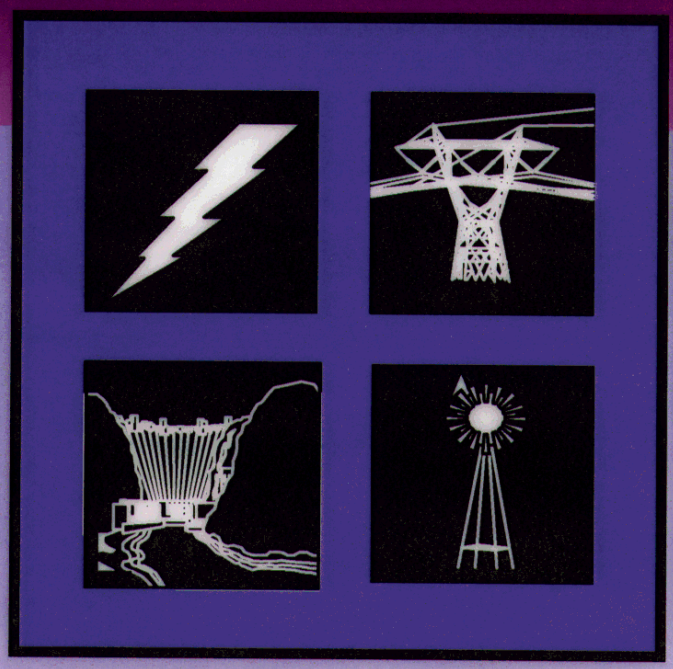
ENVIRONMENTALLY SOUND INFRASTRUCTURE IN APEC ELECTRICITY SECTORS:

A Report to the APEC Energy Working Group



APOGEE RESEARCH with
Canadian Energy and Environmental Economics
East-West Center
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August 1997

Acknowledgements

THIS report was prepared by Apogee Research International, Ltd. (Toronto, Canada) under contract to Natural Resources Canada.

We would like to thank our consulting team for their hard work and timely contributions. In particular, we wish to express appreciation to John Cameron, Mary Jarbeau and Rose Odom of Apogee, Mitchell Rothman of Canadian Energy and Environmental Economics (Toronto, Canada), John Soderbäum of ACil (Paris, France) and Ronald Hagen, Duangjai Intarapravich and Cary Bloyd at the East-West Center (Honolulu, United States).

Guidance and critical reviews of draft material were generously provided by: Gil Winstanley and Claude Gauvin of Natural Resources Canada; members of the APEC Energy Working Group; and John Hartwell and Paul Ross at the APEC Energy Working Group Secretariat.

Valuable input was received from: members of the Ad Hoc Business Forum and Electricity Regulators' Forum; participants at the APEC IPP Best Practices Workshop held in Honolulu on April 23-24, 1997; members of an international advisory panel established by Apogee for this study; and business representatives and government staff who kindly participated in interviews and responded to information requests.

Opinions and information contained in this report remain, of course, the responsibility of the authors.

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EXECUTIVE SUMMARY

Introduction

DRIVEN by strong economic growth, demand for electricity is growing rapidly in the Asia-Pacific region. The International Energy Agency projects that electricity demand in the Asia-Pacific Economic Co-operation (APEC) member economies as a whole will grow by over 50% between 1992 and 2010. Demand in the developing and newly industrialized member economies could grow by up to 268% over the same time period.

Adequate and reliable supplies of power to satisfy demand are essential to ensure continued economic growth and increases in standards of living. While conservation can play a role, massive additional investments in new electricity generation capacity will be necessary if projected consumption needs are to be met, and so that lack of electricity does not become a bottleneck. Investment requirements for electricity capacity for APEC economies as a whole could be more than US$1.6 trillion to 2010. Approximately 75% of this could be required in developing and newly industrialized economies.

APEC member economies are generally finding that needed investments are too expensive to undertake exclusively through nationally owned or subsidized power utilities. Consequently, there has been a trend to liberalize and privatize power production and distribution systems, which is also in keeping with the worldwide move towards more competitive electricity markets. This trend is typified by the increased role for independent power producers (IPPs) in the power sectors of many APEC economies. However, in almost all member economies, the growth in demand will be met by a combination of public and private investment.

While the current mix of usage among thermal (basically fossil fuel), nuclear, and hydroelectric power varies widely in APEC economies, most members will meet the bulk of their new requirements from thermal sources.

These large increases in electricity generation will affect the environment. Environmental impacts range from local effects such as those caused by particulate emissions, to regional ones, such as acid rain from SO_2 emissions, through to truly global effects such as climate change. Already many developing APEC economies are experiencing an increase in environmental degradation as a result of their fast-paced development and the associated growth in electricity generation.

The challenge facing APEC member economies is to achieve both their environmental and investment objectives. Although this is a difficult task, it is not impossible.

Good environmental policy practices can provide for effective and consistent enforcement, transparency and predictability to assist power producers in complying with environmental requirements, and flexibility to meet the environmental requirements in the most cost effective manner possible. At the same time, such practices can serve to attract new investment capital by reducing risks, simplifying due diligence processes by lenders, and creating level playing fields. New investment capital, in turn, can bring with it technologies that meet world class performance standards in both energy efficiency and environmental performance. Frequently, investment capital also comes subject to world class environmental standards imposed by financiers.

During their 1996 meeting in Sydney, the APEC Energy Ministers agreed that, “the application of economically sound measures to minimize the adverse environmental impacts of energy production and use is essential to protect the well being of both present and future generations.” Consistent with that statement, the ultimate objective of this report is to identify good policy practices which APEC member economies can use to meet the challenge of achieving both their environmental and electricity investment objectives. Its recommendations are aimed at furthering the adoption of these good practices.

Principles and Practices to Meet the Challenge

FIVE general principles characterize many of the good environmental practices identified in this study. The principles emerged from two sources: discussions with investors and developers regarding what is needed from environmental policy practices to encourage investment; and, an examination of common elements of practices member economies are adopting to achieve environmental and investment objectives. The principles are as follows.

- *Efficiency*: To reduce impacts on the environment, opportunities for improving efficiency in electricity generation, transmission, distribution, and consumption should be fully exploited as a first step. This will reduce the need for capacity expansion, the quantity of fuel consumed and environmental impacts. Cost-based pricing is one of the critical factors for the success of efficiency programs.

- *Transparency*: Environmental requirements should be clearly defined and information should be readily available on what the requirements are, how power producers can demonstrate compliance and how non-compliance will be treated.

- *Predictability*: Risk associated with changing environmental standards and granting of environmental approvals should be minimized. Timelines and measurable criteria for environmental approval processes are two examples of ways to increase predictability. When changes are necessary, they should evolve predictably and early warning should be provided.

- *Consistency*: Environmental requirements — including all standards, non-compliance penalties and approval requirements — should be applied consistently and fairly to all power producers during IPP proposal evaluations, environmental approval processes, operations, etc. A level playing field is increasingly important for member economies moving towards more competitive market structures.
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- *Cost Effectiveness*: Environmental requirements should be designed for cost effectiveness, for example by providing flexibility to power producers to meet environmental objectives using whatever compliance strategy is most cost effective.

The study also defines six policy areas where these principles should be applied to identify good practices. The areas are energy efficiency, environmental approvals processes, environmental standards, market based instruments, monitoring and enforcement, and IPP processes.

The good practices identified in this study are not necessarily appropriate for every APEC member economy. Each good practice must be considered within the unique environmental, economic, institutional and technological characteristics of the member economy. The good practices constitute a range of options from which member economies can select based on their own circumstances.

Energy Efficiency

IMPROVED energy efficiency can help meet environmental and electricity supply goals. More efficient generation, transmission and distribution of electricity increases the effective supply and can reduce environmental impacts. More efficient use of electricity by consumers makes the available supply go further to meet the electricity needs of the economy. It also reduces

the need for consumption of fuel inputs and subsequent generation of polluting by-products, thereby reducing environmental impacts.

Recognizing that some good practices are not appropriate for economies with decentralized, competitive electricity markets, we recommend that:

1. Member economies ensure that energy policy encourages an efficient and cost-effective electricity sector.

Good practices include:

- ➢ When consistent with an economy's electricity market structure, planning processes should use least-cost planning, also known as Integrated Resource Planning (IRP).
- ➢ Electricity prices should be based on long run marginal costs.
- ➢ Electricity should not be subsidized.

2. Member economies ensure that electricity is generated efficiently, using technologies that get the best-practice level of usable energy from a fuel source.

Good practices include:

- ➢ Cogeneration — projects that make use of the exhaust heat from electricity generation — should be encouraged to save energy and reduce environmental impacts.
- ➢ Programs should be implemented to improve generation efficiency, for example by ensuring that contractual arrangements with IPPs encourage efficient production.
- ➢ Generation opportunities which use waste products should be exploited.

3. Member economies ensure that electricity is transmitted and distributed efficiently, with a best-practice level of losses.

Good practices include:

- ➢ Programs should be implemented to promote efficiency in transmission and distribution.

4. Member economies ensure that their electricity end-use needs are met in the most efficient and cost-effective manner possible.

Good practices include:

- ➢ Programs to increase end-use efficiency should be implemented, such as demand-side management (DSM) programs — government or utility programs to promote end-use efficiency.
- ➢ Demand side management programs — defined broadly to include legislation and regulations, pricing mechanisms, financial incentives, competition and award programs and education and information programs — should be subject to monitoring and evaluation.
- ➢ Government policies should be co-ordinated with DSM policies and programs.
- ➢ Financial mechanisms should be adopted, where needed, to promote DSM.
- ➢ Information transfer mechanisms should be put in place, involving both the general public and commercial and industry energy managers.
- ➢ The development of energy services companies — companies that finance and implement energy efficiency improvements — should be encouraged.
- ➢ Training information and capabilities should be exchanged within and between economies.

Environmental Approval Processes

ENVIRONMENTAL impact assessment (EIA) and other environmental approval processes are the number one concern of business investors and lenders related to environmental policy practices. It is in these processes, and not so much the environmental standards themselves, where good practices are most needed. Practices which reduce monetary costs, time delays and uncertainty whether approvals will be granted should be promoted.

To reduce costs, delays and uncertainty, we recommend that:

1. Member economies ensure EIA and other environmental approval processes are transparent.

Good practices include:

- EIA and other environmental approval processes should be specified in clear legislative, policy and regulatory frameworks.
- Implementing guidelines and manuals for the electricity sector should be available to assist project proponents.

2. Member economies ensure approval processes are cost effective to allow for informed decisions without imposing undue requirements and costs on project proponents.

Good practices include:

- A centralized agency or co-ordinated harmonized approach should be established to facilitate EIA and other environmental approval processes.
- Public participation should be encouraged to increase the public acceptability of projects.
- Duplicative processes by different EIA and other approval agencies should be eliminated, and approvals processes should be harmonized between jurisdictions.
- EIAs should be scaled to reflect the degree of environmental risk posed by a project.

3. Member economies ensure EIA and other approvals processes can be completed in a timely fashion.

Good practices include:

- Approval processes should be conducted early in the design stage.
- Timelines should be established for public input, review of EIAs and other approval applications, and government decisions.
- EIA requirements and other approvals should be integrated.

4. Member economies ensure approval processes are predictable in that uncertainty regarding outcomes is reduced through clear decision rules and timelines.

Good practices include:

- Approval decisions should be based on objective evaluation criteria.
- Any site-specific criteria required for approval should be well defined at the outset of the EIA process.

Environmental Standards

EACH APEC member economy has chosen a level of environmental standards in consideration of its environmental, socio-economic and technological characteristics. However, *how* those standards are specified can affect the way the business sector perceives the investment climate. Common forms of standards include ambient environmental quality standards, point source discharge standards, technology standards and fuel quality standards.

To create a strong investment climate while achieving environmental goals, we recommend that:

1. Member economies ensure that environmental standards are transparent so as to assist power producers in assessing risks and complying with the standards.

Good practices include:

- ➢ Environmental standards should be embodied in clear legislative, policy and regulatory frameworks.

2. Member economies ensure environmental standards are predictable over time to reduce the risk to power producers of changes in environmental standards and to allow power producers time to implement cost effective compliance strategies.

Good practices include:

- ➢ Environmental standards should be set high enough to reduce the risk of future increases in the stringency of environmental standards and the consequent need for expensive retrofits.
- ➢ If more stringent environmental standards are contemplated for the future, those higher standards should be specified now to provide power producers with maximum planning horizons.

3. Member economies apply environmental standards consistently to all producers to create a level playing field.

4. Whenever possible, member economies should specify environmental standards as performance standards, not technology standards or fuel quality standards.

5. Member economies specify environmental standards to protect local environmental quality without compromising regional or global environmental quality. Reliance on stack height requirements to disperse pollutants should be avoided if regional environmental quality may be threatened.

Market Based Instruments

MARKET based instruments are policy instruments to achieve environmental objectives by creating price signals that encourage business to make environmentally sound decisions. The major advantage of market based instruments is that they offer power producers flexibility in how they contribute to achieving environmental objectives. This flexibility can allow environmental objectives to be achieved at a lower cost than through other mechanisms.

One form of market based instrument — emissions trading in its various forms — is particularly useful for controlling total emissions in a region while allowing new facilities to site there. However, it does require accurate monitoring and strong enforcement to be environmentally effective. To help achieve environmental goals cost effectively and to allow economic growth, we recommend that:

1. Member economies consider the use of market based instruments as a cost effective means to achieve environmental objectives.

Good practices include:

- Emissions trading, particularly for SO_2 and NO_x emissions, should be considered.
- Intra-utility emissions trading, particularly for SO_2 and NO_x emissions, should be considered.
- Activities implemented jointly — where companies invest in greenhouse gas reduction projects in economies where the costs of doing so are lower — should be considered.

Monitoring and Enforcement

MONITORING and enforcement are essential elements of an environmental protection program. Monitoring and enforcement can also promote power production investment if they are designed to reduce and clarify the risk of investment. For example, well-designed monitoring programs can reduce risk by providing important information on the operation and maintenance of a power plant to both regulators and operators.

To ensure monitoring and enforcement provides for strong environmental protection without hindering investment, we recommend that:

1. Member economies implement effective monitoring to accurately detect deviations from environmental standards, and that effective enforcement mechanisms exist to deter such deviations.

Good practices include:

- ➢ Monitoring should take place and accurately reflect actual performance of the facility.
- ➢ Enforcement should take place, and penalties for noncompliance should be set at a level which encourages compliance.
- ➢ Trained and qualified staff should perform monitoring, inspections, and enforcement.

2. Member economies develop transparent monitoring and enforcement criteria so that operators and enforcers are able to easily verify compliance.

Good practices include:

- ➢ Clear statements of monitoring requirements and enforcement mechanisms should specify who is responsible for monitoring, what monitoring procedures are required, and how monitoring data will be used to verify compliance.

3. Member economies ensure responses to non-compliance, and any rewards for compliance, are predictable.

Good practices include:

- ➢ Clear statements of the consequences of failing to meet standards, and possible rewards for good behaviour, should be specified.

4. Member economies ensure consistency across power producers in the application of environmental performance monitoring and enforcement programs.

5. Member economies consider introducing flexibility in monitoring and enforcement programs so as to allow power producers to comply with environmental requirements more cost effectively.

Good practices include:

- ➢ A tiered enforcement approach that balances cooperation with coercion should be used when the situation allows.
- ➢ Voluntary, self-auditing or third party certifications (e.g. ISO 14000) should be used, if appropriate, to make programs more cost effective.

IPP Processes

INDEP ENDENT power producers (IPPs) can help host economies meet both environmental and infrastructure investment goals. They help meet environmental goals by using current, efficient and relatively clean technologies for electricity production. They help meet investment goals by bringing investment capital with them.

To create a strong investment climate while achieving environmental goals, we recommend that:

1. Member economies ensure that the process for environmental aspects of IPP approvals is clear.

Good practices include:

- ➢ Requests for proposals (RFPs) should specify in detail the process for environmental approvals.

2. Member economies ensure that the evaluation processes for IPPs is transparent, with clearly stated rules and criteria.

Good practices include:

- ➢ The RFP should specify the evaluation factors and the weights for environmental criteria to be used in evaluation.

3. Member economies ensure that environment related risk is allocated to the party best able to control the risk.

Good practices include:

- ➢ Risk related to changes in environmental requirements should be allocated to government, while risk related to environmental performance should be allocated to the IPP developer.
- ➢ Fuel quality restrictions specified in the RFP should allow the IPP to switch fuels in order to meet the environmental standard.

4. Member economies ensure that environmental requirements are applied consistently during the IPP process.

Good practices include:

- ➢ If utility avoided cost is used as a price cap for IPPs, the avoided cost used should be for facilities which have to meet the same environmental standards as the IPPs.
- ➢ All IPPs should be held to the environmental standards as set out in the RFP.

Recommended Next Steps

The rapid growth in electricity needs within the APEC region presents a significant challenge to meeting environmental goals *and* electricity infrastructure investment goals. This study identifies numerous policy practices available to help ensure investments result in environmentally sound electricity infrastructure.

Achieving both environmental and investment objectives within the electricity sector will require ongoing efforts from business and government to identify and implement good practices. APEC member economies sharing their experiences with various policy and administrative practices should play an important role in those efforts.

This study provides a beginning for the necessary efforts, not the end. It suggests principles for identifying good policy practices, as well as specific good practices in six areas (energy efficiency, environmental approval processes, environmental standards, market based instruments, monitoring and enforcement, and IPP processes).

The principles are ***predictability***, ***transparency***, ***consistency***, ***efficiency*** and ***cost effectiveness***. Discussions with stakeholders and an assessment of current environmental policy practices indicate that practices consistent with these principles will serve both environmental and investment objectives.

Each policy practice that meets these principles is not necessarily suitable for all APEC member economies. Instead, the good practices identified in the study are offered as a menu of options from which member economies may identify practices that are appropriate within the unique environmental, economic, institutional and technological context of each economy.

The principles and good practices were developed specifically for the electricity sector. They are, however, highly applicable to other sectors within the power industry. Indeed, good practices within environmental approval processes, environmental standards, and monitoring and enforcement, for example, generally apply to all energy sectors, as well as other industries.

To advance the implementation of good environmental practices, we recommend the following.

1. Endorse the Principles

To meet the dual environmental and investment objectives, the principles of ***efficiency***, ***transparency***, ***predictability***, ***consistency*** and ***cost effectiveness*** should guide environmental policy practices, on paper and in practice.

As a first step in implementing the principles, it is recommended that the APEC Energy Ministers endorse the principles for the purpose of selecting, implementing and administering environmental policy practices. Ministers should also note that there are many good practices consistent with the principles available to further the achievement of environmental *and* investment objectives.

2. Review Current Environmental Practices

Member economies could review their current environmental practices in light of the principles and good practices. It is recognized that not all good practices described within this study are applicable to all member economies. Nonetheless, member economies may identify useful practices to adopt within their unique contexts.

3. Facilitate Further Dialogue on Implementing Good Environmental Practices

This study provides a foundation for dialogue between government and business, and among APEC member economies on good environmental practices. The Energy Working Group is a valuable forum to facilitate that dialogue.

The IPP study provides a useful model for continuing the dialogue. In the IPP study, a workshop reviewed a consulting study and provided valuable input and verification of principles and best practices.

The Energy Working Group could consider such a focused, international workshop as a means of:

- promoting further discussion and dissemination of good environmental practices; and
- identifying ways of overcoming barriers to implementing good practices.

Since energy agencies generally do not implement or administer many of the good practices, representatives from both energy and environment agencies, as well as appropriate energy regulatory bodies, should be encouraged to participate. Business representatives would also be essential to ensure the workshop reflects the practical concerns of investors and developers.

4. Further Document Environmental Practices

APEC has already undertaken some documentation of environmental requirements, most notably the Clean Fossil Energy Experts' Group's *Study on Atmospheric Emissions Regulations in APEC Economies and Their Compliance at Coal-Fired Plants* (January 1997). Further documentation of environmental practices in APEC member economies would serve two purposes:

- it would increase the transparency and clarity of environmental requirements, thereby facilitating investment and compliance; and
- it would aid member economies in developing their environmental practices.

Environmental assessment processes, other environmental approval processes and environmental standards for non-coal-fired plants are three areas where documentation would be most useful. Since such documentation would be useful to other multilateral organizations, co-sponsorship of a study might be considered.

The Energy Regulators' Forum has documented member economies' practices regarding other issues — for example, electricity tariffs and IPP processes during their meeting in April 1997 — and may be an appropriate venue for documenting environmental practices.

5. Identify and Implement Best Practices to Facilitate Transfer of Clean and Efficient Technology

Access to clean technologies is essential to achieving both investment and environmental goals for the electricity sector. The APEC Technical Seminars on Clean Coal Technology proved valuable in disseminating information on technology options. IPPs also assist in transferring technologies to developing economies.

Our discussions with business representatives regarding environmental practices revealed that technology transfer is hindered by certain types of policies unrelated to the environment. Provisions within trade and tax policies are most important in facilitating transfers of clean and efficient technologies. The Energy Working Group could consider undertaking a detailed study on good policy practices to encourage clean technology transfers. The study might:

- document current policies in APEC member economies affecting technology transfer;
- identify principles and good practices that facilitate technology transfer; and
- recommend ways for APEC member economies to implement good practices.

An important component of such a study should be input from business representatives and government agencies responsible for implementing practices that affect technology transfer.

6. Share Experiences on Ways to Encourage Demand-Side Efficiency as Electricity Markets Become More Competitive

As electricity sectors become more open and competitive, traditional DSM programs become less applicable. Yet energy efficiency remains a significant opportunity to help achieve environmental goals in most APEC member economies. The key issues are:

- what is the appropriate balance between investments in generating capacity and investments in energy efficiency?
- how can member economies encourage demand-side efficiency within more competitive electricity market structures?

