Sectors: A Report to the APEC Energy Working Group*, August 1997.

The developing member economies of APEC are facing two major obstacles to satisfy their increased electricity demands. One is the need for huge amounts of investment to ensure electricity supply. Total requirements of investment for electricity within APEC as a whole could be more than $US 1.6 trillion to 2010. Approximately 75 percent of this will be in the developing economies. Fulfillment of the need for such huge investment is very difficult for developing countries because investments for electricity require enormous initial layouts and take many years to be paid off. Without succeeding in acquiring this investment, the lack of electricity supply will become a bottleneck to future economic growth in developing member economies in the future.

Another obstacle is environmental problems, such as air pollution including greenhouse gas emissions (GHG), water pollution and the accumulation of solid wastes. Of all these problems, global warming is perhaps the most serious and most difficult to solve because it will require a reduction in GHGs on a global scale, with the benefits not necessarily felt by the countries emitting the gases. While air and water pollution can potentially be reduced with technology, like scrubbers in coal-fire plants or water filters, global warming can only be realistically solved by reducing the output of carbon dioxide and other GHGs by improving the efficiency of energy production and consumption. A major problem in this regard is that electricity generation in most developing countries is extremely inefficient and they lack the technology and infrastructure necessary to raise the efficiency.

As discussed in section 1, the APEC Energy Working Group is promoting IPPs' participation in the Asian electricity market. This direction of APEC energy cooperation is beneficial from the viewpoint of investment requirements, because IPPs provide the funding to

build the necessary facilities that can provide much needed electricity. However, there is a danger that IPPs can make environmental problems worse. In most IPP projects, thermal small-scaled plants are chosen for their low cost of construction and operation. Thermal small-scaled electricity plants are less efficient and cause relatively more carbon dioxide than larger plants. For this problem, the EWG has proposed IPP environmental guidelines for participating electricity market. However, as with all agreements in APEC, the guidelines are followed only on a voluntary basis and are not enforceable. Therefore there are limitations to the extent that IPPs can solve the dual problem of increased electricity and reduced GHGs.

2.2 Possibilities and Barriers for the Spread of Renewable Energy

One way to overcome the dilemma between energy supply increase and environmental protection in developing countries is to focus on renewable energy as a promising energy source, especially in rural electrification. It is often said that renewable energy is too expensive to be commercialized, but continued technological innovation has reduced its price considerably. For example, solar cell panels which cost $1,000 a peak watt in the 1960s and $30 in the 1970s are only $4 now and the price continues to fall. Wind power which cost 30 cents per KWh in the late 1970s, now costs only 3.5-4 cents per KWh in locations with good wind conditions. In the United States, wind power, which is the most competitive renewable energy, is now cheaper than nuclear power or electricity from petroleum. Only coal-fired plants are comparable to wind power in price per KWh. [7]

In spite of such success in lowering the cost of renewable energy, their share of total electricity production is still minimal. Even in the United States, its share of all electricity supply (excluding hydroelectricity) is less than 1%. It is estimated that developing countries generate only 0.3% of their electricity from renewable energy.[8]

The poor penetration of renewable energy into the electricity market can be attributed in particular to three barriers. First, due to technical limitations, renewable energy can only generate electricity on a limited scale. Both wind and photovoltaic generators can generate at most 500KW per unit, and therefore are too small for most industrial uses. In addition, the intermittence of wind and solar is another technical obstacle to overcome.

The second barrier is the large initial investment costs. Although renewable energy

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[7] For this description about recent improvement of renewable energy technology, I referred to John J. Berger, *Charging Ahead: The Business of Renewable Energy and What It Means for America*, Henry Holt and Company New York, 1997 and EIA's report on Renewable Energy released on their website, *http://www.eia.doe.gov*.

[8] EIA's report on Renewable Energy released on their website, *http://www.eia.doe.gov*.

requires no fuel cost in operation, the initial capital costs are still much more expensive than coal or petroleum plants and these costs must be financed at the start of the projects. Because of the savings made from fuel costs, the initial large investment can be cost-effective over the whole lifetime of plant, but there are some risk premiums that are difficult to ascertain at the beginning of construction and it is hard for many governments or utilities companies to justify a large outlay of capital, the benefits of which will only be noticed many years down the road.

The third challenge for the spread of renewable energy is the dominance of the existent fossil-fueled plants. The United States currently has about 100GW of electric generating capacity that is at least 40 years old and at least half of those plants will probably keep operating for another 20 years.[9] It usually takes a very long time before investment in electricity plants is completely recovered. There are few incentives for electric companies to replace fossil-fueled plants that are operable for another two decades. In addition, as long as the trend towards relatively cheap oil or coal continues, power producers have no incentive to switch to other forms of power generation even when they construct new plants or replace existing ones.

Considering the barriers examined above, some developing countries have considerable advantages for overcoming such obstacles. For example, some developing countries need a great demand for peak load power in many areas that do not need a large scale. There are large non-electrified parts, especially in rural areas, for which renewable energy is very suitable because of scarce population and remoteness from a central grid. Compared with the declining generation cost by renewable energy, the improvement of transmission technology has been very slow, and transmission and distribution costs rise as the distance from grids increases. For example, in Indonesia, which consists of around 17,500 islands and stretches about 5,000 km from east to west, transmission and distribution losses (% of energy made

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[9] See John J. Berger, *Charging Ahead: The Business of Renewable Energy and What It Means for America*, Henry Holt and Company New York, 1997.

available) surpass 15 percent.[10] Large fossil-fueled plants, whose economy of scale works above 300MW, are very inefficient if they transmit from a central grid to many scattered areas. Thus, the decentralization of rural electrification in some developing countries is one area in which small-scale plants using renewable energy would be more efficient.

As for the third barrier of the ready availability of preexisting coal or oil generators, and the difficulty of switching from one type of generation to another, in many non-electrified rural areas new plants would not be competing with preexisting ones since there are no plants in the first place. Once the plants are built, there would be costs savings for fuel and transportation of fuel, as well as efficiency gains from the reduced need to extend the span of transmission grids. As a result of the cost reductions made in renewable energy generation, when the total costs for construction, fuel and transmission etc. are made, renewable energy is becoming more and more attractive in terms of price.

Despite the potential of renewable energy, the second barrier—the need to raise a large initial investment—is the most difficult challenge for developing countries. As mentioned before, in the case of renewable energy the total amount of money needed to run a plant must be laid out before any electricity is even generated. Governments in most developing countries, especially local governments that are usually the main actors in rural electrification, have no leeway to invest large sums of money at one time, even though that investment would pay off in the long term.

One way to overcome the second barrier of developing countries is through what is called joint implementation, which is a way for developed and developing countries to cooperate on GHG emission reduction projects. The idea is that governments and firms from developed countries invest in projects in the developing countries that increase energy efficiency and are given credits for reducing GHG emissions. This gives incentive to find the most cost effective way to reduce GHG emissions and it promotes a private sector transfer of

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[10] See Apogee Research International, *Environmentally Sound Infrastructure in APEC Electricity Sectors: A Report to the APEC Energy Working Group*, August 1997, pp. 28.

technology to the developing countries. APEC has the potential to play a critical role in promoting joint implementation among its members, which are both developed and developing countries. However APEC will have to link its activities with other international organizations if it is to be successful, and the most pertinent on in terms of global warming is United Nations Framework Convention on Climate Change in Kyoto (UNFCCC COP3, Kyoto Conference), in which the basic model of joint implementation was introduced.

2.3 Global Warming and the Outcome of the Kyoto Conference

Provisions against global warming under an international framework began at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil in 1992. At the Rio conference, the world's governments agreed to try to stabilize emissions of the so-called greenhouse gases (GHGs) to prevent global warming. However, governments agreed only to make an effort, with no binding commitments and no penalties for countries that failed to meet their goals. The Rio treaty set the "aim" of lowering global emissions to the 1990 level by the year 2000. With only three years left to the year 2000, however, it is clear that the objective will not be met.