Initial efforts — including some by the APEC Inter-Utility Demand Side Management Liaison Group — have been made to address the issue. However, competition is still new to most electricity markets, and experience with DSM is evolving rapidly. Further efforts to share experience with DSM in competitive markets are needed if the environmental and economic benefits from energy efficiency are to be realized.

The Energy Working Group could facilitate development of a better understanding of how demand side efficiency can be encouraged within the evolving electricity sectors in APEC member economies. For example, a study on best practices for energy services companies might be useful.

The following three recommendations are potentially of longer term significance, and might also be considered by the APEC Energy Working Group.

7. Assess the Potential to Reduce Air Emissions from Electricity Generation Using Market Based Instruments

Market based instruments offer significant potential to help member economies achieve their environmental objectives at a lower cost than more traditional policy instruments.

In its various forms, emissions trading has particular appeal for reducing emissions from electricity generation. Successful trading programs in the United States illustrate the potential economic and environmental benefits from these policy instruments. Yet there remains much uncertainty about the potential for applying market based instruments within other APEC economies, particularly developing economies.

Since emissions from electricity generation are a serious concern in many APEC member economies, the Energy Working Group could consider further examination of emissions trading to assess:

- the conditions for successful trading programs in the electricity sector;
- whether and how emissions trading might be applied in developing economies; and
- the extent to which emissions trading might assist APEC member economies in meeting their environmental objectives for the electricity sector.

Although there are already many efforts underway to explore activities implemented jointly (AIJ) for greenhouse gas emission reductions, consideration of potential roles for the APEC Energy Working Group in facilitating AIJ may also be useful.

8. Co-ordinate Between Energy and Environment Agencies

In many APEC economies, implementation of the good practices is a responsibility of environment agencies, not energy agencies. Therefore, co-ordination is required to ensure environmental policy practices meet both environmental and energy investment objectives.

APEC member economies could use this study as a basis for discussions between energy and environment agencies to:

- identify existing practices that may be inconsistent with the principles for good practice; and
- identify good practices that may be suitable within their economy to achieve both environmental and investment objectives.

9. Develop Future Up-Dates of the Inventory of Good Practices

There will be a need to up-date the inventory of good practices identified by this study. Good environmental practices evolve continuously.

Key drivers of this evolution include:

- growing experience with innovative environmental policies;
- market structures moving towards increased competition;
- better availability of new clean technologies and more cost-effective opportunities for environmental protection;
- changes in environmental quality due to continued economic expansion;
- international negotiations on climate change, transboundary air pollutants and other environmental issues; and
- changes in public preferences as a result of higher incomes, growing understanding of environmental concerns and other factors.

We recommend, therefore, that in five years the Energy Working Group examine the need to up-date the inventory of good practices and re-assess the good practices member economies are adopting.

1. INTRODUCTION

1.1 The Investment Challenge

RAPID economic growth and development in the Asia-Pacific region is creating large increases in the demand for electricity. Projections from the International Energy Agency suggest electricity consumption by Asia-Pacific Economic Co-operation member economies will increase by 51 to 81% between 1992 and 2010.[1] Developing and newly industrialized member economies could see electricity consumption grow by up to 268% over the same time period.

Adequate and reliable supplies of power are essential to ensure continued economic development. Already, the Asia-Pacific Economic Co-operation (APEC) member economies collectively increased electricity generation by 3.6% per year between 1990 and 1994.[2] However, as shown in Table 1.1, massive additions to generation capacity will be necessary if projected consumption needs are to be met.

Investment requirements within APEC as a whole could be more than US$1.6 trillion to 2010. Approximately 75% of this will be in developing and newly industrializing economies. Needs could be met partially through efficiency improvements and demand side management, but demand is growing so rapidly that large investments in capacity increases will be necessary.

Without this investment, electricity supply could become a bottleneck that hinders economic development. Economies suffering from capacity shortfalls or system unreliability will find it increasingly difficult to attract and retain industry investment. As industries become globalized, they may choose to direct new investment, or even relocate existing operations, to economies that have more reliable power supplies.

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1 The APEC member economies are Australia, Brunei Darussalam, Canada, Chile, the People's Republic of China, Hong Kong, Indonesia, Japan, Malaysia, Mexico, New Zealand, Papua New Guinea, the Philippines, the Republic of Korea, Singapore, Chinese Taipei, Thailand and the United States.

2 International Energy Agency.

Table 1.1: APEC Electricity Generation Capacity to 2010

Economy	Generation Capacity (GW) 1995	2010	Annual Growth Rate
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%
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	na	na	na
Philippines*	8.6	29.9	8.1%
Singapore*	4.7	9.0	4.1%
Chinese Taipei	21.9	61.7	7.1%
Thailand	17.9	61.2	8.5%
United States	3362.0	4209.0	1.5%

Notes: % change is annualized.
U.S. data is consumption in TWh.
* Base year is 1994.
** Base year is 1992.
Sources: Blake Dawson Waldron (1995), East-West Center, and U.S. Department of Energy.

Provision of electricity is also seen as an integral part of efforts to improve living standards. Many developing economies have rural electrification programs aimed at extending the supply of electricity to provincial towns or villages. These programs are designed to not only provide the population with essential social amenities and improve economic productivity, but also bring with them environmental benefits. For example, substituting for traditional fuels, such as wood, may reduce deforestation, desertification and loss of biological diversity.

Given the major consequences of not meeting electricity needs, APEC member economies are placing a high priority on expanding generation capacity. Many member economies, however, are finding that needed investments are too expensive to undertake through state owned or subsidized power utilities. In some cases, limits on the size of domestic capital markets are also constraints.

Consequently, there has been a trend to liberalize and privatize power production and distribution systems, though the extent of the liberalization varies. In many economies, power purchase agreements between utilities and independent power producers are currently playing an important role in meeting investment goals.

1.2 The Environmental Challenge

UNLESS mitigation actions are taken, electricity generation has a broad range of negative effects on the environment. Some of the most important of these are shown in Table 1.2. These environmental impacts range from local effects such as those caused by particulate emissions, to regional ones, such as acid rain from SO_2 emissions, through to truly global effects such as climate change. In some cases, the electricity sector may be a major contributor to the environmental problem and, in other cases, the electricity sector may be responsible for only a small portion of the problem.

Table 1.2: The Contribution of the Electricity Sector to Key Environmental Problems

Environmental Problems	Contribution of Electricity Sector
Ambient air quality	➢ NO_x, SO_2 and particulate emissions from fossil fuel combustion
Global climate change	➢ CO_2 emissions from fossil fuel combustion
	➢ CO_2 sink losses from hydro project flooding
	➢ Leakage of natural gas during transport and handling
Water pollution	➢ Effluent from coal-fired plants
	➢ Toxic fluids from geothermal plants
	➢ Acid drainage from coal mines and ash disposal sites
Solid waste	➢ Coal bottom and fly ashes
	➢ Gypsum from de-sulphurisation
Acid deposition	➢ SO_2 and NO_x emissions from fossil fuel combustion
Land use and siting	➢ Flooding and deforestation from large hydro developments
	➢ Degradation caused by coal-mining

Source: Adapted from International Energy Agency (1997), *Asia Electricity Study*, IEA/OECD, Paris.

Already many developing APEC economies are experiencing an increase in environmental degradation as a result of their fast-paced economic development and the associated need for rapid growth in electricity generation. Local ambient air quality is of particular concern in many locations. Electricity generation contributes a significant share of total atmospheric emissions in most APEC economies. Furthermore, the electricity sector's share is likely to increase significantly in developing APEC economies as the share of electricity in the total energy mix increases.

The consumption of fossil fuels in the electricity sector is also one of the most important sources of greenhouse gas emissions. In light of current commitments to reduce greenhouse gas emissions and possible new commitments from the upcoming Third Convention of the Parties to the United Nations Framework Convention on Climate Change, many member economies are increasingly concerned about greenhouse gas emissions from the electricity sector.

1.3 Opportunities to Meet Both Challenges

THERE is no inherent inconsistency to achieving both environmental and investment objectives in APEC member economies. Good environmental policy practices can provide for effective and consistent enforcement, transparency and predictability to assist power producers in complying with environmental requirements, and flexibility to meet the environmental requirements in the most cost effective manner possible. At the same time, such practices can serve to attract new investment capital by reducing risks, simplifying due diligence processes by lenders and creating level playing fields. New investment capital, in turn, can bring with it technologies that meet world class performance standards in both energy efficiency and environmental performance. Frequently, investment capital also comes subject to world class environmental standards imposed by financiers or IPPs themselves. The real challenge is to identify those good practices that serve both investment and environmental needs.

1.4 The Role of APEC and the EWG

DURING their 1996 meeting in Sydney, the Energy Ministers of all APEC member economies agreed that "the application of economically sound measures to minimize the adverse environmental impacts of energy production and use is essential to protect the well being of both present and future generations." The Energy Ministers further agreed that "priority should be given to activities which concurrently enhance economic development and mitigate environmental impacts."[3] The Ministers also endorsed the *Non-Binding Energy Policy Principles* which clearly indicate the need to integrate energy investment and environmental issues.

Prior to the 1996 Ministers' meeting, the Australian Department of Primary Industries and Energy, in its capacity as shepherd of the APEC Regional Energy Co-operation Working Group (the Energy Working Group or EWG), commissioned a report *Regional Co-operation for Power Infrastructure*.[4] The report noted that:

The most appropriate model [to achieve environmental goals] in any given member economy will depend on a range of economy-specific issues, including for example the domestic tax regime. However, all member economies are developing a range of solutions and working at developing regulatory and fiscal policies that encourage environmental protection without discouraging business sector investment.

Significant benefit would be obtained from dialogue with the business sector in relation to these issues and information sharing between member economies regarding the various models available.[5]

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[3] APEC (1996), *Energy: Our Region, Our Future*, First Meeting of APEC Energy Ministers, Sydney, Australia, August 28-29, 1996.

[4] Blake Dawson Waldron (1995), *Regional Co-operation for Power Infrastructure*, A Report to the APEC Energy Working Group.

[5] *Ibid.*, page 123.

The Ad Hoc Business Forum on Regional Co-operation for Power Infrastructure ("Ad Hoc Business Forum") echoed these thoughts within their work program noting that:

- *…the EWG could identify principles designed to improve the predictability of environmental regulation to reduce investment risk, focusing on promoting transparent, certain and predictable regulatory frameworks.*
- *…work should focus on identifying regulatory methods which may be used to strengthen environmental performance, rather than the use of specifications as to particular fuels or technologies.*

Similarly, the APEC Electricity Regulators' Forum included in their work program the need to examine:

- the implications and impact of the continuing structural, institutional, competitiveness and environmental reforms being implemented in APEC member economies for:
  - *power sector financing structures and risk management;*
  - *procuring business sector investment; and*
  - *incorporating environmental considerations in power project planning and decision-making procedures*

In August 1996, the APEC Energy Ministers endorsed the work programs of the Ad Hoc Business Forum and the Electricity Regulators' Forum.

1.5 Study Objectives

APEC member economies face significant challenges to meet their environmental goals *and* facilitate the massive investments in new electricity generation capacity required to meet electricity needs. This study, funded by the Government of Canada, seeks to identify good policy practices that APEC member economies are adopting to facilitate achieving both their environmental and investment goals in the electricity sector.

More specifically, the study provides:

- an opportunity for APEC member economies to share their experiences with practices that achieve both environmental and investment objectives; and
- recommendations, for the APEC Energy Ministers to consider at their meeting in Edmonton in August, on how to facilitate implementation of good practices.

In these ways, the study contributes to the implementation of the Energy Ministers' declaration in Sydney and the work programs of the Ad Hoc Business Forum and the Electricity Regulators' Forum.

1.6 Methodology and Format

NATURAL Resources Canada contracted an international consulting

team led by Apogee Research International, Ltd. of Toronto to undertake this study. The study is based on six major research tasks:

- interviews with business investors and government representatives;
- input from an international team of recognized experts in the electricity sector and the environmental field;
- input from business and government representatives attending the IPP Best Practices Workshop held in Honolulu, United States on April 23 and 24, 1997;
- input from the members of the Ad Hoc Business Forum and Electricity Regulators' Forum during their meetings held in Honolulu on April 22 and 25, 1997 respectively;
- input from the Energy Working Group at their meeting in Santiago, Chile on May 13 and 14, 1997; and
- a review of relevant literature, including those documents cited in Section 12.

The report consists of 10 substantive sections as follows.

Section 2 identifies major trends in the electricity sector that are driving the search for good practices and describes the implications of those trends for the environment and environmental policy practices.

Section 3 briefly summarizes the practices APEC member economies are currently using to achieve their environmental objectives in the electricity sector and identifies six areas where good practices are needed most, namely:

- energy efficiency;
- environmental approval processes (including environmental impact assessments);
- environmental standards;
- market based instruments;
- monitoring and enforcement programs; and
- IPP processes.

Section 4 provides an overview of principles to identify good practices.

Sections 5 through 10 identify principles and good practices for each of the six areas, and provide case studies to illustrate the good practices.

Section 11 provides recommendations to facilitate implementation of good practices to achieve both environmental and investment objectives.

2. ELECTRICITY TRENDS IN THE APEC REGION

SEVERAL trends within the electricity sectors of the APEC region are influencing the good practices member economies are adopting to achieve both their environmental objectives and their investment objectives. The two most important trends relate to fuel choice and market structure reforms. This chapter surveys these trends and their possible environmental implications. While the environmental implications are not known with certainty, two points are clear:

- there are opportunities available for APEC member economies to advance both their environmental and investment objectives; and
- good environmental policy practices are needed to ensure that this happens.

2.1 Trends in Fuel Choice

TABLE 2.1 shows the recent trends in the fuels for electricity generation within APEC member economies. As in most of the world, three broad categories of large scale power generation have proved practical in most APEC member economies. These are thermal (basically fossil fuel), nuclear, and hydroelectric power. Geothermal power is also practical in about half the member economies, though it tends to be relatively small. Geothermal power has been most extensively exploited in New Zealand, the Philippines, Indonesia, Japan, and the United States with smaller activities in Thailand, Taiwan, Mexico, China, and Chinese Taipei. Geothermal energy potential is important in the Philippines and Indonesia.

Table 2.1: APEC Electricity Generation 1985-1994

Economy	Source	Power Generation (TWh)			Annual Growth	
		1985	1990	1994	1985-1990	1990-1994
Australia	Total	121.0	155.1	171.6	5.1%	2.6%
	Thermal	106.0	140.2	156.0	5.8%	2.7%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	15.0	14.9	15.7	-0.1%	1.3%
Brunei	Total	0.9	1.3	1.7	6.9%	7.4%
	Thermal	0.9	1.3	1.7	6.9%	7.4%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	0.0	0.0	0.0	na	na
Canada	Total	459.1	482.0	548.0	1.0%	3.3%
	Thermal	94.8	112.2	125.4	3.4%	2.8%
	Nuclear	60.5	72.9	108.9	3.8%	10.5%
	Hydro/Other	303.7	297.0	313.7	-0.5%	1.4%
Chile	Total	14.0	18.4	24.8	5.5%	7.8%
	Thermal	3.5	8.9	6.7	20.6%	-6.9%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	10.6	9.5	18.1	-2.1%	17.6%
China	Total	410.7	621.2	885.6	8.6%	9.3%
	Thermal	318.3	494.5	703.3	9.2%	9.2%
	Hydro/Other	92.4	126.7	169.4	6.5%	7.5%
	Nuclear	0.0	0.0	12.9	na	na
Hong Kong	Total	18.6	28.3	33.6	8.8%	4.8%
	Thermal	18.6	28.3	27.2	8.8%	1.3%
	Nuclear	0.0	0.0	6.4	na	na
	Hydro/Other	0.0	0.0	0.0	na	na
Indonesia	Total	16.9	34.9	50.3	15.6%	9.6%
	Thermal	13.7	28.1	41.9	15.4%	10.5%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	3.2	6.8	8.5	16.2%	5.6%
Japan	Total	672.0	857.3	952.0	5.0%	2.7%
	Thermal	422.9	557.4	614.2	5.7%	2.5%
	Nuclear	159.6	202.3	259.7	4.9%	6.4%
	Hydro/Other	89.4	97.6	78.1	1.8%	-5.4%
Korea	Total	58.0	107.7	156.3	13.2%	9.8%
	Thermal	37.6	48.4	93.5	5.2%	17.9%
	Nuclear	16.8	52.9	58.7	25.9%	2.6%
	Hydro/Other	3.7	6.4	4.1	11.7%	-10.4%
Malaysia	Total	14.6	23.7	37.7	10.3%	12.3%
	Thermal	10.8	19.5	32.9	12.5%	13.9%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	3.7	4.2	4.8	2.6%	3.3%
Mexico	Total	85.4	114.3	132.8	6.0%	3.8%
	Thermal	57.6	82.9	95.8	7.5%	3.7%
	Nuclear	0.0	2.9	4.2	na	9.3%
	Hydro/Other	27.7	28.5	32.8	0.5%	3.6%

Economy	Source	Power Generation (TWh)			Annual Growth	
		1985	1990	1994	1985-1990	1990-1994
New Zealand	Total	27.3	31.6	34.1	3.0%	1.9%
	Thermal	6.5	6.1	5.7	-1.3%	-1.6%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	20.9	25.6	28.4	4.1%	2.7%
Papua New Guinea	Total	na	na	na	na	na
	Thermal	na	na	na	na	na
	Nuclear	na	na	na	na	na
	Hydro/Other	na	na	na	na	na
Philippines	Total	21.8	27.5	29.5	4.8%	1.8%
	Thermal	11.3	16.0	19.8	7.2%	5.5%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	10.5	11.5	9.7	1.9%	-4.2%
Singapore	Total	10.0	15.7	20.1	9.5%	6.3%
	Thermal	10.0	15.7	20.1	9.5%	6.3%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	0.0	0.0	0.0	na	na
Chinese Taipei	Total	55.6	87.0	113.1	9.4%	6.8%
	Thermal	19.9	45.9	69.3	18.2%	10.8%
	Nuclear	28.7	32.9	34.9	2.7%	1.5%
	Hydro/Other	6.9	8.2	8.9	3.4%	2.0%
Thailand	Total	23.1	44.2	69.8	13.9%	12.1%
	Thermal	19.4	39.2	65.6	15.1%	13.7%
	Nuclear	0.0	0.0	0.0	na	na
	Hydro/Other	3.7	5.0	4.2	6.2%	-3.9%
United States	Total	2621.9	3197.3	3472.7	4.0%	2.1%
	Thermal	1921.4	2277.8	2495.8	3.5%	2.3%
	Nuclear	406.7	611.6	678.0	8.5%	2.6%
	Hydro/Other	293.9	307.8	298.8	0.9%	-0.7%
All APEC	Total	4630.7	5847.5	6733.7	4.8%	3.6%
	Thermal	3073.1	3922.5	4584.0	5.0%	4.0%
	Nuclear	672.3	975.5	1163.7	7.7%	4.4%
	Hydro/Other	885.2	949.6	995.1	1.4%	1.2%

Source: International Energy Agency. Figures for Hong Kong supplied by the Energy Efficiency Office, Electrical and Mechanical Services Department, Hong Kong Government.

Of the more widely practised forms of electricity generation, the mix of usage among thermal, nuclear, and hydroelectric varies widely. Economies in which over half of all power is generated by thermal resources include Australia, Brunei, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, the Philippines, Singapore, Chinese Taipei, Thailand, and the United States. Economies that produce over half of their power using hydroelectric resources include Canada, Chile, and New Zealand. Nuclear power provides over one-fourth of the electricity generated in Japan, Korea, and Chinese Taipei and nearly 20% of the electricity generated in Canada and the United States.

While, resources permitting, any of the three basic types of electricity generation might dominate an economy's power generation, most APEC member economies will get most of their future power from fossil fuels. This is due to a variety of practical economic considerations. Both nuclear and large scale hydroelectric power production require high capital expenditures and have long lead times, often a decade or more. Their lower operating costs do not offset the greater capital risks for most private developers, so privately owned nuclear facilities are not being developed now. Large-scale hydraulic resources are rare, and are often controlled by public interests.

Nuclear and hydroelectric power are promoted in some economies partly on the basis of criteria other than economics. Usually, these criteria are grouped under the term "energy security," which has a goal of reducing the economy's vulnerability to large shocks due to fluctuations in the price and availability of imported fuels. Energy security therefore often involves obtaining large or increased shares of energy production through domestic resources, and ensuring that fuel imports are varied by fuel type and source.

Most APEC economies advocate energy security in one form or another. Japan, Korea, China, and Chinese Taipei among others now promote nuclear power for energy security reasons. A review of actual plans indicate that approved power reactor projects are numerous only in China and Korea with the share of nuclear power in electricity production under existing plans likely to fall in Japan and Chinese Taipei and possibly Korea. Energy security also often encourages hydroelectric power, but most economies that depend heavily on hydroelectricity have found themselves reliant on unpredictable weather patterns.

Most privatized power generation has been thermally based. Moreover, recent development of combined cycle gas turbine technology has significantly raised the thermal efficiency of gas-fired generation. There are indications that these technological trends will continue.

Turbine technologies have improved the economics of using natural gas, waste gases, and lighter oil products the most, though they might be used for oil products as heavy as low sulphur fuel oil. Standardized designs permit the installation of combined cycle plants within a period of a few years. Costs of installation can be significantly lower per megawatt compared to the relatively high costs per megawatt for nuclear and hydroelectric plants.

Similar, though by no means as significant, fuel efficiencies have been found in steam generation and internal combustion technologies. New methods of handling heavier fuels, such as coal and fuel oil, also promise to increase their efficiencies. This is especially true for methods that gasify coal or fuel oils to make them more acceptable in combined cycle gas turbine environments.