At the Kyoto Conference, the agreement on the introduction of numerical targets for the reduction of GHGs in specific countries was a notable outcome. This went one step further than the general aim of reducing emissions on a global scale as in Rio. In the Kyoto agreement, Annex I countries—the industrialized countries and those from the former Soviet Union—must cut GHG emissions by at least 5% as a whole for five years from 2008 to 2012.[11]

During the negotiations, there were controversial disputes between developing and developed countries. As a result, numerical targets were not introduced for the emissions from developing countries. However, the future increase of GHG emissions is likely to come from

[11] The documents of Kyoto protocol are available in UNFCCC Homepage, *http://www.UNFCCCc.de*.

the developing countries in the wake of rapid economic growth as discussed in 2.2. To control the dangers of global warming successfully, a reduction of GHG emissions from developing countries is essential. However, any attempt to impose numerical targets for the developing countries without some form of compensation would provoke severe opposition.

In terms of practical measures for reducing GHG emissions from the developing countries, the basic model of joint implementation was outlined in Article 12 of the Kyoto Protocol. Joint implementation is expected to promote technology transfer from developed to developing countries and help to reduce GHGs on a global scale. Several year's experience after the Rio Summit, we have recognized that for most industrialized countries there is not much room for squeezing large reductions of GHGs without sacrificing economic growth. Joint implementation is also expected to secure economic growth not only of developing countries through energy efficient technology transfer, but also of developed countries. We will discuss details of joint implementation in the next section, in connection with APEC ECOTECH framework.

3. Future Cooperation for Energy and the Environment under APEC

3.1 Policy Instruments for Reducing GHGs and Joint Implementation

There are, theoretically, five major policy instruments to control the level of GHG emissions, including: 1) the command and control approach, 2) energy taxes, 3) carbon taxes, 4) tradable carbon taxes, and 5) joint implementation.[12] Except for the first one, these solutions are market-based or economic-incentive instruments. Considering the present lack of a supranational authority that could impose policies on each nation state, the first one, the command and control approach, is functionally impossible. So we will discuss the other four

[12] See Zhongxiang Zhang, *The Economics of Energy Policy in China: Implications for Global Climate Change*, Edward Elger Cheltenham UK, 1998.

options.

Energy taxes and carbon taxes are based on similar principles. In both cases, taxes are imposed according to the amounts of heat or carbon emitted by the burning of energy sources. The taxes can be expected to decrease GHG emissions through price mechanism effects on energy consumption, technological advances and switching to fuels that are less polluting. For the purpose of reducing GHG emissions, carbon taxes are more effective because energy taxes may impose more taxes on oil or nuclear fuel than coal, which produces less electricity per unit that other fuels but more carbon dioxide. Energy taxes may lead to an increase in the consumption of coal and thus greater GHG emissions, whereas carbon taxes can be expected to reduce GHG emissions because fuels that emit less carbon dioxide would be chosen.

While carbon taxes would be theoretically effective in decreasing GHG emissions to some extent, there are profound obstacles to their implementation. Their international application would likely cause similar disputes to those at the Kyoto Conference. It would be difficult to impose an even tax on all countries, both developing and developed. Carbon taxes have an indirect effect on the macro economy of each country through energy consumption. The economic structure in many developing countries depends heavily on primary industries. In addition, their technologies are less efficient and need more energy than developed countries. Carbon taxes would have a regressive impact on developing countries and cause very strong opposition from them. In a political sense, the imposition of carbon taxes is not a viable option, and even the developed countries would probably have a difficult time introducing a carbon tax if it meant sacrificing economic growth.

Tradable carbon taxes are a more flexible measure since they allow the trade of carbon emissions' permits among countries. As long as the marginal cost of reducing GHG emissions differs among countries, countries have an incentive to trade permits with the market price of carbon emissions being equal to the marginal cost of reduction, and thus make a net gain. The process continues until the marginal cost of reducing GHG emissions is equalized across

countries, inducing a cost-efficient distribution of GHG emissions.

This mechanism is designed to make the best use of market-based adjustments. In theory, on the global level the costs required to reduce GHG emissions would be minimized. As long as trade is promoted in the market, there should be no inequalities in the process. However, there remains a very difficult problem to solve, which is the allocation of the initial emission permits among countries.

Once an international emission budget is set, the next step would be how to allocate the initial emission permits to each participating country. Rules applied in the process of allocation would have to be based on a uniform percentage reduction, historical GHG emissions, current GDP and population. However, there is no is no indication that the world's governments are anywhere close to an agreement on which rules should be applied in the allocation of initial permits because of never-ending conflicts of interest among and within countries. At the Kyoto Conference, developing countries strongly opposed the numerical targets applied to them. Tradable carbon taxes are premised on the introduction of numerical targets and are promising measures only if they can succeed in overcoming the difficult problem initial allocation.

Considering all possible options, at present joint implementation is the most effective provision for applying a market based strategy to reduce GHG emissions. Joint implementation means the investor country invests in emission reduction projects in another (host) country where the costs of reducing GHG emissions are relatively lower than trying to achieve an equivalent reduction within one's own country and is credited, in whole or in part, for emission reductions in its own GHG accounts. Joint implementation enables the investor countries to "shop around" for the lowest way to limit emissions. Thus, it offers the potential for reducing the global costs of GHG reductions.

GHGs emitted in one place on the Earth has the same effect as those emitted somewhere else. The effect is global, so it does not matter whether GHGs are reduced in Japan or in China, but matters whether we are able to reduce on a global scale. This logic makes joint

implementation reasonable to prevent global warming.

The difference from tradable carbon taxes is that, in the case of joint implementation, numerical targets do not always have to be set for developing countries. Joint implementation would be able to functionally reduce GHG emissions if numerical targets of developed countries only are set. As far as developing countries are concerned, through participating in joint implementation they can get increased access to more advanced technologies and additional funding, although the extent of participation would depend on the definition of incremental cost of the joint implementation deal. This will make it possible for the developing countries to increase energy efficiency and lower emissions while achieving the same rate of economic growth.

Joint Implementation can be broadly defined as an attempt to reduce global cost of meeting a particular GHG emission target. At present, a concrete framework for promoting joint implementation in APEC has not yet formed. In this regard, ECOTECH could play a vital role in promoting joint implementation.

3.2 APEC's Advantage in Introducing Renewable Energy and Reducing GHGs

In the Kyoto Protocol, Article 12 proposes that this joint implementation, which is called a 'clean development mechanism,' is introduced among Annex I countries. However, combined with the joint implementation framework, APEC ECOTECH could enhance its activities by helping to introduce renewable energy into developing countries. As discussed in section 2, the potential of renewable energy in meeting new energy requirements in developing countries is much greater than in developed countries. Especially in developing member economies of APEC, there are many advantages, which include geographical factors like large land areas (China) or the existence of many islands (Indonesia and the Philippines). In these countries there are a lot of non-electrified villages, especially in rural areas. Accompanied with rapid economic growth, the demand for electricity in such remote areas continues to grow rapidly.

China is one of the largest countries in the world geographically, and its population is the largest. In China, the government has made great efforts to supply electricity to rural areas since the 1970s. For an energy source, the government selected not only small hydroelectricity plants but also small coal-fired plants. As a result, it is said that in rural China small coal-fired plants, with less than 500KW per plant, account for 5GW of total installed capacity.[13] Those plants consume much more coal per kW than other forms of generation, including large-scale coal-fired plants, and hence produce proportionately more GHGs. In the case of China alone, the replacement of such small coal-fired plants with renewable energy would have benefits for reducing GHGs. This case is one of many possibilities for joint implementation to work in the APEC region.

As indicated in 2.2 above, the most challenging barrier for the spread of renewable energy is raising funds that are required for large initial investment. Joint implementation could play an important role in overcoming this problem. As a result of the UNFCCC Kyoto Conference, especially numerical targets for the reduction of GHGs emissions among Annex I countries, developed countries have the incentive to make some projects for renewable energy with developing countries. APEC developed member economies, such as the United States, Canada and Japan, have little room to reduce GHGs without sacrificing future economic growth. Under the Kyoto Protocol, a 7 percent numerical target for reduction of GHGs was allocated to the United States, and 6 percent to Canada and Japan. Considering the limited possibilities of the developed countries to realistically achieve those reductions by reducing GHG emissions at home, they essentially will have to utilize joint implementation to reduce emissions in other countries in order to attain the targets that were promised without sacrificing economic growth.