When the available fossil fuels are considered, there has been a strong trend toward the use of natural gas when it is inexpensively available, that is by pipeline. Liquefied natural gas (LNG) is more expensive and local conditions prevail in fuel selection. While coal burning has been criticized for its environmental impact, it is second in popularity only to natural gas for new generation resources. Moreover many environmental problems associated with coal have technological solutions, though at a price.

Oil has borne the brunt of energy security concerns, but is also usually more expensive than most other available power fuels. This has led to a global decline in oil use for power generation. Combined cycle technology might improve the economics of lighter oil products but it is unclear if this is enough to increase overall oil consumption in the power industry, especially in the APEC region.

Even though renewable resources, including geothermal and wind, are expected to grow rapidly, they are not expected to form a large fraction of the total resource base. Other renewable resources, such as refuse-derived fuels and landfill gases, are considered thermal fuels. Most are unlikely to be used for large-scale generation though urban, agricultural, and industrial wastes are being used more and more as power fuels.

Given these trends in fuel choice, particularly the high degree of reliance on fossil fuels, clean technology development and transfer is essential to ensure that electricity infrastructure is environmentally sound.

2.2 Market Structure Reforms

THE large amounts of capital required and, in some cases, the limited size of domestic capital markets are important factors leading the APEC economies to turn increasingly to the private sector for investment capital for electricity infrastructure. Other factors, however, are also at work. The change in generation technologies has made smaller plants, with smaller investments, competitive in price and efficiency with large-scale centralized generation.

Private capital providers are more likely to make the smaller, shorter lead time, investments. Improved information technology makes easier the integration of several independent suppliers into a transmission and distribution network. There is also a growing worldwide trend away from regulation and towards competition in many sectors that provide basic infrastructure, like telecommunications, transportation and electricity.

Several benefits are expected from changes in the structure of electricity markets.

1. Falling prices for electricity services. Most experience to date has been in the contract provision of electricity services through power purchase agreements. The first agreements in Asia were often in the 7-9 cents(US)/kWh range. Lately the norm has been 5-6 cents/kWh, with a few contracts below 5 cents/kWh.

2. Reduced need for government subsidies. Governments no longer wish to subsidize power investments. New and innovative forms of private power plant financing have developed that appeal to international as well as local capital, at lower financing costs and without government borrowing or guarantees.

3. Location advantages of smaller power plants. Monopoly utilities often built large and expensive plants at remote locations that met engineering requirements for scale economies. Private plant builders build smaller plants that come quickly into service according to financial criteria. Smaller plants are more easily located, often close to major markets.

Competitive power providers have little interest in controversial locations that delay revenue receipts. Locations near markets reduce transmission costs and controversies.

4. Many complexities of monopoly rate regulation are avoided. Markets set prices rather than regulators. Concerns regarding various forms of regulation change in character toward fairness issues. Any judicial function of regulation might end.

5. Power production becomes more specialized and new products are developed. Cogeneration, which initially meant selling steam from power plants to industries in addition to electricity to utilities, has developed and proven profitable. Now the concept includes additional products and selling power to many separate customers. In some areas there is increased involvement of power plants in such new services as desalinating seawater, reducing solid wastes, and providing building materials for the construction and highway industries.

Electricity markets can be at many different points on the spectrum of the degree of privatization and deregulation; each point has different characteristics with respect to market function. One end of the spectrum is the monopoly supplier, which is a state-owned enterprise (SOE) or government department. Such utilities typically co-ordinate their investments with state energy policies and price controls, and with regional policies if they are regionally owned or controlled. Typically, in systems with large SOEs, each SOE will have one or more franchises to be the exclusive seller of electricity in a region.

A next step in opening up markets is for the monopoly utility to begin to purchase power from other entities, frequently private businesses. Such private power generators are called independent power producers, or IPPs. In systems with a monopoly utility, IPPs generally sell all their power to the monopoly utility, who then mixes it with its own generation and sells it to wholesale and retail customers. In some cases, the franchised supplier can be a private corporation.

A system can prepare for competition by dividing the integrated utility function into generation, transmission, distribution, and support services. Some degree of competition might be permitted in generation or in supply of retail electricity, but contracts govern power sales between levels of the supply system. Government involvement can continue to include price regulation but more and more seeks to assure competitive fairness. Efforts to direct energy policies might remain in place but are more difficult to implement. Governments might still be involved, either through regulation or through remaining SOEs, in the decision to build new generation facilities.

The final stage is to establish competitive markets in most sectors. Some power is still sold through long term contracts but large volumes are also sold through bid-driven markets. Marginal buyers and sellers are often anonymous. Marginal prices are market set rather than contract or regulation determined. Electricity consumers might choose their retail electricity providers, so a distinction evolves between local, low voltage electricity distribution and electricity marketing. Government involvement is primarily to assure the fairness of the process. Governments are not responsible for decisions to build or shut down electricity generation facilities; these decisions are at the discretion and the risk of the private companies which will own the facilities.

National, regional, and local systems often change at different rates. In economies with federal systems, regional governments may own, control or regulate significant parts of the electricity system. These governments may differ significantly in their desire for change. Central government goals might differ from local or regional interests. Most economies develop an evolving compromise among central and local government authorities regarding their roles. There appears to be an evolution toward greater local and regional policy control, while the impetus for reform is often initiated by the central government.

It is likely that the electricity supply system in the immediate future will continue to be dominated in most APEC economies by vertically integrated, monopoly suppliers who have an exclusive supply franchise and an obligation to supply electricity. These suppliers will be the focus of planning for and implementing expansion of the electricity system. If such economies are expecting that their electricity system will be evolving in the direction of greater competition, they should try to devise policies and practices which will be compatible with greater private sector participation and more competitive systems. Such policies and practices include those to protect the environment.

2.3 Environmental Implications

IT is not certain how the environment will be affected by the trends in the electricity sectors of APEC member economies. On one hand, it is sometimes advanced in arguing against the liberalization of the electricity sector that independent power producers will neglect environmental protection in the pursuit of greater profits. On the other hand, there are numerous reasons why market structure reforms may reduce environmental impacts due to effects on regulatory arrangements, technology choices, fuel choices and electricity tariffs. It are these opportunities that member economies need to take advantage of to promote environmentally sound investment.

2.3.1 Regulatory Arrangements

All economies have some form of regulations to protect and preserve their environment. A recent joint study by the Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations Development Programme (UNDP) of developing economies in Asia identified two different institutional arrangements for regulation of the electric industry.[6]

Regulation is either by a government entity (such as a ministry responsible for the environment or energy) or the utility is responsible for regulating itself (self-regulation). The study found that a problem with the former approach was that regulators tended to be more lenient with public enterprises. On the other hand, with the latter approach there is some doubt as to whether it will ensure that sufficient weight is given to environmental protection. This is particularly the case in circumstances where demand is growing rapidly and utilities may become increasingly focused on avoiding supply shortfalls.

[6] Ali, Z. and M. Jaafar (1995), *Private Sector Participation in Power Generation and its Consequences on Environmental Quality (An Emerging Trend in Asia)*, Economic and Social Commission for Asia and the Pacific and the United Nations Development Programme, New York.

However, when the private sector enters the electricity market a new arrangement comes into effect, that of the public sector regulating the private sector. Indeed the regulator might in some cases be the same public sector entity that is in competition with the private sector entrant. It is perhaps not so surprising then that regulators are often more stringent in enforcing the application of environmental rules on the private sector. It would thus seem that there is little reason to fear that the environment would suffer on this score as a result of increased private investment in the power sector.

Indeed there is some evidence that the introduction of private sector investment can lead to restructuring of the organizations dealing with environmental matters within energy ministries and utilities through the creation of specialized units responsible for the environmental regulation and monitoring of the electricity sector. These units have a good understanding of the electricity industry and of current and future developments in clean energy technologies.

In addition, by focusing solely on the regulation of the power sector, these units can avoid some of the manpower and resource difficulties that environmental ministries (who are responsible for the regulation of all the sectors in the economy) often face. As a result environmental management may become more effective.

2.3.2 Technology Choice

Because of the private sector's desire to minimize risk, IPPs are more likely to choose to build their plants using existing and proven technologies (for example, combined cycle plants, open cycle gas turbines and conventional coal-fired boilers). Advanced and more environmentally benign technologies, such as pressurized fluidized bed combustion, fuel cells and solar power, are not normally seen as viable options.

Nonetheless, there are several reasons why the introduction of private power producers can lead to improved environmental performance of the electricity sector. Many of the plants built by IPPs have been designed to meet world-class environmental and efficiency standards. It is unlikely that they would seek to vary their production processes to take advantage of more lenient environmental standards.

In addition, given the high cost of retrofitting plant and equipment and the anticipation that economies with lower environmental standards are likely to increase them, IPPs may find that the least cost approach is to adopt the same high environmental standards they use in the power stations they have built in other economies.

Furthermore, multilateral lending institutions usually require that project construction and equipment conform to international environmental and efficiency standards before they will provide funds for a project. Most lending institutions now have their own minimum environmental standards for funding. The importance of multilateral lending to energy sector development is, however, declining,

Finally, there is the desire to be seen as a good corporate citizen. Private power developers are usually multinational firms with subsidiary companies in many economies. It is their interest to maintain an image as a good and environmentally aware company.

This is both to avoid protests from their shareholders as well as to protect their business opportunities elsewhere in the world. The legally enforceable liability for environmental damage caused by the operations of the firm provides a powerful constraint on company decisions. Thus, environmental protection issues are likely to be an integral part of the decision making process of private power producers.

The above arguments all suggest that private investors are more likely to build power plants that are equal to, if not better than, those of public utilities in terms of efficiency and emissions. To the extent that they are more efficient they will set new benchmarks for environmental performance which in turn puts pressure on existing plants to be retrofitted or upgraded to meet the same performance levels.

It has been argued that the private sector's "technological conservatism" reduces the incentive for them to spend money on research and development by comparison with state-owned utilities where economies of scale make financing R&D easier. This could be overcome by incorporating financial incentives into the power purchase agreement (PPA) with the IPP to use more environmentally friendly technologies. There is of course a financial penalty associated with such an approach, either through higher electricity tariffs for customers or a direct cost to the budget as a result of any subsidies that are paid to the IPP. On the other hand, ensuring technologies are environmentally sound can avoid social costs of environmental degradation and the need for costly retrofits in the future.

2.3.3 Fuel Choice

Like technology, fuel choice is strongly driven by economics.[7] In the case of the electricity sector, the investor will consider factors such as the outlook for demand growth, fuel costs and security of supply, capital costs and investment risk. Given that different fuels have different environmental impacts, the choice of fuel does have implications for the environment. Investors will chose fuels (and technologies) that are the lowest cost compromise between the capital cost of plant construction and the on-going costs of fuelling and operating the plant. Gas-fired plants are often a particularly attractive option for IPPs. Reasons for this include:

- the relatively low capital cost of constructing a gas-fired plant;
- the use of a well established technology;
- shorter construction times;
- the relatively high fuel conversion efficiency of gas-fired plants; and
- the lower environmental impact of gas-fired plants.

[7] International Energy Agency (1994), *Electricity Supply Industry - Structure, Ownership and Regulation in OECD Countries*, IEA/OECD, Paris.

On the other hand an IPP may chose a different fuel if it has to bear the cost of constructing either LNG or pipeline facilities. A recent study by the International Energy Agency found that several developing economies plan to significantly increase the amount of coal used for power generation.[8]

This is in part because of the ready availability of coal either from domestic production or imports through a well-established international market for coal. A desire to diversify energy use (particularly away from oil) in many economies is another reason for increased use of coal.

Ultimately, fuel choice will depend upon perceptions about price and availability of fuel options as well as how to minimize the cost of environmental compliance. There are however a number of steps that economies can take to influence fuel choice. These include bans on particular fuels, informal agreements not to use certain fuels, differential taxation rates and fuel production or consumption subsidies. Of these measures, only one, informal agreements, would appear to be influenced by the ownership or structure of the electricity sector.

2.3.4 Electricity Tariffs

Prices to end-users are ultimately one of the strongest signals of the true cost of electricity, including factors such as environmental controls. Prices are perhaps the key mechanism for influencing end-user behaviour, for example to encourage greater efficiency of electricity use. The introduction of private investment in the electricity sector is creating a number of different pressures on electricity prices. Some of these act to increase prices, others tend to put downward pressure on prices.

Some might argue that electricity bought from IPPs will be more expensive to reflect the operator's explicit need for a rate of return on the capital that has been invested. Furthermore, the private sector operator may pay a higher risk premium on their capital, increasing borrowing costs compared with a state-owned utility that is backed by an implicit or explicit government guarantee.

On the other hand, the greater efficiencies generally achieved by the private sector operators could be expected to moderate any increases in costs or prices. Which, if any, of these cost pressures dominates will depend on a number of factors, including:

- the IPP's required rate of return (which in turn will depend upon considerations such as an assessment of the risks of investing in a particular economy);
- the nature and timing of reforms of the electricity sector; and
- how well the regulatory arrangements put in place allow a competitive market to develop.

The extent that the correct signals are sent to end-users depends on whether electricity prices reflect the real cost of generation, including environmental protection costs.

[8] International Energy Agency (1997), *Asia Electricity Study*, IEA/OECD, Paris.

2.4 Conclusions

REGARDLESS of the specific impacts of electricity generation and market structure reforms, two points emerge from the above discussion. First, the trends are providing opportunities for APEC member economies to achieve environmental and investment objectives. New investments can be structured to introduce new, cleaner and more efficient technologies for electricity generation, fuel processing and emissions control.

Second, the trends are bringing new challenges to APEC member economies in their selection of environmental policy practices. What member economies need are good policy practices to ensure that the rapid changes occurring in their electricity sectors result in the establishment of environmentally sound electricity infrastructure.

3. AREAS FOR GOOD ENVIRONMENTAL PRACTICES

TO IDENTIFY areas where good environmental practices are needed, various business representatives were interviewed and current environmental policy practices were reviewed. Six areas for good practice were identified, namely:

- energy efficiency;
- environmental approvals processes;
- environmental standards;
- market based instruments;
- monitoring and enforcement; and
- IPP processes.

This section of the report briefly summarizes the selection of these areas.

3.1 Current Practices in APEC Member Economies

APEC member economies already have in place numerous practices to help achieve their environmental objectives within the electricity sector. Given the variations in socio-economic, technological, environmental and political characteristics within the APEC region, it is not surprising that the practices implemented by member economies vary widely. This provides an opportunity to learn about the good practices that various member economies have adopted. Once identified, member economies can determine whether the good practices would assist in better achieving environmental and investment objectives within the context of their unique situations.

Nonetheless, there are commonalties among environmental policy mechanisms in APEC member economies. Nearly all members rely on the general types of environmental policy mechanisms briefly summarized below. Full descriptions are contained in the sections of the report dealing with each area. It is in these areas that the search for good practices that achieve both environmental and investment goals begins.

- ***Energy Efficiency***: Increasing energy efficiency can contribute significantly to the achievement of environmental and electricity supply goals. More efficient generation and transmission of electricity will let existing resources produce more usable electricity, meeting more needs without having to put in more capacity, and without causing any further impact on the environment. More efficient use of electricity stretches the existing resource also, by making the conserved electricity available to other customers. In most cases, conservation programs have much lower environmental impacts than would result from generating the electricity conserved.

- ***Environmental Impact Assessment***: Environmental impact assessments (EIAs) are used in APEC economies to control the risk of adverse environmental impacts resulting from electricity and other projects. Requirements for EIAs impose costs on business investors, including direct monetary costs, time costs, and uncertainty costs. As such, there is an ongoing need by economies to manage the costs to business of these processes, while upholding environmental objectives.
- ***Other Environmental Permits and Approvals***: Other approvals involving environmental considerations are required for electricity sector projects, including zoning permits, operating licenses, construction permits and electricity sales licenses. The design of such approval processes is an important concern of business investors considering electricity infrastructure projects.
- ***Environmental Standards***: Once facilities are constructed, the most important policy mechanisms to control environmental impacts from facility operations are ambient environmental quality standards, point source discharge standards, technology standards and fuel standards. The design of the standards, rather than the level of the standards, can hinder investment in electricity infrastructure.
- ***Monitoring and Enforcement Programs***: A wide range of monitoring and enforcement activities, including both positive incentives ("carrots") and negative incentives ("sticks"), are found in APEC member economies. Some economies are implementing new approaches to monitoring and enforcement that provide flexibility to avoid some of the most costly impacts on industry while still achieving strong monitoring and enforcement.

3.2 Additional Areas for Good Practices

IN addition to the common environmental policy mechanisms listed above, several other areas for good practice were identified.

- ***IPP Processes:*** The processes some member economies are using to encourage independent power production — requests for proposals, proposal evaluations and negotiation of power purchase agreements — have a variety of elements pertaining to the environment. Good practices here can help facilitate IPP investments that are consistent with environmental objectives.
- ***Market Based Instruments***: Market based instruments are mechanisms to implement environmental standards. A few member economies are finding that market based instruments can provide power producers with more flexibility than traditional environmental standards, thereby reducing the costs of achieving environmental standards and allowing economic growth in areas that might otherwise experience deteriorating environmental quality from increased electricity production.

4. PRINCIPLES FOR GOOD ENVIRONMENTAL PRACTICES

WITHIN the six areas where good practices are needed, the study analysis and input suggested five major principles for identifying what constitutes "good" practices, i.e. practices that help achieve investment *and* environmental objectives for the electricity sector. Additional principles are also relevant within each of the six areas.

The five major principles are:

- transparency;
- predictability;
- consistency;
- efficiency; and
- cost effectiveness.

These principles were identified through two major sources: discussions with business representatives about what is needed from environmental policy to facilitate investment; and an analysis of the common elements of practices member economies are implementing to achieve their environmental and investment goals.

Environmental policy practices that meet these principles will help member economies to attract investment in electricity infrastructure. In the broadest sense, private capital is attracted to investment opportunities where the highest returns are available at the lowest risk. The level of environmental standards is not necessarily a consideration in investment decisions, so long as the way the standards are achieved does not create greater risk for investors and the costs of complying with environmental policies are factored into the rate of return. The principles help reduce the environment-related risks to investors.

At the same time, applying the principles will help member economies to achieve their environmental objectives. For example, high degrees of transparency and predictability in environmental policy practices can enhance compliance with environmental requirements.

Within the six areas for good practices, some principles are more relevant than others. There are also nuances and interpretations of the principles that are specific to each of the six areas.

Therefore, for each of the six areas, a section below provides:

- background describing in detail the current practices and the environmental and investment concerns related to the area;
- a list of the principles most relevant to the area and discussion of how the principles should be interpreted;
- descriptions of the good practices; and
- case studies of how member economies are applying the good practices.

5. ENERGY EFFICIENCY

5.1 Introduction

IMPROVED energy efficiency can help meet both environmental and electricity supply goals. More efficient production of electricity increases the effective supply and can reduce environmental impacts. More efficient use of electricity by consumers makes the available supply go further to meet the electricity needs of the economy. Both improved production and improved end-use efficiency can avoid or postpone new investment in supply capacity.

Balancing investment in improved efficiency against investment in new supply is a goal of energy planning. Energy planning is usually done by government or a government agency. It involves consideration of many sectors of an economy and many issues. All APEC member economies have some agency charged with overall energy *analysis*, but the degree of centralization of energy *planning* varies widely.

Governments set a policy framework for energy decision making, which can range from centralized control to a decentralized market. In APEC economies with decentralized, competitive markets, market forces drive decision makers to produce and use energy efficiently. Some types of government programs that encourage energy efficiency are not applicable in these economies.

In other APEC economies, however, the electricity sector will continue for some time to be characterized by vertically integrated utilities with an obligation to serve public interests rather than act solely as profit maximizing enterprises. Such entities have incentives to undertake electricity system supply planning. Where the electricity system is planned, effective planning calls for integrated demand and supply plans.

For those economies that do not have competitive electricity markets, an integrated energy strategy is the starting point for effective overall energy planning. The World Bank defines an integrated energy strategy as:

> *An interrelated set of measures that position the energy sector towards the most efficient, equitable, and environmentally-benign resource use. The strategy requires decisions on both the energy supply and demand side about sector structure, institutions, ownership, financing, fuel availability (coal, oil, gas), technology availability (import restrictions), structures of end-use markets, pricing policy, standards, service levels, and so on.*[9]

Formulating an integrated energy strategy therefore requires governments to address both supply of and demand for energy. The comprehensiveness of an integrated energy strategy forces planners to recognize the close interrelations between energy and the economy, and the dependence of energy decisions on decisions affecting the whole economy.

Electricity is an integral part of the energy planning process. The electricity planning system should consider the balance between supply and demand solutions to the changing needs of the electricity market and ensure the efficient production, delivery and use of electricity. Such planning can be within the context of an integrated energy strategy, as part of planning for the electricity system alone, or through market mechanisms. Planning should recognize that building new capacity is not the only way to meet increased consumer needs for electricity. Meeting increased consumer needs without adding generation capacity can have significant environmental benefits.

Consumer prices can be an important component of energy planning. If consumer prices are kept below costs by subsidies or other means, the consumer receives an incorrect signal and makes decisions accordingly. That leads, among other things, to using electricity inefficiently. Efficient use implies using only as much electricity as is required to meet the end-use need.

The potential for efficiency improvements is large. One study estimated that efficiency improvements and proper pricing could reduce greenhouse gas emissions in the developing world by up to 30%, while increasing the rate of economic growth.[10] The World Bank estimated that incorrect pricing, and subsidies of up to two-thirds of cost in some economies, caused use of 20% more electricity than if prices reflected costs.[11]

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[9] World Bank (1993), *Energy Efficiency and Conservation in the Developing World*, World Bank Policy Paper.

[10] Anderson, D (1993), "Energy Efficiency and the Economics of Pollution Abatement", *Annual Review of Energy and the Environment*, Annual Reviews, Inc.

[11] World Bank (1994), *Economywide Policies and the Environment: Emerging Lessons from Experience*, Washington, D. C.

Proper pricing is also desirable for the investor. If the price for electricity from existing facilities is kept below its cost, it will be harder for new facilities to recover their costs. They must either receive the same subsidy as the existing generators, or they must sell to an entity which will be able to receive the subsidy. An investment in new facilities will be seen as less risky if its product can be sold at a market price that will pay for the investment.

This chapter will first consider the principles to ensure the efficiency of the supply capacity, and then will discuss efficiency in use of electricity.

5.2 Efficiency in Generation, Transmission and Distribution

5.2.1 Background

INEFFICIENT plants get less electricity from a given amount of fuel. Efficiency is measured as heat rate (Btu/kWh) or as thermal efficiency (fraction of input BTUs that is converted to electricity). Low efficiency can arise from poor design, inadequate maintenance, or inefficient operation.

Thermal efficiency in a system is a function of generation technologies and fuel types. Low levels of thermal efficiency can reduce the amount of electricity produced by an existing thermal station. It has been estimated that older power plants in some economies get from 18 to 44% less electricity from a unit of fuel than do efficient plants.[12] A more recent World Bank study found that low thermal efficiency of electricity generation in China, India and Indonesia resulted in generation losses more than 20% greater than in economies with more efficient generation.[13]

Table 5.1 shows some data on thermal efficiency in several APEC economies over the period 1980-1990. Some economies, like Thailand and Indonesia, show a pattern of increasing efficiency. There are also differences between economies. The size of some of the differences suggests the potential for efficiency gains. For example, in some APEC economies, the organization of the electricity industry has tended to favour smaller units, which generally have lower thermal efficiencies.[14]

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12 World Bank (1993), *The World Bank's Role in the Electric Power Sector*, World Bank Paper.

13 Ishiguro, M. and T. Akiyama (1995), *Energy Demand in Five Major Asian Countries*, World Bank Discussion Paper 277. The same study noted that South Korea had addressed its problem of energy losses in the power sector.

14 Ibid.

Table 5.1: Combustion Thermal Plant Conversion Efficiency
(% Of Input Energy Converted To Electricity)

	1980	*1985*	*1988*	*1989*	*1990*
China	25.7	28.0	29.1	26.4	
Indonesia	28.8	37.5	31.1	28.2	32.4
Japan	38.1	38.2	38.6	38.8	38.8
Korea	35.7	37.6	34.8	36.1	35.7
Thailand	34.2	38.2	38.0	38.0	39.8

Sources:Data cited from Asian Development Bank (1993), "Electric Utilities Data Book" and M. Ishiguro and T. Akiyama (1992), "Handbook of Electric Power Industry (Japan)", in *Energy Demand in Five Major Asian Developing Countries: Structure and Prospects,* World Bank Discussion Paper No. 277. Additional data from Agency of Natural Resources and Energy, MITI, Japan.

Also, there may be differences between SOEs and private developers in the efficiency of operation of the thermal plants. Some economies which have used IPPs extensively have found that the private producers tend to have higher conversion efficiencies than the SOEs. This is because the IPPs use more efficient technology and operate it more efficiently. Private companies have greater incentives towards efficient operation than the SOEs.

Reducing production inefficiencies and decreasing losses is an effective way of increasing electricity supply, thereby avoiding the environmental impacts of building new generating stations. This approach to increasing supply is also often more cost effective.

Cogeneration is one way to improve the overall conversion efficiency of power projects. Cogeneration projects make use of the exhaust heat from electricity generation. The heat can be used in industrial processes, in district heating schemes, in greenhouses, or in other ways. The overall heat recovery rate for cogeneration projects is much higher than (as much as double) that for a conventional generation source. Cogeneration is frequently mentioned as an important option for reducing the environmental impact of electricity generation.[15]

Losses in transmission and distribution are categorized as technical and non-technical losses. Technical losses are those due to the efficiency of the transmission and transformation equipment. Power is lost in any transmission or transformation. The higher the transmission voltage, the lower the relative losses; the more efficient the transformer, the lower the transformation losses. All such losses are considered technical losses.

Non-technical losses are electricity that final users consume from the grid, without being billed by the utility. Non-technical losses can come from a variety of sources. Although they do represent electricity that is ultimately consumed, it is not likely to be consumed efficiently since it is unpriced.

[15] Sheinbaum, C. and L. Rodriguez (1996), "Industrial Cogeneration in Mexico: Opportunity for GHG Mitigation and Regulation Barriers," in *IAEE, Proceedings, 17th Annual North American Conference*, Boston, MA.

Table 5.2 compares losses in transmission and distribution for several APEC economies. There is a wide difference between economies in their levels of losses. The fact that one economy has higher losses than another does not necessarily indicate that one is less efficiently operated. The nature of the system, including its geographical layout and the distances between the generation sources and the load centres, affect the level of losses.

Some economies show consistently low losses, some have relatively high but decreasing losses, and some have no clear trend in losses. For example, the data in the table show a steady increase in efficiency in Indonesia from the early-1980s onward, and a similar trend in Korea and China. The decreasing loss rates, and the height of some of the rates shown in the table, suggest that efficiency can be improved.

Table 5.2: Transmission and Distribution Losses
(% of Energy Made Available)

	1980	***1985***	***1988***	***1989***	***1990***	***1991***	***1992***
China	8.5	8.3	7.4	7.3	7.1		
Indonesia	19.2	15.9	17.8	16.6	16.4	16.4	15.9
Japan	5.8	5.8	5.7	5.6	5.7	5.8	5.8
Korea	6.4	5.9	5.8	6.1	5.6	5.6	5.7
Thailand	9.8	11.7	10.5	10.2	10.9	11.5	10.9

Source: Data cited from Asian Development Bank (1993), *Electric Utilities Data Book* and M. Ishiguro and T. Akiyama (1992), "Handbook of Electric Power Industry (Japan)" in *Energy Demand in Five Major Asian Developing Countries: Structure and Prospects,* World Bank Discussion Paper No. 277.

5.2.2 Principles for Good Practice

The following four principles can be applied to help ensure that energy is generated, transmitted, distributed, and consumed efficiently.

Cost-effectiveness — The system should meet the economy's end-use needs in the most efficient and cost-effective manner possible. Planning processes should balance demand and supply possibilities, choosing the alternatives with the lowest cost to meet any given end-use need. Resources should be used efficiently.

Generation Efficiency — Electricity should be produced efficiently, using technologies that optimize the usable energy obtained from a fuel source. Improvements that economically increase the efficiency of existing generation facilities should be implemented. In designing new systems, generation efficiency should be optimized against capital cost.

Transmission and Distribution Efficiency — Both technical and non-technical transmission and distribution losses should be minimized to the extent that is economically feasible. Investments which improve the system's efficiency at lower cost than that of new generation should be implemented.

Cost-based Pricing — Costs to the consumer should reflect costs of production. In the long run, prices should reflect the long-run marginal cost of production. This allows consumers and producers to make appropriate decisions.

5.2.3 Good Practices

- Planning processes should use least-cost planning, which can also be called Integrated Resource Planning (IRP).

The World Bank said that "the essential concept of integrated energy resource planning is the equal treatment, or integration, of energy-based and conservation-based energy services."[16] Least-cost planning requires consideration of demand and supply sources of increased electricity capacity on an equal basis. To meet an anticipated level of end-use demand, least cost planning looks for the most efficient method of meeting that demand.

Case Study: Integrated Resource Planning in the Philippines

In the Philippines, NPC (the state-owned utility) recently shifted its planning framework to IRP. To facilitate this shift, it has acquired specific IRP software developed in the United States. The software model allows competitive analysis of alternative projects, including demand- and supply-side projects. It can handle thermal, hydro and renewable resources as well as Demand Side Management (DSM). NPC is expected to start using the model early in 1997, and its next 10-year development plan will be based on IRP principles.

- Electricity prices should be based on long run marginal costs.

Subsidized electricity prices do not give consumers incentives to use electricity efficiently. Where possible, electricity prices should be based on long-run marginal costs, the cost to the society of the next unit of electricity available. That gives consumers proper signals to guide their level of consumption. If social goals require that electricity be available to low-income consumers, the resulting subsidy should be limited. Lifeline rates are an example of a targeted subsidy.

- Electricity should not be subsidized.

According to a recent World Bank study, many economies in East Asia have reformed their electricity prices so that they have removed all, or a substantial fraction, of the subsidies which were in place. This trend has affected the prices of almost all energy sources, including petroleum-based ones. The degree of subsidy has dropped quite noticeably in electricity markets. The Bank study specifically cites Indonesia, the Philippines and Thailand among APEC member economies as having substantially removed price subsidies for electricity. The Bank study states, "There are few, if any, remaining subsidies on energy inputs in the region."[17]

- Generation opportunities which use waste products should be exploited.

Exploiting generation opportunities which use waste products will increase electricity production and reduce air emissions. Opportunities include landfill gas, refuse, derived fuels, coke oven emissions and flare gas.

[16] World Bank 1993, *The World Bank's Role in the Electric Power Sector*.

[17] Hammer, J. and S. Shetty (1995), *East Asia's Environment: Principles and Priorities for Action*, World Bank Discussion Paper No. 287.

Case Study: Power from Waste in Thailand

Thailand has recently instituted a small power producers (SPP) program. Its purpose is to initiate private sector development of small power facilities from sources with relatively low environmental impacts. These include non-conventional sources such as wind, small hydro, and solar; energy from agricultural or industrial waste; and cogeneration. As of July 23, 1996, a total of 84 proposals had been received. Of these, 22 were based on using waste products such as bagasse and palm oil waste. These 22 projects proposed a total generating capacity of 492 MW, of which 229 MW was for sale to EGAT (the Thai utility). EGAT hopes to buy up to 3200 MW of capacity from SPP producers by the year 2000.[18]

- Cogeneration should be encouraged to save energy and reduce environmental impacts.

Cogeneration facilities get much higher levels of heat recovery from the primary energy source than do conventional boiler or other conversion technologies. Cogeneration opportunities can be more attractive at the time that new industrial steam hosts are being built, because it is easier to build in electricity generation at the time the steam facility is first constructed than it is to retrofit.

Case Study: Cogeneration in Chinese Taipei

In 1988, Chinese Taipei adopted a set of measures to promote cogeneration. The measures included making Taipower obligated to purchase the electricity, setting the purchase price of the electricity at Taipower's avoided cost or at Taipower's time of use rate, whichever the generator chose, and making Taipower provide back-up and supplementary power. These incentives were only available if the project used at least 20% of the total output as heat and if it achieved an overall efficiency of at least 50%.

The result was a significant expansion in cogeneration in Chinese Taipei. In 1986, there were 475 MW of cogeneration facilities installed. By 1994, that amount had more than quadrupled, to 1,980 MW of installed capacity, representing 9.4% of the total system. The largest growth came from the petrochemical, metals, paper and textile industries. These industries have significant requirements for process steam, and therefore make good candidates for cogeneration facilities. It is estimated that the total installed capacity will increase to over 4,000 MW, or almost 15% of the total system, by 2000.[19]

Case Study: Cogeneration in the People's Republic of China

China wants to expedite the development of cogeneration to conserve energy, reduce pollution and increase electricity production. The program offers cogeneration enterprises low-interest loans of up to 30 to 40% of the total investment. The government will also supply the enterprises with a part of the materials, coal and equipment utilized in the plan.

Other incentives include the reduction of sales taxes and setting beneficial prices for the heat output. Since the program began, the capacity of cogeneration units in the program has reached

[18] International Energy Agency (1997), *Asia Electricity Study*, IEA/OECD, Paris.

[19] Hsu, George J. Y., "The Restructuring of The Electric Power System in Taiwan," in *IAEE, 19th International Conference, Proceedings*, 1996.

400 MW, which has saved 6 million tonnes of oil equivalent annually.

- Programs should be implemented to improve generation efficiency.

There are several ways in which member economies could improve generation efficiency. For example, contractual arrangements should try to encourage good maintenance and good management of the generation facilities. Proper energy pricing will also help encourage efficiency in generation.

- Programs should be implemented to promote efficiency in transmission and distribution.

Improved maintenance and operating procedures can increase the efficiency of the transmission and distribution system. Targeted programs can include better inventories and use of spare parts and better maintenance. Systems can also be designed for higher efficiency by reducing transmission line length and increasing voltages.

Case Study: Improvement in Transmission and Distribution Efficiency

Several APEC economies have been improving their transmission and distribution efficiency over the last 15 years. As the data in Table 5.2 show, the general trend has been for the loss fractions to decrease. Particularly notable is Korea, which has reduced its loss fraction from over 20% in the 1960s to under 7% by 1980 and to under 6% by 1990, about equal to the level in Japan. This reduction in losses allowed an increase in effective electricity supply of over 10% without any increase in generation capacity, and without any additional emissions from generation. China has also reduced its level of losses continuously over the decade of the 1980s, from about 8.5% in 1980 to just over 7% in 1990. This allowed an increase of 1.5% in electricity availability. Indonesia has also reduced its losses, from about 19% in 1980 to about 16% by 1992. The Philippines has enacted legislation requiring investor-owned electric utilities and cooperatives to reduce their loss ratios or face fines. The legislation imposes loss caps on each utility, and reduces the caps in each of the four years of the program, starting in 1996.[20]

5.3 Efficiency in End-use

5.3.1 Background

GOOD practices for promotion of efficiency in electricity end-use depend partly on the character of the electricity market. If the market is highly competitive and price-driven, private companies may pursue efficiency improvements in order to improve profits.

If the market is more centralized, there may be a need to promote end-use efficiency to overcome various barriers. In either case, because of the high cost of information gathering, central energy agencies may obtain and disseminate information that helps decision makers understand the benefits and costs of possible efficiency improvements.

[20] International Energy Agency, op.cit.

Promotion of end-use efficiency by electric utilities or government agencies charged with energy or electricity planning is often called Demand Side Management (DSM). Economically efficient conservation programs undertaken directly by consumers or through energy services companies (ESCOs) with a motivation of saving money are not usually called DSM. This section will primarily discuss traditional DSM programs, but will also mention the emergence of private-sector energy efficiency initiatives, including ESCOs.

The basic concept in adopting DSM measures by the utilities is that an adopted DSM measure should cost less than the utilities' avoided cost, which is the long-run marginal cost of new supply (including costs of transmission and distribution). Therefore, DSM measures are cost-effective and a successful DSM program could reduce electricity demand growth significantly while saving utility investment. However, in an economy which may see an average electricity demand growth rate of 8% or more per year, the absolute impacts of DSM will be small as compared to the total new capacity requirement.

The effect of DSM on the environment depends on what generation is displaced. Displacing domestic fossil fuels means displacing environmental impacts both in fossil fuel extraction and in electricity generation. For example, environmental impacts from coal production include the impacts from mining and surface reclamation. Environmental impacts from electricity production and consumption are associated with ash disposal, air pollution, acid rain, electromagnetic fields from transmission lines and plant siting. The environmental benefits to an economy from the DSM program will thus vary by fuel type and fuel source.

For example, China uses domestic coal as a major fuel for power generation, so the electricity saving from DSM will reduce the environmental impacts from coal production as well as reducing SO_2 emissions from coal burning. On the other hand, Chile generates most of its electricity from hydro resources. The reduction in electricity consumption due to DSM programs will not have as much impact on reducing air pollution; its main environmental benefit is the need for fewer and smaller dams. Finally, DSM may influence environmental impacts by reducing daily or seasonal peaks, thereby altering generation and fuel share patterns.

Various DSM mechanisms exist in APEC member economies. A mix of mechanisms is typically utilized. The mechanisms can be grouped as follows. Note that two groups of mechanisms — command and control, and financial incentives — are often not applicable in economies with decentralized, competitive electricity market structures.

Legislation and Regulation. Legislation and regulation can impose energy-saving measures. This group includes the implementation of energy efficient building codes, guidelines and design standards; energy auditing; appliance and equipment performance standards; and compulsory end-use equipment efficiency labelling. For example, Thailand has implemented an energy conservation promotion act requiring large commercial buildings and factories to have energy audits and to retrofit to meet government standards. Efficiency labelling for residential appliances is required in many economies such as Japan, Singapore and the U.S., and is voluntary in others, like Thailand.

Government legislation or regulation for energy efficiency can be a relatively easy way to implement energy saving programs, because they do not require any direct program expenditures. However, the standards should be set in recognition of the difficulty of enforcement, especially if much of the equipment is not domestically manufactured.

Pricing Mechanisms. Pricing mechanisms such as time-of-day rates, seasonal rates or interruptible rates are common in APEC member economies (e.g., China, Chinese Taipei and Thailand). Hong Kong restructured its tariff to discourage excessive consumption. Singapore phased out "promotional tariff blocks" (which were introduced in 1972 to encourage higher energy consumption to achieve economies of scale) to reduce rising electricity demand and encourage energy efficiency.

Command and Control. The command and control system is used in some APEC economies. Many utilities in the People's Republic of China use a quota or rationing system on electricity consumption to control consumer's load.

For example, Hubei Province assigned an electricity quota to principal industrial companies to control electricity use in the industrial sector. The quota is reported to have saved 7.5% of the industrial consumption from 1990 to 1995.

Financial Incentives. This mechanism includes measures such as tax or import tariff reductions for energy efficient equipment, low-interest loans for efficiency retrofits, and subsidies or rebates to make up for the higher capital costs of energy efficient equipment. This is the mechanism most widely adopted in APEC member economies to motivate customers to buy energy efficient equipment.

For example, in 1995 Hong Kong launched a pilot scheme for the public housing sector to promote the replacement of conventional incandescent light bulbs with compact fluorescent lights (CFL) by having the utility subsidize CFL sales to customers. Korea introduced experimental rebate programs for efficient lighting appliances by offering a 30% rebate on purchase and installation costs. In Japan, energy conservation equipment is eligible for either a tax credit of 7% of the standard equipment price, or an additional depreciation allowance of up to 30% of the standard equipment price. Many utilities in the United States and Canada had DSM programs of this kind, offering financial incentives for various kinds of energy-saving equipment.

Competition and Award Programs. Awards promote competition among manufacturers to produce higher efficiency appliances and among individuals to promote energy efficiency. The U.S., Hong Kong, Indonesia, and the Philippines offer award programs for energy efficient products. Japan has several award programs for individuals who render distinguished service in energy management, and an award to factories that have achieved significant results and have set good examples.

Education and Information Programs. Education and information programs help overcome the barrier of lack of information. Such programs include public awareness campaigns in newspapers, newsletters, radio, and TV on the benefits of electricity savings, educational campaigns like energy efficiency education kits for school children, seminars and workshops for teachers and incorporating energy efficiency information in school curriculum and training programs for builders, auditors and energy managers. Hong Kong set up an Energy Efficiency Center to educate people on how and why to consume energy more efficiently.

Just as they are at different points along the spectrum of electric industry structures, APEC member economies are at different phases of DSM Programs. For example, the U.S., Canada and Japan have DSM programs which have matured and, in some cases, been reduced as other mechanisms promote end-use efficiency. Thailand and Korea recently established full-scale DSM programs. Indonesia and Chinese Taipei are at the pilot project stage. In addition, while in some economies (e.g., Thailand), the DSM program is centrally mandated and funded, in others (e.g., the U.S.), DSM programs are being implemented through regional utility companies with little legal authority or standardization across the economy's regions. What follows are examples of current DSM programs in some APEC member economies.

- DSM programs in the U.S. are a two billion dollar per year industry. Almost 1,000 utilities in the U.S. have implemented DSM programs with varying degrees of success. The U.S. DSM programs occur on a utility specific basis under guidelines established by individual state regulators. As markets in the U.S. become more competitive, utility DSM programs have diminished and ESCOs have emerged.
- Thailand is adopting a comprehensive five-year DSM program that consists of 6 sub-programs: residential, business/government/state enterprise, industrial, energy demand management, awareness building and DSM evaluation, with a total budget of $172 million. The first plan was designed for the period 1993-1997 with a total savings goal of 1,427 GWh. This plan, however, was revised in 1995 and a more ambitious savings goal of 3,404 GWh was set for the end of 1998.
- Indonesia designed DSM activities in three stages prior to full scale implementation: (1) preliminary study of DSM potential; (2) pilot project; and (3) DSM Master Plan development. Preliminary studies started in 1992, followed by pilot projects from 1993 to 1997. Pilot projects include lighting efficiency for residential and commercial customers.
- Hong Kong launched energy efficient lighting pilot schemes in 1995 targeting lighting in the public housing sector and non-profit schools. They are now planning a pilot launch of similar schemes for commercial offices. The other DSM activities are on education, tariff restructuring and load research.

- The Philippines implemented a "Power Patrol Campaign" in 1993 with a target of saving 10% of energy consumption. The Campaign is on-going and seeking to broaden the program outreach. A DSM project was just launched in the Philippines in January 1996. It is funded by the Global Environmental Facility and administered by U.S. Agency for International Development. The project's goal is to put in place "the foundations for sustainable DSM in the Philippines" and to create a replicable and self-sustaining program.