In many ways these projects are like a public good for both positive and potentially negative reasons. On the one hand, the transfer of technology to help the developing countries

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[13] See Yingzhong Lu, *Fueling One Billion: An Insider's Story of Chinese Energy Policy Development*, Washington Institute Press Washington D.C., 1993.

reduce their GHG emissions would be a benefit to all countries and peoples of the world. On the other hand, there is the risk of free riders who enjoy the benefits of others' efforts without doing their part. Joint implementation is a kind of technology transfer, which is a very complex process involving not only governments but also private sectors in both technologically advanced and recipient countries. A pre-established set or rules to ensure the protection of intellectual property rights is vital to encourage participation of the private sectors in the member economies, who might shy away from projects in which the question of property rights is ambiguous. In combination with guarantees for protecting property rights, the capacity building of the recipient countries, such as human resource development, is strongly needed for promoting technology transfer.

In both these senses, multilateral cooperation would be more effective than bilateral. In this sense APEC is already well equipped to tackle these issues. A particular characteristic of APEC from the perspective of technology transfer is that the grouping has both technology advanced and recipient countries as members under its framework. They have all agreed to work together to look for solutions to common problems and have accumulated a great deal of diplomatic and technical skills. In addition, the EWG can provide the information and organize the logistics for joint implementation projects. APEC should now take the initiative to promote joint implementation as part of the UN's efforts at GHG reductions, which are limited only to Annex I countries now.

Conclusion

This paper has considered two interconnected questions: one was how to enhance the function of APEC's economic and technical cooperation and the other was how to promote the spread of renewable energy into developing countries as part of a greater goal of reducing global greenhouse gases. Both questions can only be answered when they are considered in combination with the framework of the UNFCCC Kyoto protocol.

In 1997, APEC was strongly criticized for its helplessness in response to the economic

turmoil that swept through the Asian region. As for ECOTECH, APEC could not take any initiative in coping with the situation in which APEC was strongly expected to play an important role. Many people were disappointed with APEC itself. Without drastic reform of framework, many feared APEC might lose a considerable amount of its influence and legitimacy.

The outcome of the UNFCCC Kyoto Conference gives APEC an opportunity to promote the use of renewable energy in the region and help reduce GHG emissions on a global scale. However, APEC can only truly play its potential role in promoting economic and technical cooperation and working towards more sustainable economic development if it incorporates the goals, and possible solutions, set out in the Kyoto protocol. On the other hand, the success of the Kyoto protocol also depends on the function of regional cooperation, to which APEC can contribute. The work of the APEC's energy working group (EWG), for example, should be commended as an important foundation of a regional framework for cooperation on energy and environmental issues. It has the potential as well to act as a catalyst for the introduction of renewable energy to meet the rising energy needs of the APEC member countries. It is necessary now to use the data and analysis function of the EWG to find projects in which joint implementation can be applied.

If energy cooperation for preventing global warming under APEC is formed successfully, there are many options other than joint implementation. With regards to emission trading, for example, APEC may propose an "APEC Bubble," under which numerical targets for reduction of GHGs could be given as a whole of APEC. This is a similar way EU suggested as "EU Bubble" in the Kyoto Conference. This may even make it easier to accommodate the demands from the developed and developing countries of APEC if numerical targets are taken as a whole rather than on an individual country basis.

If APEC is successful in linking ECOTECH to the global agenda, it could prove to be a stepping stone to a more intricate network of regional and global cooperative efforts. The question of global warming can only be tackled on a global scale through universal multilateral

institutions. However, in terms of resources and pre-established networks, regional cooperative efforts have the potential to become a vital link in the global effort. This is a role that APEC could play by using regionalism as a support for, rather than an alternative to, globalism. This in turn could strengthen the legitimacy of the ECOTECH agenda and stimulate cooperation within APEC itself.

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