With many years of experience with DSM, some APEC member economies offer significant learning opportunities. Drawing mainly from U.S. experience, one recent report identified the following lessons.[21]

- Large gains in energy efficiency can be made from using commercially available technologies. A study by EPRI in 1990 found that 24 to 44% of the energy being consumed could be saved using commercially available technologies.
- Energy efficiency equipment is more cost effective to install in new houses, commercial buildings or industrial facilities than in retrofits of existing buildings where equipment must be replaced. Because much of the growth in energy usage in developing economies is for new facilities, promotion of energy efficiency in new buildings can be very effective at reducing energy demand.
- Attention to energy efficiency improvements should also be given to existing buildings. A U.S. study showed potential for energy efficiency improvements of as much as 80% in an existing office building.
- Marketing materials on DSM programs should be simple, straightforward, and address the needs of the customers. Marketing materials work best when they emphasize energy savings as well as non-energy environmental values, and when they are targeted to particular customer segments.
- Electricity prices should represent the utility's marginal costs. Higher electricity prices will shorten the payback period for energy efficient equipment and make customers readier to invest.
- Programs should be self-sustaining in the market place. Rebates to end-use customers for energy efficient equipment have limited value as long term DSM tools. In addition to the end-use customer, a self-sustaining process should also involve equipment manufacturers, wholesalers, retailers and other contractors.
- DSM should be viewed as a co-operative endeavour to leverage limited DSM funds. This includes co-operation between electric utilities in different regions of the economy; electric utilities in different economies; or electric, gas and water utilities in the same region who deal with the same end-use customers, in order to share tools, models, databases and lessons learned.

[21] **Hagler Bailly Consulting Inc. (1996),** ***A DSM Manual for the APEC Economies,*** **San Fransisco, CA.**

In addition to these lessons, the U.S. experience may also illustrate the impact of market liberalization on DSM. As electricity markets have become more competitive, DSM expenditures – which raise costs and reduce sales – have dropped. Utility DSM expenditures in the U.S. peaked at nearly $3 billion in 1993, or about 1.5% of industry revenues, and have dropped since.[22] Several factors have contributed to this: utility avoided costs have dropped substantially; aggressive DSM utilities now have mature programs; and increased competition has driven utilities to concentrate on lower prices. Although actual DSM expenditures of the U.S. utilities in 1993 were 6.5% lower than projected, energy savings were the same as projected earlier while potential peak reductions were 9% higher than previously projected.[23]

In a fully competitive market, utilities will de-integrate the generation, transmission, and distribution functions. Generation activities will be handled by an unregulated company with no incentives to reduce electricity sales. The restructured industry could be expected, from a public standpoint, to under-invest in energy efficiency. Environmental and societal benefits of DSM will not be recognized by any of the parties. The transmission and distribution companies may target local areas for DSM to minimize investment in new capacity. The new unregulated retail ESCO will provide DSM services that have a financial payoff, but will not provide DSM services only to help achieve social goals such as improving environmental quality or promoting social equity.[24] Some utilities may choose to offer energy conservation assistance as part of customer retention programs.

However, as long as an electricity system remains centrally controlled and planned, with a single entity responsible for the provision of electricity, there is still scope for DSM as part of the integrated energy planning activities. Where it is cheaper to reduce demand than to increase supply, the integrated planning system will support the DSM activity.

To achieve the environmental and investment benefits of DSM, will require APEC member economies to overcome a number of barriers. The most common barriers to DSM are summarized below.

- ***Lack of information***. Many customers lack knowledge of the potential savings that can accrue from energy-efficient investments, as well as the information and technical expertise to choose and install energy-efficient equipment. Acquiring the necessary information can be costly for individual customers, which is why information DSM programs can be effective.
- ***Limited access to capital***. Consumers are often hindered by a lack of access to capital to buy costly equipment. Also, most DSM programs are highly capital intensive. Virtually all their expenditure occurs at the start of the project, because the more efficient equipment costs no more to operate and maintain than does conventional equipment.

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22 **Hadley, S., and E. Hirst (1995)*, Utility DSM Programs from 1989 Through 1998: Continuation or Cross Roads?*, Oak Ridge National Laboratory, CON-DE-AC05-84OR21400, Oak Ridge, Tennessee.**

23 **Hadley, S., and E. Hirst (1995)*, Utility DSM Programs from 1989 Through 1998: Continuation or Cross Roads?*, Oak Ridge National Laboratory, CON-DE-AC05-84OR21400, Oak Ridge, Tennessee.**

24 **Hagler Bailly Consulting Inc. (1996), *A DSM Manual for the APEC Economies*, San Fransisco, CA.**

- ***High initial cost of energy efficient equipment***. High initial costs can raise the payback period above the cut-off point for corporate funding.
- ***High import tariffs on energy efficient products***. High import tariffs stop the products from entering the domestic market. Such market protection gives fewer incentives to local manufactures to innovate and produce energy efficient products.
- ***Low electricity prices***. Electricity prices are heavily subsidized in many developing countries to achieve social objectives. The lower the electricity price, the slower the penetration of electricity-saving measures. Subsidizing electricity prices is a market distortion and makes DSM and energy-efficiency programs less successful.
- ***Short payback periods***. Consumers require a rapid payback, generally from 6 months to 3 years.
- ***Split responsibilities***. Tenants and landlords have little incentive to install energy-efficiency measures, because tenants do not own the buildings and landlords do not pay the electricity bills.
- ***Lack of access to and trust in efficiency equipment***. Because energy efficient equipment is new to the market, it could be viewed as too risky to purchase.

5.3.2 Principles for Good Practice

Cost-based pricing — Electricity prices should reflect the true costs of production and distribution. Without sufficient price signals to encourage energy and economic efficiency, the consumer will not have the proper incentives to adopt DSM technologies.

End-use efficiency — Electricity should be used efficiently. Changes in energy-using equipment that conserve energy at a lower cost than that of generation should be implemented.

Information — Information on more efficient uses should be compiled and disseminated. Lack of adequate information about comparative costs and efficiency of equipment is one of the most important barriers.

Targeted financial programs — Financial incentive programs to promote energy efficiency should be targeted to ensure that the DSM program savings have costs lower than the utility avoided cost. Financial subsidy and rebate schemes will help remove the first cost barrier, and lower the payback period. They can help bridge the difference in payback periods between the consumer and the utility. Financial mechanisms can also include lower tariffs or lower taxes on energy efficient products, or higher taxes on inefficient equipment.

5.3.3 Good Practices

- Programs to increase end-use efficiency should be implemented.

End-use efficiency programs should be implemented as part of an integrated energy planning process. DSM programs may consist of a variety of specific program elements, each aimed at exploiting an opportunity for energy efficiency. The programs should be designed so that the costs of the demand reduction are below the avoided cost of generating electricity.

Case Study: Energy-Efficient New Housing Program in Canada

Canada has a cold climate and a significant amount of electric space heating in houses. Canada started its Super Energy-Efficient Home energy efficiency program in 1982. The program sets a standard (the R-2000 standard) for energy efficiency and environmental responsibility in new houses which exceeds energy efficiency in conventional housing by as much as 50%. Training, inspection and certification are offered to builders who construct houses to this standard.

The program costs are estimated at C$60 million, of which C$50 million are funded by Natural Resources Canada and the rest comes from other supporting partners, including the Canadian Housing Industry, energy utilities, provincial governments and equipment manufacturers. Program funding is in place until 1997.

It is estimated the average new home in Canada now consumes 35% less energy than the average new home built in 1980, and approximately C$150 million in energy savings have been attained by houses built to the R-2000 standard since the program started.

- Information transfer mechanisms should be put in place.

Sound information transfer mechanisms are needed at two levels, those involving the general public, and those associated with commercial and industrial energy managers. Customers often do not participate in the DSM programs because they do not understand the energy (and money) savings available. Information gathering costs are very high for a single consumer.

If information is provided by a program, it can help consumers make choices on their own to save money and electricity. Information transfer can educate energy managers on the benefits of new energy saving technologies and the requirements for successful operation.

Case Study: Residential Appliance Labelling Program, Australia

The Australian and New Zealand Minerals and Energy Efficiency Council (ANZMEC) has a residential appliance labelling program to provide information about energy performance of major appliances. Standard energy efficiency labels are mandatory on all new appliances. A product's performance is indicated by a comparative "star rating" scheme and estimates of the annual electricity consumption. The currency of the labelled energy consumption and star rating algorithms are being reviewed. In the years since the program started, the star ratings of some types of appliances have increased as manufactures respond to consumer pressure for higher efficiency appliances. The program also covers international standards harmonization issues within the context of APEC and energy efficiency initiatives of the International Energy Agency and Organisation for Economic Cooperation and Development.[25]

Case Study: Industry Energy Research and Development Program, Canada

The Industry Energy Research And Development (IERD) Program was set up to help industry to undertake research and development for products, processes or systems that increase efficiency of industrial energy use. IERD promotes wide commercial use of technology developed under the program. Companies can receive up to 50% of the total estimated eligible costs of an approved project. The cost-sharing ratio depends on factors such as degree of risk, potential energy savings, and degree the technology developed can be adopted by other companies. The program is considered very successful. An evaluation in 1994 showed that 80 projects were completed, with energy savings of 3.1 million barrels of oil equivalent annually and benefits to the country of about C$14 annually for every C$1 contributed by the program.

- Training information and capabilities should be exchanged within and between economies.

Effective training is often the critical component in implementing successful DSM programs and energy efficiency policies. However, since many of the most useful new technologies have not been utilized in an economy, the skills necessary to successfully install and maintain the systems are not available. As such, it can be difficult to know where to obtain the information on successful training programs and where to procure training services. Developing a compendium of successful DSM and efficiency training programs in member economics would identify where best to gather information on programs.

[25] Government of Australia (1997), *Compendium of Australian Energy Efficiency Programs*, http://netenergy.dpie.gov.au/info/compendium/ansmec2.html. A program to consider energy labelling for commercial and industrial electrical equipment is in research stages.

Case Study: Technology Transfers for Energy Management in the Philippines

The Philippines developed a four-year Technology Transfer for Energy Management (TTEM) Program. About $2.4 million was set aside as the Demonstration Loan Fund to finance energy efficiency investments at below market interest rates. This loan was to be used to demonstrate efficient technologies and practices not widely used in the Philippines. Loan recipients were required to share their experiences with other industries and allow tours of their facilities. The program also focused on building institutional capabilities for energy efficiency within both the private and public sectors by providing, for example, technical training to staff and seminars for both energy end-users and financial sector companies.

More than 120 companies received free technical assistance through TTEM, which identified about 100 potential projects and 30 demonstration projects. Sixteen of the demonstration projects were funded through TTEM, with the remainder financed by the companies involved. For the 16 TTEM funded projects, the average payback period was 2.5 years with an average internal rate of return of 40.7%. On an aggregate basis, these 16 projects saved 78,000 barrels of fuel oil worth $2.5 million annually. This annual saving includes 2.0 MW of electricity demand reduction and 1.3 MW of created cogeneration capacity.[26]

- DSM programs should be subject to monitoring and evaluation.

Monitoring and evaluation is important to the success of DSM programs. Measuring consumer participation, market penetration, participant satisfaction, actual energy saving, persistence of the savings, and effectiveness, for example, would help the utilities to make continuous program adjustments to enable them to reach their DSM targets more easily. Existing monitoring and evaluation techniques (such as program tracking systems, customer surveys, building energy computer simulations, on-site inspection, energy-usage billing data, end-use metering and load research metering) could be transferred to APEC member economies. However, some techniques may need modification to be useful in other economies.

Case Study: Market Research for Program Design, U.S.

Public Service Indiana (PSI) of the U.S. was a good example of using market research in its DSM program design. Careful market research allowed the programs to target customers and address customer concerns. The research revealed that decisions on emergency motor replacements and on large-scale replacements for efficiency are made at different levels of the organization, and allowed targeted marketing for each. It also allowed programs to be targeted at reducing payback periods, since that is the decision criterion customers were using more widely.

[26] **Flanigan, T., and P. Rumsey (1996),** ***A Compendium of Asian Energy Efficiency Success Stories,*** **The Results Center, IRT Environmental Inc., and the International Institute of Energy Conservation.**

- Government policies should be co-ordinated with DSM policies and programs.

The successful DSM program will require good DSM policies as well as good overall support policies. Supporting policies such as those on import taxes must be consistent with the underlining DSM goals. A utility's comprehensive DSM program could be co-ordinated and supported by a central energy efficiency program. Economies could also benefit from information on policies which have been successful in other APEC member economies.

Case Study: Co-ordinated Government and Utility Policies in Thailand

Thailand has co-ordinated governmental policies for energy efficiency and energy conservation goals. Energy efficiency and energy conservation activities in Thailand are being implemented by both government agencies and the Electricity Authority of Thailand (EGAT), a state enterprise utility. EGAT is responsible for DSM programs in Thailand. However, EGAT cannot enforce mechanisms, and has to use voluntary programs.

In 1992, the same year as the DSM program was adopted, the Thai government enacted the Energy Conservation Promotion Act and established the Energy Conservation Program (ENCON) which included legislative measures for energy conservation and energy efficiency, as well as voluntary work on energy efficiency and renewable energy.

Legislated energy conservation under ENCON covers energy conservation in buildings, factories, machinery, and equipment and the promotion of energy-efficient materials. The owners of the "designated" buildings and factories are required by law to establish and meet energy conservation targets and plans, and to submit them to the government every three years.

The voluntary work of the ENCON program focuses on the introduction and dissemination of renewable technologies; stimulation of the industrial capacity in energy efficient and renewable energy equipment in Thailand; and promotion of research and development. The Energy Conservation Fund budget for 1994 to 1999 was $771 million.

- Financial mechanisms should be adopted, where needed, to promote DSM.

Two types of financial mechanisms are important to successful DSM and energy efficiency programs. The first is related to the overall promotion, administration, monitoring and evaluation of the programs. This is needed because in countries without a history of DSM or energy efficiency programs, the concepts behind the benefits of such activities are not clear to the general public.

The second financial need is to overcome the concentration on upfront costs, the high discount rate exhibited by energy consumers, and the lack of capital for efficiency related purchases. APEC economies could benefit from information on financial mechanisms which have been successful in other APEC economies.

Case Study: Thailand's Energy Conservation Fund

Thailand established an Energy Conservation Fund in 1992 to be used as working capital and as grants, subsidies or low-interest loans for use on energy efficiency, energy conservation and related environmental programs. The fund started with about $60 million from the Oil Fund and receives annual revenue of about $80 million from a small ($0.003 per litre) petroleum tax, contributions from domestic gas concessionaires, and foreign donations.

The fund currently has about $340 million. The total budget for the initial five year program (1994-1999) is $771 million. About 70% of the fund is to be used to subsidize the owners of commercial buildings and factories for energy audits, energy conservation plans and building retrofits to, at least, meet the government standards. The remaining 30% is to fund the recipients who want to work voluntarily on energy efficiency, energy conservation and renewable energy.

In addition, EGAT operates the DSM program in Thailand with a four year budget of about $172 million. Of the total budget, about $110 million is set aside to be used for various financial incentives to customers such as interest-free loans for 25 months for consumers who buy air-conditioners with high energy efficiency, or pre-financing to entrepreneurs for 3 years without interest for the differential price between energy efficient and standard motors.

- The development of energy services companies (ESCOs) should be encouraged.

ESCOs help solve the problems of access to information and capital that are among the most important barriers to energy conservation. In doing so, ESCOs also make promotion of energy efficiency into a self-sustaining, profitable business. By gathering expertise and information on how to save energy and money, and offering the information to multiple clients,

ESCOs can provide a service to energy users which users could not economically provide themselves. Often, an ESCO will offer its services free to the energy user, making its profit from the saved energy costs and sharing the savings with its client. Proper energy pricing is usually necessary for ESCOs to succeed.

Case Study: Setting up ESCOs in the Peoples Republic of China

A new program is anticipated to start in China to set up experimental ESCOs.[27] *The program will fund an Energy Management Company (EMC) Demonstration with about U.S.$200 million. Three demonstration EMCs will be developed and grow as commercial businesses in China. They are expected to undertake investments for host clients, who will then get energy savings from the improved equipment.*

The EMC will be paid from the energy savings, until they have recovered their full costs, including compensation for risks and a reasonable profit. After that, the host company will own the equipment fully. Three EMCs were established in 1996 in preparation for this project. They are publicly-owned provincial-level companies.

[27] World Bank (1997), *China Energy Conservation Project*.

This project is being introduced gradually, and with considerable support, in recognition of the fact that energy performance contracting is very new in China. The initial projects chosen will use proven technology in applications where savings can be easily verified, and where payback periods are relatively short. The government implementing agency, the State Economic and Trade Commission, will help coordinate the project within China's legal, taxation and institutional framework.

6. ENVIRONMENTAL APPROVALS PROCESSES

6.1 Background

ENVIRONMENTAL impact assessment (EIA) and other environmental approval processes are business investors' number one concern related to environmental policy practices. It is in these processes, and not so much the environmental standards themselves, where good practices are most needed to facilitate investment in electricity infrastructure.

Business concerns with environmental impact assessment and other approval processes centre around three issues:

- monetary costs;
- time costs; and
- uncertainty costs.

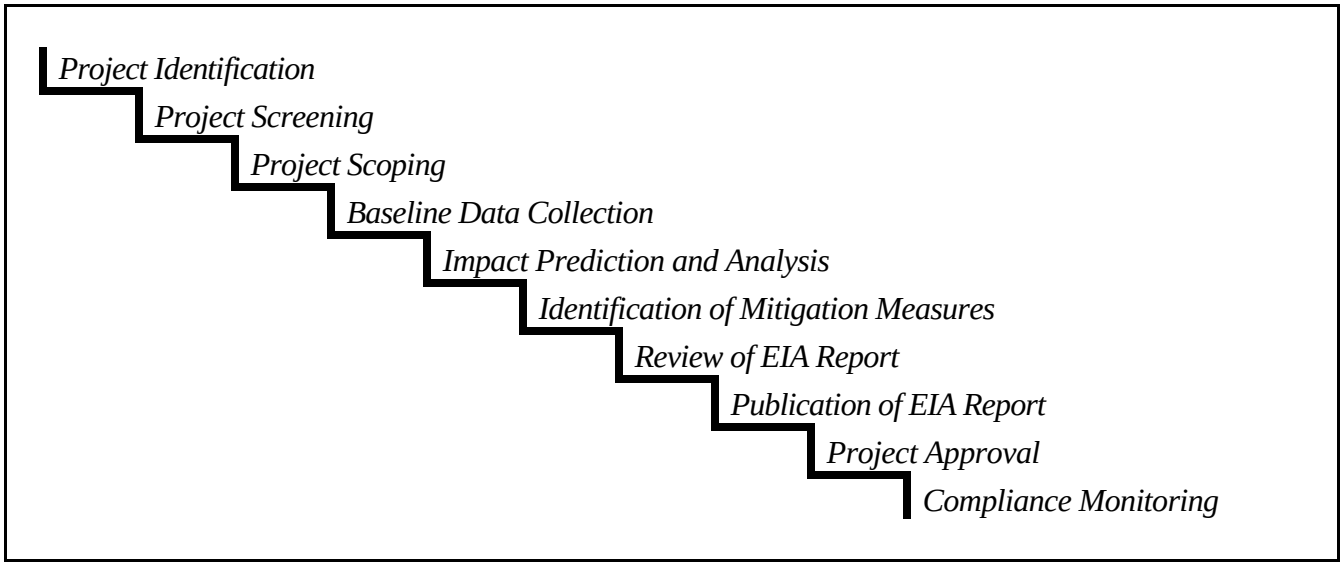
Practices which reduce the extent of these three types of costs, while maintaining environmental protection objectives, should be promoted.

6.1.1 Environmental Impact Assessment Processes

Among business sector investors, there is widespread support for the concept of EIAs, given that EIAs can reduce uncertainty over securing construction and operating licenses, and can reduce the liability risks in the short-term and long-term. In addition, EIAs can verify that public support for projects exists, thereby reducing the risk that a development, once underway, might be halted by public opposition. In effect, EIAs have become an integral component of due diligence exercises.

Nonetheless, EIAs result in monetary, time, and uncertainty costs to project proponents. Monetary costs include the expenses of collecting data, preparing reports, and possibly revising project designs to mitigate impacts. Time costs include the time spent preparing EIA reports, attending EIA reviews, and delays to project implementation. Uncertainty costs are the uncertainty surrounding whether, when, and under what conditions approvals will be granted.

The specific components of environmental impact assessment processes vary among the economies. This includes, for example, the range of projects requiring EIAs, the scope of impacts addressed, the types of documents and presentations required, and ongoing mitigation and compliance monitoring activities. However, ten general features tend to be common among economies, as illustrated below.[28]



In addition to EIA requirements of individual economies, project proponents may also face EIA requirements from multi-lateral lenders. Most development aid packages from lenders now explicitly require that project proponents conduct environmental impact assessments prior to receiving aid. This is particularly true for electricity sector projects, given their potential environmental and economic impacts. Often, lending organizations assist in financing these environmental impact assessments, thereby reducing the burden on power project proponents. In addition, manuals and guidelines are usually available to further assist business in ensuring that all relevant impacts are assessed.

For example, the World Bank requires that borrowers conduct EIAs for power generation projects, which must address all major environmental consequences, impacts on health, cultural property, tribal people, and settlement patterns.[29] The United Nations Development Programme (UNDP) and the Asian Development Bank (ADB) also require that EIAs be conducted for projects with potentially adverse environmental impacts they finance.[30,31]

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[28] World Resources Institute (1995), *Strengthening EIA Capacity in Asia: Environmental Impact Assessment in the Philippines, Indonesia, and Sri Lanka*, Prepared by D. Smith and M. van der Wansem.

[29] World Bank (1991), *Environmental Assessment Source Book, Volume 3, Guidelines for Environmental Assessments of Energy and Industry Projects*.

[30] United Nations Development Program (1992), *Guidelines for Environmental Management and Sustainable Development*.

[31] Lohani, B. (1992), "Environmental Assessment and Review during the Project Cycle: The Asian Development Bank's Approach", in *Environmental Impact Assessment: Principles and Procedures*, edited by E. Munn, John Wiley and Sons.

While the EIAs of multi-lateral lenders must be completed, there do not appear to be clear policies within member economies identifying the extent that their own EIA requirements must be satisfied at the same time.

6.1.2 Other Environmental Approvals Processes

In addition to conducting environmental impact assessments, proponents of new or expanding power generation projects must secure a variety of other approvals, including:

- zoning or construction permits/approvals; and
- operating and sales licenses/certificates.

The number of, and requirements for securing, these other approvals vary among the APEC economies. In general, economies require that an EIA be conducted, followed by securing the remaining zoning, construction, operating, and sales licenses. As such, other environmental approvals are often contingent upon having an approved EIA. In addition, the continued validity or issuance of new approvals may depend on meeting ongoing environmental standards, in particular air emissions standards.

A number of criticisms have been directed at these other environmental approval processes of APEC and other economies. All criticisms derive from the fact that approval processes impose money, time, and uncertainty costs which business investors identify as unnecessary. Typical concerns stem from:

- the numerous agencies which must be contacted to obtain the required approvals;[32]
- the need for similar approvals or approval input from different levels of authority;
- duplication of information contained in the other approvals (and EIAs);
- the length of time taken in reviewing applications for other environmental approvals;
- lack of guidance for submitting applications or objective criteria for granting approvals;
- lack of precision and clarity within the environmental rules, creating ambiguity in the requirements or their legal interpretation; and
- lack of internal consistency among environmental requirements at different levels of government.

[32] These may include several national agencies responsible for energy, the environment, and planning, as well as corresponding regional and local agencies.

6.2 Principles for Good Practice

BUSINESS investors point to the need for good practices to reduce the costs and uncertainties associated with environmental approvals processes. The following principles can be used to identify good practices.

Transparency — The EIA and other approval processes are well-defined in law, the responsibilities of all parties clear, and justification for approval decisions is made available.

Predictability — Uncertainty regarding the outcomes and timing of EIA and other approval processes is minimized.

Cost-effectiveness — The EIA and other approval processes allow for informed decisions without imposing undue requirements and costs on project proponents.

6.3 Good Practices

- EIA and other environmental approval processes should be specified in a clear legislative, policy and regulatory framework.

THE framework should specify responsibilities of different parties in submitting and evaluating applications. In addition, the framework should manage other elements of the EIA and other approvals process, such as harmonization between jurisdictions and agencies, the relationship between compliance with EIAs and other approvals, and enforcement and penalty mechanisms.

Most APEC economies have in place legislation that specifies when and how EIAs are to be conducted. For instance, these include Australia's Environmental Protection Act, Chile's Environmental Base Law, New Zealand's Resource Management Act, Papua New Guinea's Environmental Planning Act, and the USA's National Environmental Policy Act.

In other cases, EIA requirements fall under several acts, regulations or decrees, depending on the nature of the project. For example, in Japan, specific national EIA legislation is being debated; however, the government has been instructing utilities to conduct EIAs since the mid 1970s. A Cabinet decision in 1977 fortified the EIA requirement for any new power plant development.

The development of transparent EIA legislation is encouraged. A great deal of experience exists in this respect. Member economies can learn from each other, and design legislation which reduces the uncertainty facing electricity project proponents regarding which projects will be subject to EIAs, what steps must be followed in submitting proposals and how these proposals will be evaluated.

Case Study: EIA Transparency in Indonesia[33]

In October 1993, the Government of Indonesia took a major step towards improving the transparency of its EIA legislation, which had existed since 1986. Regulation 93-51 was established to eliminate some confusion (and sources of de-lays) which had arisen in practice.

[33] World Resources Institute (1995), *Strengthening EIA Capacity in Asia: Environmental Impact Assessment in the Philippines, Indonesia, and Sri Lanka*, Prepared by D. Smith and M. van der Wansem.

For instance, the new regulation clarified responsibilities and streamlined processes to:

- *simplify project screening procedures;*
- *eliminate some preliminary EIA stages and reviews;*
- *ensure early submission of monitoring plans; and*
- *clearly establish the responsibilities of BAPEDAL, Indonesia's EIA agency.*

In addition, BAPEDAL was granted authority to establish guidelines for reviewing environmental impacts, co-ordinating multi-sectoral reviews, and providing technical advice.

- Implementing guidelines and manuals for approvals processes should be available to assist project proponents.

A major concern of business is the uncertainty in the EIA process, and how proposals will be evaluated by government agencies. This uncertainty can result in fewer electricity sector projects. To reduce this uncertainty, agencies can publish comprehensive guidelines describing the EIA submission and evaluation processes. These guidelines may cover all projects, but would ideally be specific to electricity sector projects. Separate guidelines for components of the EIA process, including descriptions of the links to other environmental approvals, would also help encourage investors.

Case Study: Implementing Guidelines in APEC Economies

Numerous economies have developed implementing guidelines or manuals as operational support for conducting EIAs. Table 6.1 lists some examples.

Beyond these EIA manuals, some economies publish guidelines specific to the electricity sector. For instance, Indonesia ("Sectoral Guidelines from Line Agencies") and Thailand ("Supplemental Guidelines for Specific Project Categories") have EIA manuals specifically for electricity sector projects.

Table 6.1: Examples of EIA Implementing Guidelines and Manuals

Economy	Implementing Agency	Supporting Manuals
Canada	Canadian Environmental Assessment Agency	"The Canadian Environmental Assessment Act: Responsible Authorities Guide"
People's Republic of China	National Environmental Protection Agency	"Guidelines for Conduct of Environmental Impact Assessments"
Indonesia	Environmental Impact Management Agency	"General Guidelines for EIA Preparation"
Malaysia	Department of Environment	"Handbook of Environmental Impact Assessment Guidelines"
Papua New Guinea	Department of Environment and Conservation	"General Guidelines for the Preparation and Conduct of Environmental Plans"
The Philippines	Department of Environment and Natural Resources	"EIA Handbook"
Thailand	Office of the National Environment Board	"Guidelines for the Preparation of Environmental Impact Evaluation"

In the U.S., the provisions of the National Environmental Protection Act (NEPA) identify EIA requirements. To support these regulations, which have been described as insufficiently detailed, the Council on Environmental Quality (CEQ) has directed federal agencies to issue their own procedures to guide EIAs under NEPA for specific sectors and project types.

The Philippines has a particularly comprehensive set of guidelines for environmental impact assessments, including those for specific projects. These include project-specific manuals for EIA scoping, conduct, and review.[34] *In addition, guidance manuals specific to other components of EIA study are available for public hearings, granting of environmental compliance certificates, compliance monitoring, and appeals.*

Despite the existence of these guidelines for specific sectors and components of the EIA process, two concerns have been raised concerning implementing guidelines. First, manuals are not always complete in terms of technical and procedural material. And second, manuals are not always readily available to project proponents.

- Any site-specific criteria required for approval should be well defined at the outset of the EIA process.

Manuals and guidelines cannot address every environmental impact of an individual project. Therefore, site-specific criteria are often required for specific projects. To facilitate investment and ensure the EIA meets the requirements of the approval agency, site-specific criteria should be defined and discussed with the proponent at the beginning of the EIA process. This will improve the predictability of the process and reduce the likelihood of delays.

- A centralized agency should be established to facilitate EIA and other environmental approval processes.

A centralized facilitating agency can reduce the burden on business of conducting environmental impact assessments. The agency should represent the concerns of energy *and* environment ministers, and have clear authority over EIA requirements from all jurisdictions within the member economy. The agency should also establish clear lines of communication with other sectoral agencies.

Most APEC economies have agencies for conducting EIAs, and making applications for other environmental approvals. These include the Canadian Environmental Assessment Agency, the Environmental Protection Agency in the People's Republic of China, Indonesia's Environmental Impact Agency, Mexico's Social Development Secretariat, and Thailand's Office of Environmental Quality and Planning. These agencies ensure that EIA requirements are met, and where applicable, co-ordinate efforts among government agencies and with business.

[34] World Resources Institute (1995), *Strengthening EIA Capacity in Asia: Environmental Impact Assessment in the Philippines, Indonesia, and Sri Lanka*, Prepared by D. Smith and M. van der Wansem, pg. 17.

Case Study: CONAMA in Chile

The Comisión Nacional del Medio Ambiente (CONAMA) is the environmental commission of Chile. CONAMA's Executive Office is the single authority responsible for ensuring that EIAs are conducted, and co-ordinates EIA activities with regional environmental branches and with all other ministries and affected institutions. Also, CONAMA is in the process of developing a streamlined process which would allow one environmental permit to be issued covering all purposes.

- EIA and other environmental approvals should be integrated with one another, to reduce duplication of effort by project proponents.

Independent approaches to securing EIA and other environmental approvals can result in direct money and time costs to business. For instance, submitting separate proposals for zoning, construction, and EIAs imposes money costs on project proponents. In addition, concerns identified by any of the oversight agencies must then be addressed separately.

APEC economies should explore opportunities for reducing duplication of effort and submissions required of potential business investors. In particular, construction and zoning applications should be considered as part of environmental impact assessments. In addition, opportunities for reducing duplicate submissions for operating and other sales licenses should be examined.

- EIA and other approval processes should be conducted early in the project design stage.

Some existing EIA processes are not initiated until after an electricity sector project is underway, including partial completion of construction activities. Project design changes resulting from mandatory mitigation measures can, in these cases, be costly for business and subsequent purchasers of electricity. Therefore, EIA assessments should be done early in the design stage of projects. Early assessments would also facilitate linking EIAs with other siting approvals.

Case Study: EIAs at the Project Design Stage in the Philippines

The Philippines Department of Environment and Natural Resources (DENR) began a major overhaul of the EIA program in the Philippines in December, 1996 (Administrative Order Number 37). The changes to the Philippines' environmental impact assessment legislation seek to ensure that environmental considerations are made:

" ... at the earliest possible stage of project development, and enhance maximum public participation in the EIA process to validate the social acceptability of the project so as to ensure the fullest consideration of the environmental impact of the project".

DENR and the National Power Corporation continue to search for improvements to both the EIA and PIP processes which will serve economic and environmental interests.

- Timelines should be specified for public input into and government decisions on EIA and other approval processes.

Introducing timeframes for public and government review can reduce the costs associated with undue time delays for power sector projects. These costs result from unanticipated delays in bringing facilities on-line, and the increased costs due to uncertainty in when subsequent elements of projects (approvals, construction, etc.) will proceed.

Case Study: Timelines in Thailand and Chinese Taipei

Timelines for conducting components of environmental impact assessments are embedded in Thailand's Enhancement and Conservation of the National Environmental Quality Act (B.E. 2535, Part IV, Environmental Impact Assessment).

The Act specifies that EIAs must be prepared " … at the stage of conducting a feasibility study …" (Section 47). This, in itself, represents a good practice given that any project design changes as a result of potentially adverse environmental impacts can be made prior to the commencement of construction or other permitting activities. Specific timeframes are identified for government review of EIA submissions (by the Office of Environmental Policy and Planning, OPP).

These timeframes are as follows:

- *if an EIA report is incomplete or incorrectly filed, project proponents are notified within 15 days of submission by the OPP and asked to remedy the shortcoming(s);*
- *upon submission of a complete and duly submitted EIA report, OPP prepares comments and refers the EIA report to a committee of experts within 30 days of submission;*
- *the review and consideration by the committee of experts takes place within 45 days of receipt of the EIA report and comments from the OPP (if the committee of experts fails to conclude its review within 45 days, the EIA is deemed to be approved); and*
- *in the event that approval for the initial EIA report is not granted, and the report is duly amended and re-submitted, the committee of experts reviews the report within 30 days of receiving the revised report (if the committee of experts fails to conclude its review within 30 days, the EIA is deemed to be approved).*

Chinese Taipei has a slightly different set of timelines used in the EIA process, one which promotes public participation. A requirement for conducting a full environmental assessment is that project proponents must hold a public presentation of preliminary information, and publish findings in the local newspapers.

Comments on the content of this information must be received (by the project proponent and the EIA authority) from the public within 15 days. A full EIA report, addressing comments received, is then prepared and delivered to the EIA authority. The full EIA report must be reviewed, and a site investigation conducted, within 30 days. The entire process must be completed within 60 days.

- Duplicative processes by different approvals agencies should be eliminated and harmonized between jurisdictions within economies.

Duplication of environmental assessment and other approval processes imposes money and time costs on business. First, business must prepare and submit multiple approvals applications, which may not be identical between jurisdictions. And second, different agencies must review these submissions. In some cases, reviews may not be concurrent. By reducing this overlap through harmonization, money and time costs can be reduced.

Case Study: Harmonization of EIA Requirements in Canada

Environmental impact assessment regulation in Canada is two-tiered: federal legislation exists under the Canadian Environmental Assessment Act (CEAA), and regional legislation exists in each of Canada's ten provinces and two territories. The requirements of EIA processes differ among provinces and territories, and with the federal legislation (see Table 6.2).

Table 6.2: Key Elements of EIA Legislation in Canada
(✓ = Yes, ○ = Sometimes, × = No)

Jurisdiction	Project Screening	Project Scoping	Public Review	Terms of Approval	Project Monitoring
British Columbia	✓	✓	✓	✓	✓
Alberta	✓	✓	✓	✓	✓
Saskatchewan	✓	✓	✓	✓	○
Manitoba	✓	×	✓	✓	✓
Ontario	✓	×	✓	✓	○
Quebec	×	×	✓	✓	○
New Brunswick	✓	✓	✓	✓	○
Nova Scotia	✓	×	✓	✓	○
Prince Edward Island	○	○	✓	✓	○
Newfoundland	✓	✓	✓	○	○
Northwest Territories	✓	×	○	✓	×
Yukon	✓	✓	×	○	×
Canada	✓	✓	✓	○	○

Source: Revised from Doyle, D., and Sadler, B. (1996), *Environmental Assessment in Canada: Frameworks, Procedures & Attributes of Effectiveness*, pg. 15.

The costs of an environmental impact assessment process, can be costly to business. Further, duplication may not result in a reduction of risk to the environment. As a result, the Canadian federal government and provinces have begun entering into bi-lateral harmonization agreements to reduce the regulatory burden facing business investors. These agreements are based on the Framework for Environmental Assessment Harmonization, approved in 1992 by the Canadian Council of Ministers of the Environment, a council comprised of the federal and all provincial environment ministers.

Three Agreements for Environmental Assessment Co-operation have been signed, for British Columbia, Alberta, and Manitoba, between August 1993 and April 1997.

These Agreements are designed to ensure that the parties "co-ordinate their respective environmental assessment processes to promote effective, efficient, consistent, and co-operative environmental assessments" and "to avoid uncertainty and duplication."

These agreements do not eliminate the need for some provincial and federal EIAs. However, they do provide for co-operation between authorities, and reduce duplication of effort. For instance, some of the major provisions of these Agreements include:

- *a joint review process;*
- *specified time frames;*
- *shared information;*
- *co-ordinated monitoring;*
- *agreement on project scopes;*
- *designated points of contact;*
- *timely access to information; and*
- *cost-sharing.*

- EIAs and other approval requirements should be scaled to reflect the degree of risk posed by a project.

Environmental impact assessment requirements in most member economies employ some form of screening and scoping process used to scale EIAs to reflect the degree of environmental risk. These screening and scoping processes reduce the time and money costs to business of conducting EIAs. Member economies should ensure that screening and scope stages are embedded in their EIA processes, and are justifiably applied. Projects that pose little environmental risk are subject to assessment commensurate with that risk.

Screening and scoping provisions such as these help ensure that undue assessment requirements are not imposed on environmentally benign projects, and that projects with potentially significant impacts are examined in greater detail. Screening and scoping criteria, however, should not be subjective whenever possible, as subjective screening criteria can create confusion over the specific EIA requirements facing business investors.

In Chinese Taipei, as in a number of other economies, EIAs may be conducted in two stages involving a preliminary review and possibly a full, detailed review. This phased approach can limit the resources required of project proponents, while maintaining an acceptable level of environmental protection. Other economies utilize similar phased approaches.

Case Study: Screening and Scoping in Australia

For instance, projects can take one of four tracks under Australia's Environmental Protection Act, depending on the nature of impacts. The Act applies to all environmentally significant decisions made by the authorities and bodies established under Australian federal law.

Proposed projects are screened, and those identified as environmentally significant are subject to one of four levels of environmental review:

- *in-house assessment;*
- *environmental impact statement;*
- *public environment report; or*
- *public commission of inquiry.*

In this manner, EIAs for environmentally benign projects may impose few demands on project proponents. On the other hand, projects with the potential to impose significant and irreversible environmental impacts are extensively reviewed to ensure that these effects are mitigated.

- Approval decisions should be based on transparent and objective evaluation criteria.

Objective criteria provide business with greater certainty in anticipating whether EIAs and other approvals will be granted. Objective criteria can reduce investments in developing electricity sector proposals which will not be granted. They can ensure that appropriate levels of environmental protection are afforded, and minimize uncertainty with respect to the terms facing business.

In addition, the objective criteria can be used by business to introduce siting and design options which do not unduly exceed environmental standards. These criteria should be embedded in law.

- Public participation in environmental impact assessments and other environmental approvals should be encouraged.

Public participation serves three purposes. First, it can increase public acceptability of power sector projects. Second, it reduces the risk that a project, once completed, will be required to incur modification or remediation costs. And third, it increases the credibility of the entire EIA and environmental management process. Encouragement should come in the form of: providing the public information on proposed projects; providing opportunities for public input to the approvals process; and facilitating communications between government, business, and the public.

Case Study: Public Participation in the Philippines

The Philippine National Oil Corporation's Northern Geothermal Exploration Project is one example where public participation resolved serious public concerns. Public consultations with two affected communities identified steps which could be taken to promote acceptance of the project.

Public involvement significantly alleviated concerns over the project, and resulted in mitigation measures acceptable to affected communities and project proponents.

Some of the steps taken to alleviate public concern were:[35]

- *forming an ad hoc public liaison committee;*
- *public review of surveys and results;*
- *public review of scoping guidelines;*
- *public support in the collection of baseline data;*

[35] Ibid, pg. 24.

- *public discussion of interim findings;*
- *on-site discussions with affected locals;*
- *consulting in local languages;*
- *holding public hearings;*
- *translating EIA reports to layman's terms;*
- *disseminating EIA reports to affected parties;*
- *establishing a multi-party monitoring committee;*
- *establishing points of contact in the community;*
- *explaining processes and results; and*
- *introducing timelines for review of results*

In 1996, the Philippine National Power Corporation began the Corporate Social Responsibility and Environmental Stewardship Program (CSRESP).[36] *The objective of this program is to integrate, co-ordinate, assess, and document programs and activities that will allow public concerns to be represented in EIAs. CSRESP supports public participation in all relevant aspects of the National Power Corporation's activities.*

Public participation does not mean informing local citizens of corporate decisions already made about projects and operations. Its purpose is to open lines of communication with the public that permit the free flow of information, encourage two-way communication, and develop mutual respect that leads to trust. The process yields good solutions: decisions are innovative and effective, and are owned by many people.

To open lines of communication between project proponents, the National Power Corporation (NPC), and the affected public, the Public Involvement Program (PIP) was developed.

PIP establishes parallel activities which strengthen communications between:

- *NPC officials and employees;*
- *municipal, provincial, and regional communities;*
- *non-government, civic, and business leaders; and*
- *other government agencies and institutions.*

Strengthening communications between these affected groups is designed to heighten public awareness of proposed projects, develop appropriate mechanisms for addressing community concerns, and generate co-operation among all parties. Achieving these objectives has benefits for all. For the NPC, policy making will be more responsive to public concerns, lending credibility to its actions and avoiding costly lawsuits and political challenges. Business benefits by ensuring that potential problems are addressed early in the design stage.

[36] National Power Corporation Resolution Number 96-190.

Ultimately, public health and the environment benefit, since the concerns of affected communities are better addressed.

7. ENVIRONMENTAL STANDARDS

7.1 Background

ALL APEC member economies have environmental standards in at least one of four forms.

Ambient Environmental Quality Standards: Most economies have adopted ambient environmental quality standards for air, water or both. Often, ambient air quality standards for particulate matter, sulphur dioxide and nitrogen oxide are consistent with the World Health Organization's guidelines. Ambient air quality standards often are not mandatory for each power plant, but rather provide a framework for setting additional standards that each plant must meet.

Point Source Discharge Standards: When ambient environmental quality standards have been insufficient to control discharges of pollutants, many APEC member economies have augmented them with point source standards for discharges to air and water. In some economies, point source emission standards differ based on the age of the plant, the size of the plant, the fuel used and whether the fuel is domestic or imported. Some economies also place a "bubble" around a group of point sources (i.e. place a cap on emissions from a group of point sources) in order to achieve local ambient environmental quality objectives.

Technology Standards: Rather than specify ambient environmental quality standards or point source discharge standards, both of which regulate environmental performance, some economies have implemented technology standards. Technology standards are defined as standards that explicitly require facilities to install and operate specified technologies. In some cases, detailed operating parameters and maintenance activities are also specified.

Fuel Quality Standards: Some member economies have implemented fuel quality standards to help achieve ambient air quality standards. Fuel quality standards are most commonly applied to the sulphur content of coal and oil.

7.2 Principles for Good Practice

EACH APEC member economy has chosen a level of environmental standards in consideration of its environmental, demographic, socio-economic and technological characteristics. However, *how* those standards are specified can affect the way the business sector perceives the investment climate.

To create a strong investment climate while achieving environmental goals, environmental standards should be consistent with the following principles.

Transparency — Information on environmental standards and what power producers must do to demonstrate compliance should be clear and readily available.

Predictability — Environmental standards should be predictable over time to allow power producers to plan effectively to meet the standards and to reduce the risk to power producers of changes in environmental standards.

Consistency — Environmental standards should be applied consistently and fairly to all power producers so as to create a level playing field.

Cost Effectiveness — Environmental standards should be specified so as to allow power producers the flexibility needed to achieve the environmental objectives in the most cost effective manner possible. The standards should allow power producers to select from the full range of production technologies, control technologies, fuel choices and operating conditions that achieve the environmental standards.

7.3 Good Practices

- Environmental standards should be embodied in transparent legislative, policy and regulatory frameworks.

IN addition to assisting power producers in complying with the environmental standards, there are a number of ways in which this good practice can facilitate investment:

- first, it can aid developers in designing facilities to meet the standards;
- second, it can help producers to understand how environmental standards may evolve over time, thereby allowing them to plan least cost approaches to meeting standards that might apply in the future; and
- third, transparent environmental standards can aid developers in conducting environmental impact assessments, as meeting standards is generally a condition for gaining project approvals.

Case Study: Transparent Environmental Framework in Chile

In 1993, the Chilean Environmental Framework Law (#19.300) was promulgated. The Environmental Framework Law (EFL) sets an integrated approach to manage environmental concerns under a statutory framework. The EFL also identifies the Comisión Nacional del Medio Ambiente (CONAMA) as the agency which manages and coordinates environmental efforts among the different Ministries of the Chilean government.

A series of environmental standards and instruments are defined under the EFL. Some standards cover specific regions of Chile, and others cover specific environmental and natural resources. These environmental standards play a central role in the strategy to remediate existing environmental issues, and avoid future environmental damages.

The EFL identifies procedures which must be followed for the periodical review of environmental and emission standards. This procedure is defined in a complementary law (DS #93), and forms the basis for transparency in Chilean environmental regulation. The complementary law:

- *defines procedures for developing new environmental regulations (primary standards to protect human health and secondary standards to protect ecosystems and natural resources);*
- *requires that existing environmental regulations be periodically reviewed;*
- *requires that CONAMA organize public institutions to propose and discuss standards;*
- *identifies data required to develop a standard;*
- *requires that an economic impact study be undertaken for each standard;*
- *defines a schedule (approximately 9 months in length) for the standard development;*
- *specifies opportunities for public consultation in the development of standards;*
- *describes the minimum information which must be contained in each standard; and*
- *identifies Ministerial responsibilities for promulgating regulations.*

The EFL and complementary law form the basis for transparent environmental regulation in Chile. Clear guidelines are in place regarding when new standards are required, how they will be developed, and opportunities for participation. Businesses know which standards they are subject to and the implications of exceeding standards.

Business must complete Plans for Control of Pollution (PCP) when environmental standards are exceeded. The PCPs identify the compliance activities that emitters must undetake to ensure that environmental standards will be met, as well as mandatory schedules for implementing activities.

- Whenever possible, environmental standards should specify environmental performance standards, not technology standards.

Performance standards are generally preferred over technology standards by those that must comply. The work program of the Ad Hoc Business Forum, for example, stated a strong preference for "regulatory methods which may be used to strengthen environmental performance, rather than the use of specifications as to particular fuels or technologies."

According to a recent publication of the EWG Clean Fossil Energy Experts' Group, most APEC member economies have established emission performance standards rather than technology standards for coal-fired plants.[37] However, member economies should review other environmental standards for the electricity sector to ensure they are specified as performance standards rather than technology standards.

[37] Clean Fossil Energy Experts' Group (1997), *Study on Atmospheric Emissions Regulations in APEC Economies and Their Compliance at Coal-Fired Plants*, APEC Regional Energy Cooperation Working Group.

Fuel standards exist within some member economies. While fuel standards can help to address environmental and other concerns, member economies should review such standards in light of whether they may be increasing unduly the costs of electricity production by not providing flexibility to power producers to select the most cost effective approaches to achieving environmental standards. For example, given flexibility, power producers may find it more economical to achieve environmental objectives by applying flue gas scrubbing or technological options related to coal preparation and processing.

- Environmental standards should be set high enough to reduce the risk of future increases in the stringency of environmental standards and the consequent need for expensive retrofits.

Experience in numerous economies and different industrial sectors indicates that retrofitting to meet environmental standards is significantly more expensive than the costs of complying with the same standards at a new facility. Retrofitting can require process redesign, structural changes, replacement of equipment and other costly activities that could be avoided if the facility was initially designed to meet the higher standards.

Apart from potential cost savings, low environmental standards may be interpreted by financiers as an indicator of high risk that more stringent environmental standards will be promulgated in the future. Depending on how that risk is allocated, financing may be more easily attained for a project subject to high environmental standards. In fact, some financiers already insist that projects meet world class environmental performance standards regardless of what legal standards may exist in an economy.

- If more stringent environmental standards are contemplated for the future, those higher standards should be specified now to provide power producers with maximum planning horizons.

Advanced planning to meet more stringent environmental standards in the future can offer significant cost savings. If tighter environmental standards are anticipated during the project planning phase, for example, the facility may be designed to accommodate additional pollution control systems or the facility may be sited closer to cleaner fuel supplies or away from urban centres. In some cases, it may even be cheaper to build the facility to meet the more stringent future standards as soon as the facility opens, rather than wait until the higher standards become legally enforceable. Additional environmental protection benefits can then be obtained while at the same time reducing overall costs.

Case Study: Evolving Emission Standards in Indonesia and the Republic of Korea

Both Indonesia and the Republic of Korea have environmental laws that specify how emission standards will evolve over time for particulate matter, SO_2 and NO_x from coal-fired plants.[38] *Both economies provide at least several years for power producers to adjust to the new standards. Such a lead-in time permits effective planning, both in terms of engineering and financing.*

[38] Clean Fossil Energy Experts' Group (1997), *Study on Atmospheric Emissions Regulations in APEC Economies and Their Compliance at Coal-Fired Plants*, APEC Regional Energy Cooperation Working Group.

Table 7.1: Emissions Standards for Coal-Fired Plants in Indonesia

	1988-95	***1995-2000***	***After 2000***
Particulate matter (mg/m^3)	400-600	300	150
Sulphur dioxide ($mg/m^{3)}$)	-	1500	750
Nitrogen oxides as NO_2 (mg/m^3)	1700-4600	1700	850

Table 7.2: Emissions Standards for Coal-Fired Plants in the Republic of Korea

	Until 31/12/94	***01/01/95 to 31/12/98***	***From 01/01/99***
Particulate matter (mg/m^3)			
Power generation/industrial boilers			
< 6,000 m^3/h	300	200	150
6,000 - 30,000 m^3/h	250	150	50
> 30,000 m^3/h	250	100	50
Sulphur dioxide (ppm)[a]			
Heat supply facilities			
Low sulphur areas	500	250	250
Other areas			
Domestic anthracite	1200	700	500
Imported coal	700	500	250
Power generation			
Domestic anthracite			
Pusan and Kangwon	1650	1650	270
Other	1200	1200	270
Imported coal	700	500	270
Nitrogen oxides as NO_2 (ppm)[a]	350	350	350

- Environmental standards should protect local environmental quality without compromising regional or global environmental quality.

In implementing environmental standards, member economies should ensure that achieving local environmental quality objectives does not compromise achieving regional or global environmental quality. Although local quality issues are often priorities necessitating quick action, careful planning to assess the full implications of technical and policy options can avoid regional or global environmental problems that will impose future remediation and/or mitigation costs.

Some economies' experiences with stack height requirements illustrate the benefits of the good practice. Serious problems in the immediate locale of some facilities led to the adoption of stack height requirements. While stack height requirements improved local air quality by dispersing emissions more broadly, regional air quality was affected, most prominently through increasing the areas affected by acid deposition. In such cases, costly air emissions control equipment has been deemed necessary even though large investments had already been necessary to meet stack height requirements.

8. MARKET BASED INSTRUMENTS

8.1 Background

MARKET based instruments have emerged as one group of policy mechanisms that, under certain conditions, may better facilitate achieving both environmental and investment goals. More specifically, market based instruments may be able to achieve environmental goals more cost effectively than traditional regulatory policies or in ways that do not hinder economic growth.

The key feature of market based instruments is that they rely on price signals to encourage business to make environmentally sound decisions. In short, power producers make choices, based on market prices, on how to achieve environmental objectives.

A number of market based instruments have been applied in APEC economies and elsewhere to meet environmental objectives relating to electric power production.

Emissions Trading — Emissions trading programs allow firms to buy or sell allowances which permit them to emit a specified quantity of emissions, under a cap which limits total emissions. Only the United States has implemented substantive trading programs.

Intra-Utility Trading — Intra-utility trading allows a single electric power facility to "trade" emissions reduction requirements among its own facilities, rather than meeting a specific standard at each facility. Canada has some experience with intra-utility trading programs.

Activities Implemented Jointly — Activities implemented jointly allow emissions sources to make and be credited for investments in pollution abatement at low-cost sources internationally. Currently, demonstration programs are underway.

Emission Charges — Emissions charges are levies on point sources of pollution for each unit of a polluting substance emitted. Emission charges are not common in APEC economies, though are a prominent component of air quality protection programs in Scandinavia.

Fuel Taxes — Fuel taxes are levies on fuel inputs, used to raise revenue and encourage energy efficiency or substitution of clean fuels for less environmentally sound fuels.

Tax Differentiation — Tax differentiation exempts environmentally sound technologies or fuels from taxes, or taxes them at a lower rate than more polluting technologies or fuels.

In some sense, the tariff and energy market reforms that most APEC member economies are undergoing can also be viewed as market based instruments. Both types of reforms facilitate business investment while establishing market forces that improve efficiency and, therefore, reduce environmental impacts.

More specifically, reductions in subsidies and movements towards full cost pricing can encourage more efficient energy consumption, thereby reducing energy demand growth, the need for investment, and ultimately impacts on the environment. In addition, market liberalization can encourage more efficient production, thereby achieving higher production without consuming additional resources.

8.2 Principles for Good Practice

TO ENSURE that business investment is not unduly hindered and that environmental objectives are respected, APEC member economies can apply the following principles in evaluating the potential of market based instruments.

Cost Effectiveness — Market based instruments should allow businesses the flexibility to adopt low or least cost compliance strategies, while achieving local, regional, and global environmental objectives.

Economic Growth — Market based instruments should facilitate economic growth and new investment in the electricity sectors, while maintaining or enhancing environmental quality over time.

By applying these principles, APEC economies can ensure that investment in electricity sectors is not unduly burdened by the selection and design of market based instruments.

8.3 Good Practices

- Emissions trading programs should be considered as a cost effective policy mechanism for achieving environmental objectives, particularly for SO_2 and NO_x emissions.

EMISSIONS trading is a market based instrument which has been adopted, primarily in the United States, to address air pollution.[39] Under an emissions trading program, a cap is imposed on total emissions from a region over a specific time period, usually a year. This cap can be used to ensure any level of environmental protection, if enforced.

Respecting the cap, emissions permits are allocated to individual sources. These permits specify the amount of allowable emissions (for example, two permits might allow a power plant to emit two tons of sulphur dioxide annually). At year's end, each source must hold at least as many permits as actual emissions. Surplus permits can be sold to other sources to allow them to be in compliance. Permit shortfalls must be purchased from other sources.

[39] Effluent trading programs have also been implemented in the United States, though not specifically to include electric power generating facilities.

As such, each emissions source is afforded two choices to be in compliance. First, they can reduce emissions in a conventional manner (for example, through fuel switching, production reductions, or installing pollution abatement equipment). Or second, emissions permits can be purchased from other sources. Purchasing permits effectively allows one source to pay others to make emissions reductions, which can lower compliance costs and make investment in the electricity sector more attractive.

Accurate monitoring of emissions and enforcement of emission permit requirements is needed for such a system to be effective. In economies where a strong regulatory infrastructure is still in development, consideration must be given to the enforceability of an emissions trading program.

Case Study: Acid Rain Program Under the U.S. Clean Air Act

The Acid Rain Program was established under Title IV of the U.S. Clean Air Act *(CAA). Its goal is to achieve significant environmental and public health benefits through reductions in emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) from electric power generating facilities. To achieve this goal by 2010, emissions of SO_2 will be reduced to 10 million tons below their 1980 levels.*[40]

The Acid Rain Program is being implemented in two phases. Phase I *began in 1995, and imposed annual emissions limits on 263 of the most-polluting (mostly coal-fired) sources, plus an additional 182 sources.*[41] Phase II *will begin in the year 2000, and will tighten emissions limits on the major coal-fired utilities and also set restrictions on other less polluting utilities.*

Under the Acid Rain Program, affected utilities are allocated emissions allowances. These allowances are distributed based on historic emissions, and form the basis for trading. Utilities may sell, on the open market, excess allowances to other companies requiring allowances.

In addition, allowances can sometimes be obtained by:

- *purchasing fixed-price reserve allowances from the EPA;*
- *purchasing allowances through EPA auctions;*
- *installing some pollution abatement equipment;*
- *early compliance with Phase II program requirements; or*
- *use of energy conservation and renewable energy.*

Therefore, individual utilities decide how best to respond to emissions limitations imposed under the Acid Rain program. Pollution abatement activities can be implemented internally, or allowances can be purchased from other sources. Since emissions standards are not imposed on a source-by-source basis, individual utilities have flexibility in deciding how to make emissions reductions most cost-effectively.

[40] In addition, the Acid Rain Program is designed to reduce national NO_x emissions by 2 million tons by the year 2000.

[41] In 1985, these utilities accounted for 57% of SO_2 emissions from U.S. utilities.

By all accounts, the SO_2 allowance trading program has achieved a high degree of success. Of the 445 affected Phase I units, all met or exceeded compliance obligations in 1995 (i.e., all held, at reconciliation, sufficient allowances to cover actual emissions). In total, 8,744,081 allowances were held in 1995 (allowing emissions of 8.7 million tons of SO_2). Actual 1995 emissions by these affected facilities, however, were only 5.3 million tons. As such, 39% of allowances were not exercised. These 5.3 million tons represent a 48% decrease in emissions from 1980 levels.

The flexibility afforded by trading under the Acid Rain Program has allowed emissions reductions to be achieved at significant cost savings to business. The U.S. Government Accounting Office estimated that total savings to utilities of U.S.$2-3 billion will result from adopting the trading program rather than uniform emissions standards.[42]

Case Study: California's Regional Clean Air Incentives Market (RECLAIM) Program

The Regional Clean Air Incentives Market (RECLAIM) program was developed to meet California USA's South Coast Air Quality Management District's need for air quality improvements. All major stationary emissions sources, including electric utilities, in the South Coast Air Basin with SO_x or NO_x emissions greater than 4 tons per year face a declining emissions cap. RECLAIM will reduce total emissions from sources under the program to the same extent as existing regulatory programs, but will reduce the costs of compliance.

Each facility falling under RECLAIM is given a single emissions allowance permit covering emissions of SO_x and NO_x from all sources on that facility. Year one (1994) allowances were based on historic SO_x and NO_x emissions. After year one, emissions allowance for SO_x decline by 6.8% annually, and NO_x by 8.3% annually, through 2003. This effectively caps the total allowable emissions under the RECLAIM program.

RECLAIM includes provisions for emission reduction credits (ERCs) and offsets. ERCs can be earned by making internal emissions reductions beyond those called for under the declining caps. Offsets can be earned by financing emissions reductions from other sources. Then, emissions reduction credits and credits for offsets can be traded on the open market. It is through this mechanism that a cost-effective pollution abatement solution is reached. Affected business can either reduce emissions internally, or finance emission reductions from other sources.

RECLAIM is expected to result in significant cost savings to business. Costs of SO_x and NO_x reductions under RECLAIM are estimated to be $80.8 million annually between 1994 and 1999.

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[42] U.S. General Accounting Office (1994), *Air Pollution: Allowance Trading Offers and Opportunity to Reduce Emissions at Less Cost*, GAO/RCED-95-30. Also see Burtraw (1996).

Under emissions standards, annual costs over the same period were expected to be $138.7 million.[43] *This represents an average savings of 42% to affected business, resulting from RECLAIM's trading provisions.*

RECLAIM is also expected to have considerably fewer adverse employment impacts. Under emissions standards, the costs of compliance were estimated to result in losses of 2,013 jobs between 1994 and 1999. RECLAIM is predicted to result in only 866 jobs foregone over the same period, saving 1,147 jobs.

- Intra-utility trading should be considered for achieving environmental objectives, particularly relating to air emissions.

Intra-utility trading allows a single electric power facility flexibility in meeting air quality objectives. Rather than imposing emissions standards at each source of emissions within a facility, a single standard is applied over all sources. Under this arrangement, a power facility can make emissions reductions at the most cost effective source on-site. Emissions reduction requirements are essentially traded among sources at the facility.

A major benefit of intra-utility trading is that it can be implemented on a relatively small scale, involving only a government regulator and one electric power facility. And despite the fact that only one facility is involved, significant cost savings can result.

Case Study: Countdown Acid Rain Program in Ontario, Canada

In Canada's province of Ontario, the Countdown Acid Rain Program limited total emissions of sulphur dioxide to 885,000 tonnes in 1986. To help meet this provincial emissions limit, a cap was imposed on SO_2 emitted from six of Ontario Hydro's thermal generating stations with 28 distinct emission sources. In addition, an emissions cap was imposed on nitric oxide from these stations.

Ontario Hydro's cap was set at 370,000 tonnes of SO_2 in 1986, declining further in 1990, and 1994 as shown in Table 8.1.

Table 8.1: Ontario Hydro's SO_2 and NO Emissions Cap

	1986	***1990***	***1994***
SO_2 Emissions (Tonnes)	370,000	240,000	175,000
SO_2 + NO Emissions (Tonnes)	430,000	280,000	215,000

Most importantly, one emissions cap was set for all 28 sources of emissions rather than for each facility or stack individually. This allowed Ontario Hydro to "trade" emissions reductions from costly sources to other cost-effective sources. The costs of imposing the emissions caps across the six stations and 28 emission sources were estimated to be 17 to 31% lower than imposing uniform emissions standards for all 28 sources.

[43] South Coast Air Quality Management District (1993), *Regional Clean Air Incentives Market (RECLAIM) - Executive Summary*, pg. Ex-19.

- Member economies should consider participating in activities implemented jointly (AIJ).

At the first Conference of the Parties to the Framework Convention on Climate Change (FCCC), an international pilot program on activities implemented jointly (AIJ), or joint implementation (JI), was initiated.[44] The AIJ program promotes international co-operation among economies, by encouraging greenhouse gas (GHG) reductions in a cost-effective and flexible manner. The pilot experience, lasting through 1999, will be used to develop guidelines and criteria for implementing and reporting on jointly implemented projects in the future.

The AIJ program promotes co-operation between economies in a similar manner to emissions trading. Rather than making emissions reductions at their own facilities, companies (donors) finance reductions at other sources (hosts) with lower costs of pollution control. Alternatively, donors may finance sequestration activities in host economies. As a result, activities implemented jointly encourage environmental protection, and lower the costs to business of undertaking these environmental protection activities.

Activities implemented jointly can have a number of benefits for host and donor economies, including:[45]

- fewer local air pollution concerns;
- reduced emissions of greenhouse gases;
- investment in green technologies and projects;
- accelerated transfer of green technologies;
- potential credit for greenhouse gas emission reductions; and
- reduced risk of investment in foreign economies.

Many APEC member economies have participated in demonstrations of AIJs. A number of examples are listed below.

Case Study: Examples of Activities Implemented Jointly

People's Republic of China-Japan Small Scale Boiler Project*: The Government of Japan and Kitakyushu City are implementing a joint project with Dalian City in the People's Republic of China. The joint effort will see the introduction of energy efficiency measures at new and existing small scale coal boilers, avoiding subsequent emissions of local air pollutants and greenhouse gases.*

People's Republic of China-United States Solar Photovoltaic Electricity Project*: Solar Electric Light Fund Inc. is assisting the Gansu Photovoltaic Company Limited to expand production of photovoltaic (PV) generation equipment in China. This initiative is expected to result in 460 tonnes of carbon dioxide emissions reductions from the operation of approximately 1000 rural farm PV systems in western China.*[46]

[44] Overviews of joint implementation can be found in Kuik, O., P. Peters, and N. Schrijver (1996), *Joint Implementation to Curb Climate Change: Legal and Economic Aspects*, Kluwer Academic Publishers; and Jepma, C. (1996), *The Feasibility of Joint Implementation*, Kluwer Academic Press.

[45] Government of the United States (1996), *Activities Implemented Jointly: First Report to the Secretariat of the United Nations Framework Convention on Climate Change*, pp. 4-5.

[46] Information on this activity implemented jointly can be found at [http://www.teleport.com/~taa/selfchin.htm].

Indonesia-Japan Renewable Rural Electrification Project*: Tokyo Electric Power Company and Kansai Electric Power Company are financing a rural electrification project in Indonesia. This electricity sector project is based on renewable energy sources, including mini-scale hydro. The project is designed to produce power, in rural Indonesia, with fewer emissions of greenhouse gases than might occur under alternative generating options.*

Indonesia-Japan Solar Rural Electrification Project*: Japanese non-government organization (NGO) Solar-Net is promoting a project with NGOs in Indonesia to introduce renewable energy in rural areas. The joint project will generate electricity from photovoltaic panels.*

Thailand-Japan Coal-Fired Conservation Technologies Project*: Kansai Electric Power Company, Chubu Electric Power Company, and Electric Power Development Company of Japan have set up a pilot AIJ project in Thailand. Modern energy conservation technologies will be introduced at a 310 MW power plant in Thailand, reducing emissions beyond those required under current law.*

9. MONITORING AND ENFORCEMENT

9.1 Background

COMPLIANCE monitoring and enforcement provisions are key elements of an effective environmental protection program in APEC member economies. Monitoring provisions are the "eyes" of an environmental program, gathering information on whether electricity generation facilities are complying with standards. Enforcement provisions are the "muscle" of a program, ensuring that electricity generation facilities get, and stay, in compliance with standards. Without monitoring and enforcement, environmental protection programs would be blind and powerless; thus, monitoring and enforcement provisions must be part of a credible environmental protection program.

Monitoring and enforcement programs can also promote power production investments in APEC economies if the programs are designed to reduce and clarify the risk of investment. Decisions by the private sector on whether and where to invest are based on an assessment of the overall risk of a project balanced against the anticipated return on invested capital that the project will bring. Policies that reduce risk and uncertainty encourage investment.

Well designed environmental monitoring policies reduce risk by providing important information on the operation and maintenance practices of a power plant to both regulators and operators. Investors and power plant operators understand that failure to meet appropriate environmental performance standards can jeopardize their success by potentially resulting in shutdowns or curtailment of power generation, imposition of fines, or liability for injuries and environmental damage. The feedback provided by monitoring can be a powerful tool in preventing and correcting these possible problems, before they escalate into financial disasters.

Clear, credible, and consistent enforcement policies reduce risk by leveling the playing field, ensuring that all competitors are operating under the same conditions and cannot gain an unfair advantage by not complying with standards.

Also, a credible enforcement program clearly defines the risk investors face for non-compliance, thus reducing uncertainty and facilitating better investment decision making.

Power producers accept the need for monitoring and enforcement, but with reservations. Monitoring and enforcement requirements can seem intrusive, burdensome, and adversarial in some circumstances, but can serve a valuable information generation and risk reduction purpose for investors.

The principles and good practices described in this section can assist in developing environmental monitoring and enforcement programs that reduce investment risk while serving to protect the environment.

9.1.1 Monitoring

The primary purpose of monitoring is to detect non-compliance with environmental standards, through the collection and reporting of information on an electricity generation facility. Monitoring can also be used in some circumstances to assess environmental quality (for ambient monitoring), set number of emission allowances needed, and determine the amount of pollution charges to be assessed.

Monitoring programs for power plants can be simple, using low-tech tools (such as observing the colour of smoke being emitted from a facility) or can be complex, using sophisticated computer equipment to continuously monitor and report emissions electronically. When choosing monitoring technologies, APEC members should take into account possible barriers to implementation such as technical expertise to operate, maintain, and repair equipment, and import difficulties, including import duties.

When designing a monitoring system for electricity generation facilities, elements that need to be considered include:

- what data to collect;
- who collects the data;
- how to collect the data;
- when to collect the data (frequency and time of day/season);
- how to report the data;
- how often to report the data,;
- to whom to report the data; and
- who will review the data.

It is important to consider in advance exactly what specific data results will mean: what data levels indicate compliance and what levels indicate non-compliance. For example, does one reported measurement exceeding a standard trigger non-compliance? Does it require multiple measurements exceeding the standard within a time period to trigger non-compliance? How accurate do the measurements need to be? What are the public health implications of the data?

The answers to these questions will depend on the specific situation and goals of the APEC member economies, but should be clearly stated in any monitoring requirements to provide investors with as much information as possible on which to base investment risk decisions.

Information collection from monitoring can seem burdensome to power producers, but can provide valuable operational feedback to protect investment. Plant operators and investors can use the information to monitor equipment performance. This may allow plant operators to detect small problems early and correct them before they develop into larger, more expensive problems such as non-compliance. For example, abnormal emission readings could indicate the malfunction of a generator or pollution control equipment before its catastrophic failure results in potential loss of revenue, increased liability for damages and injuries, and penalties for non-compliance.

Also, very often, if equipment is not operating properly with respect to one function (emissions) it may also not be operating at peak efficiency in other areas.

The most common mechanisms for monitoring programs are self-monitoring and inspections, with citizen complaints and ambient monitoring mechanisms used less frequently. Self-monitoring places the majority of the burden for data collection and reporting on the facilities. Generally, data is collected over time and according to accuracy and reliability standards.

Inspection programs rely on the government, and in some cases a third party, to collect compliance data. An inspection usually presents a "snapshot" of an electricity generation facility, information about compliance at a specific point in time, although inspections also can include review of past performance, such as monitoring logs. Inspection programs can be very effective mechanisms for detecting non-compliance, but are resource intensive requiring trained personnel to conduct the inspections. Also, inspections can raise issues such as access to facilities and amount of prior notice to provide to facilities.

Very often, monitoring programs use a combination of approaches, using self-monitored and reported data to screen facilities for further inspection. The choice of particular approaches, or combination of approaches, depends on the situation and objectives for individual APEC member economies.

9.1.2 Enforcement

Choosing the method and processes for enforcing environmental regulations is a complicated exercise. Changing non-compliant behaviours requires an understanding of the motivations underlying the behaviours including economic self-interest, fear of liability, societal norms, moral values, and sense of professional conduct.[47]

Whatever the motivation, two basic approaches to compliance enforcement can be used by APEC member economies. The "stick" approach punishes offenders for non-compliance in order to deter future non-compliance from this offender and other offenders. Three factors are important to this approach:

- a credible likelihood of detection of a violation;
- swift and sure enforcement response; and
- appropriately severe sanctions.[48]

In addition, to be effective, the threat of detection, timely response, and sanction must be perceived as "real" in order for the public and regulated parties to take the threat seriously.

[47] Wasserman, Cheryl E. (1992), "Federal Enforcement: Theory and Practice", in *Innovation in Environmental Policy: Economic and Legal Aspects of Recent Developments in Environmental Enforcement and Liability*, T. H. Tietenberg, editor, Edward Elger Publishing Limited, England.

[48] Ibid., Page 23.

When designing an enforcement system that focuses on punishment, APEC members should consider the following elements:

- level and form of response (fines, sanctions, loss of permits, criminal penalties, limits to future operations, additional monitoring requirements, civil damage lawsuit assessments);
- timing of response; and
- fairness of process and level of response.

APEC economies with mature environmental enforcement programs have primarily focused on deterring non-compliance by punishing offenders. Recently, however, some economies have begun to recognize the benefits of a co-operative approach that is more favourable to investments.

An effective enforcement system can use methods other than punishment to bring those not in compliance into compliance. The "carrot" can be used as well as the "stick." These approaches are sometimes called "compliance promotion." Compliance promotion offers to APEC member economies a broad range of tools to encourage compliance. For example, technical assistance and training programs can be very effective if electricity generation facilities want to comply, but don't know how. Encouraging voluntary efforts and informing the community of requirements are also elements of compliance promotion. Other programs could reward good environmental behaviour by reducing monitoring, record keeping, and reporting requirements or by reducing the number of inspections.

An important facet of encouraging compliance with environmental standards by power producers is ensuring that standards do not impose unreasonable or unenforceable requirements. Operators of power plants are more willing to comply (and investors more willing to invest in projects) if the environmental standards and enforcement activities are perceived as fair, consistent, and reasonable. To achieve fairness and reasonableness, regulators can work with power producers during the regulatory development process to ensure that requirements are not overly burdensome without commensurate environmental benefits.

The precise blend of the "carrot" and "stick" approaches is dependent on the specific goals of the APEC member economies, but a credible, fair, and strong deterrence element should be part of an environmental enforcement program. To be most effective in ensuring compliance and protecting investment, the enforcement program adopted by the APEC member should include clear statements of consequences for non-compliance and, if possible, the benefits of compliance. The consequences should be substantial enough to counterbalance any economic benefit gained from non-compliance. Consequences are most commonly monetary, fines or penalties assessed to the violating facility, but can include other mechanisms, including revocation of operating licenses or, in extreme cases, criminal and civil prosecution and punishment. Also, the likelihood of the consequences being imposed should be high enough to be credible.

An enforcement program that uses a tiered response to non-compliance can promote investment. The tiered approach may begin with an informal letter and offer of technical assistance for a first, inadvertent, minor violation. Subsequent violations would trigger increasingly formal and stringent responses, with recurring, deliberate, major violations drawing large penalties and formal legal or administrative actions. Legal actions can be civil (involving fines only) or criminal (fines and jail time) for multiple or particularly egregious offences.

A tiered approach may be more efficient from the APEC member's perspective because it allows the government to focus its limited enforcement resources on major violators. Aiming limited resources at key violators helps leverage enforcement dollars through visible enforcement actions that increase the credibility of sanctions and can focus on non-compliance causing the greatest environmental harm. This approach may be more efficient from the investor's point of view because it allows power producers to correct minor non-compliance, while still deterring major violations.

Current regulatory reform initiatives are experimenting with these and other approaches that promote investment and protect the environment. Some APEC economies, such as the United States, are experimenting with approaches that promote compliance by rewarding firms that demonstrate good environmental management practices. Canada is using a multi-faceted approach that uses a variety of tools including:

- education and information;
- promotion of technology development and evaluation;
- technology transfer;
- consultation on regulation development and review;
- environmental codes of practice and guidelines; and
- promotion of environmental audits.[49]

These programs, and others like them in APEC economies, promote an "investor-friendly" atmosphere by providing tangible, "real world" rewards to firms that practice good environmental management and voluntarily comply with environmental requirements.

9.2 Principles for Good Practice

AS THE previous discussion demonstrates, designing environmental compliance monitoring and enforcement programs that both protect the environment and promote investment is a complex task that must bring together many program elements to reconcile diverse competing interests. Some common principles, however, seem to underlie programs that both protect the environment and promote investment.

[49] www.ec.gc.ca/enforce/policy/english/meas.htm

Transparency — Operators and enforcers should be able to easily verify when in compliance and when not in compliance. This includes knowing the rules and having good enough monitoring to know if a facility is in compliance with the rules.

Predictability — Response to non-compliance, and any rewards for compliance, should be predictable.

Consistency — Environmental performance monitoring and enforcement should be applied consistently and equitably to all power producers.

Effectiveness — Environmental performance monitoring should be able to accurately detect deviations from standards, and effective enforcement mechanisms should be able to deter deviations from standards.

9.3 Good Practices

- Clear statements of monitoring requirements and enforcement mechanisms should clarify who is responsible for monitoring, what the standards are, what the consequences are for failing to meet the standards, and what the possible rewards are for good behavior.

CLEAR statements of monitoring and enforcement requirements and consequences for electricity generation facilities alleviate ambiguity and confusion for all parties concerned. Investors will be able to more reliably predict the risk and consequences of their investments, as well as more accurately estimate the operating, monitoring, and compliance costs of facilities.

Also, both investors and operators can more effectively plan for the capital investments for monitoring and compare these with likely fines. Power plant operators can comply more effectively with requirements when they understand the requirements and the penalties for non-compliance. Regulators can more effectively enforce, and the general public can more easily comprehend and respond to, clearly defined requirements.

Besides clarifying investment risk, clear statements of monitoring and enforcement requirements and consequences for electricity generation facilities can reduce transaction costs. Ambiguous statements with ill-defined requirements increase the need for legal and technical experts to interpret the requirements, at additional costs to investors.

In addition, clear statements are often perceived as being more fair, since clarity can eliminate the potential of some operators pushing the envelope to take advantage of ambiguities.

Case Study: Canada Clearly Describes Responses to Violations

Under the Canadian Environmental Protection Act, Canada has developed a system of responses to violations that is clearly explained and available to the public through a variety of means, including the Internet.[50] *The policy begins by explaining the factors to apply when deciding what enforcement action to take including the:*

- *nature of the violation;*
- *effectiveness in achieving the desired result with the violator; and*
- *consistency in enforcement.*

The policy then clearly identifies the possible responses, including warnings, directions by inspectors, ticketing, orders by the Minister, injunctions, prosecution, penalties and court orders upon conviction, and civil suit by the Crown to recover costs. The policy goes on to explain the components of each of these responses in detail, as well as the appropriate situations and conditions in which to use the response. For example, the policy explains that inspectors may use warnings when they believe that a violation is continuing or has occurred and the degree of harm or potential harm to the environment, human life or health appears to be minimal. When deciding to use a warning or a more severe action, inspectors may also consider the company's compliance history and whether the company has made reasonable efforts to remedy or mitigate the consequences of the offence.

Clear statements of policies and responses such as these reduce ambiguity and provide investors and operators with realistic information about the risks of their investment.

- Monitoring should take place, and accurately reflect actual performance of the facility.

Compliance monitoring can increase operating costs of a facility but is a necessary element of an environmental program. The goal is to collect the correct amount and type of information to assess compliance, in the most cost-effective manner. The frequency, level of detailed data, and the items being monitored should correspond to some environmental goal and not impose monitoring for its own sake.

If used properly, data obtained from monitoring can be a powerful tool for facility operators in evaluating the performance of their facility and taking preventive and corrective actions. Monitoring data can also be used to identify firms that have environmentally sound practices and may be prime candidates for incentives and reward programs.

[50] www.ec.gc.ca/enforce/policy/english/resp.htm

Case Study: Continuous Emissions Monitoring under the U.S. Acid Rain Program

The Acid Rain program contains an innovative feature with regards to monitoring utility emissions — power producers must install and operate a continuous emission monitoring (CEM) system that collects data on SO_2, NO_X, CO_2, opacity, and volumetric flow of emissions. The systems must be tested, operated, and maintained according to rigorous quality assurance standards, including many standard test methods developed by the American Society for Testing and Material (ASTM, a non-governmental standard setting body).

The data is transmitted electronically to the Environmental Protection Agency's (EPA's) Emission Tracking System (ETS) on a quarterly basis, eliminating a source of data entry errors. According to EPA, the CEM system has produced a large volume of remarkably accurate data.

The data is useful for power producers as well as EPA. The CEMs provide accurate, real time measurements of emissions so that power producers can determine almost instantaneously if they are in compliance or not. This rapid availability of emission information allows the utility greater flexibility in choosing compliance options, including purchasing allowances. For example, under the SO_2 emissions allowance trading program, exceeding the year end SO_2 emission allowance results in an explicitly stated penalty of over $2,000 for each ton exceeded. The SO_2 allowances are trading on the open market for less than $100 per ton.

The real-time, accurate data from CEM provides the utility with an early warning that a facility may exceed its emission allowance within ample time to purchase additional allowances at less than $100 per ton, rather than exceeding existing allowances and facing a $2000 penalty. The accurate data also verifies any emission reductions, allowing the power producers to get credit for pollution reduction measures, both with EPA and the public.

The CEM provisions of the Acid Rain Program have imposed additional information gathering burdens on the power producers, but the additional cost, thus far, has been outweighed by the early warning and greater flexibility benefits afforded by the actual measurement of SO_2 emissions.[51]

- Enforcement should take place and penalties for noncompliance should be set at a level which encourages compliance.

In order to be credible, there should be a reasonable likelihood that a violation will be detected and that penalties will be imposed. These penalties for violations should be set at a high enough level to deter non-compliance. The penalty must at least cover the economic gain of non-compliance. For example, if a facility lowered costs by not complying with a standard, the penalty for non-compliance should at least recover the full value of the lowered costs. Although this practice may result in larger penalties, it can protect investment. If the penalty is not set high enough, a competitor can achieve economic advantage by not complying, thereby jeopardizing the profit potential of a complying investor. Setting penalties in this manner can help maintain a level playing field, thereby protecting investors.

[51] www.epa.gov/acidrain/scorcard/es95main.html#intro

Case Study: China's fees reflect costs

"Since the late 1970s, China has implemented a system of pollution charges. In the mid 1980s, the system of pollution charges became a comprehensive system covering all provinces. The system of pollution charges has more than one hundred charge rates for four categories of pollution: sewage, noise, radioactive waste, and solid waste. The charges are imposed in accordance with established standards. The system of pollution charges is an economic means to make polluting enterprises manage, prevent, abate or eliminate the discharge of pollutants…"[52]

The system of exceedance pollution charges is based five principles:

- *the charges are set slightly higher than the operating costs of pollution reduction equipment and include the depreciation of the lump sum investment for equipment. This prevents the polluter from paying the charge rather than taking pollution reduction measures;*
- *the charges are consistently applied for equivalent quantity and quality of the discharge;*
- *the charges are levied for discharge of multiple pollutants at a single facility;*
- *the charges are higher for more harmful pollutants; and*
- *the criteria for the charges are based on science and are easily enforceable.*

The levy and use of the pollutant charges has strengthened business management to achieve savings and wise use of resources, as well as controlling pollution.[53]

- Staff responsible for monitoring, inspections and enforcement should be well trained and qualified.

A well-trained staff is an integral part of effective monitoring and enforcement programs. Particularly if new or sophisticated technologies are being introduced, training is necessary for the operators to fully understand and properly implement requirements. Training for operators (and investors) can include topics such as arguments for why compliance makes business sense, why requirement is important, how to comply, and consequences of non-compliance. This type of education promotes voluntary compliance.

Training is equally important on the inspection and enforcement side of the equation. Inspectors are the "front line" of an enforcement program and, as such, require training in a broad range of skills: legal, technical, administrative, and communication.[54] A well trained, impartial inspection staff can provide the foundation on which to build an effective enforcement program. Benefits to business investment result from reduced time costs involved in ensuring they are in compliance.

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[52] Fourth International Conference on Environmental Compliance and Enforcement (1996), *Financing Environmental Permit, Compliance, and Enforcement Programs*, Page A-28.

[53] Government of China (1992), *Pollution Charges in China*, NEPA, Pages 10-11, 18.

[54] Government of the United States (1992), "Principles of Environmental Enforcement," *Proceedings, Volume 1: International Conference on Environmental Enforcement*, Environmental Protection Agency, pp. 6-8.

Case Study: Mexico's Training Initiative:

In June to July of 1992, Mexico reorganized its environmental enforcement authorities into a new Secretariat of Social Development (SEDESOL), with an independent Attorney General's Office for Environmental Protection (PROFEPA) in charge of SEDESOL's environmental inspectorate. PROFEPA turned to the initial task of reforming and upgrading its environmental inspectorate.

Mexico used training and technical assistance as a tool to build this new enforcement capacity. From March, 1992, through July, 1993, 370 SEDESOL inspectors attended six "Multi-Media" Inspector Training courses, sponsored by the U.S. EPA. Training was also provided in a variety of other topics including environmental impact assessment, and using aerial photography to identify potential waste disposal sites.

From this base of trained personnel, Mexico was able to enhance its environmental inspection and enforcement program, providing a more stable, predictable environmental program conducive to investments.[55]

- A tiered enforcement approach that balances cooperation with coercion should be used when the situation allows.

Basically, a tiered enforcement approach uses a variety of tools and methods to enhance compliance. The approach begins with compliance promotion to encourage voluntary co-operation and compliance.

If a violation is found and enforcement response is necessary, a tiered approach involves matching the response to the severity of the violation. For minor, first time violations, the enforcement may start with an informal response that could include offers of technical assistance.

This type of system allows for the efficient correction of minor or inadvertent non-compliance, but still maintains the enforcement tools to punish severe or repetitive violations. This tiered approach can reduce costs to business in cases where fines are, justifiably, not used.

Case Study: United States Promotes Voluntary Compliance and Co-operation

The United States is implementing a number of programs that enhance traditional compliance programs with initiatives to reward firms for good environmental management practices. For example, the U.S. Environmental Protection Agency (EPA) recently established a policy to encourage voluntary self-auditing and compliance by offering incentives to firms that voluntarily discover, disclose, and correct violations. If a violation is found through a voluntary environmental audit and is promptly disclosed and expeditiously corrected, EPA will not seek gravity-based (i.e., non-economic benefit) penalties and will generally not recommend criminal prosecution.

[55] Fulton, S., and L. Sperling (1994), "North American Trading Partners: Canada, United States, and Mexico as an Enforcement Network," *Proceedings, Volume 1: Third International Conference on Environmental Enforcement*, pp. 349-350.

EPA will also reduce gravity-based penalties by 75% for violations that are voluntarily discovered, disclosed, and corrected, even if the violation was not found through an environmental audit. EPA will still seek to recover any economic benefit gained from the violation in order to prevent any competitive advantage.[56]

A similar program offers small businesses incentive to voluntarily report and correct violations. Under certain conditions (first time violation, not criminal conduct, and not causing significant threat), EPA will refrain from initiating an enforcement action seeking civil penalties, or will mitigate civil penalties, if the small business makes a good faith effort to comply with environmental requirements by receiving compliance assistance or promptly disclosing the findings of a voluntarily conducted environmental audit.[57]

Another program experiments with the use of "Supplemental Environmental Projects" (SEPs) as part of penalties for violations. SEPs are environmentally beneficial projects that may be undertaken by a violating entity as part of a settlement agreement. SEPs can be in the form of public health, pollution prevention, pollution reduction, and environmental restoration and protection projects. All else being equal, the final settlement penalty will be lower for a violator who agrees to perform an acceptable SEP compared to a violator who does not agree to perform a SEP. Thus, environmental benefits are realized at a lower cost to the violator.[58]

Finally, a pilot program, the Environmental Leadership Program (ELP), offers entities with mature environmental management systems (in place at least 2 years), and community outreach and employee involvement programs with incentives to join the ELP. The facility completes and submits an application and participates in an on-site visit by EPA and State personnel. Review of the application, opportunity for public comment, and an analysis of compliance history complete the process. Participants receive public recognition for their leadership; the benefits of streamlined administrative procedures (e.g., expedited permit modifications and reduced reporting requirements); reduced inspections by EPA and the State; self-correction periods for violations; mentoring; information sharing among ELP participants; and technology transfer conferences.[59]

Case Study: Thailand Uses Expedited Process

"In June of 1995, the Thai government set up two committees to hand down fines against firms that fail to adhere to industrial pollution control regulations. The committees are intended to speed up the process of penalizing firms when violations are deemed unintentional by avoiding drawn out legal proceedings.

[56] http://es.inel.gov/oeca/auditpol.html

[57] http://es/inel.gov/oeca/smbusi.html

[58] http://es.inel.gov/comply/oeca/policy/html#intro

[59] http://es.inel.gov/oeca/naa97.html

The committees will deal with violations to Thailand Factory Act, whose implementation is the responsibility of the Ministry of Industry. The act requires operators of industrial sites to receive a three-year renewable operating license from the Industrial Works Department and gives the department the authority to refuse a factory license on environmental grounds.

Plant managers who operate without valid licenses are normally subject to fines up to 200,000 baht (U.S.$80,000) and a two-year prison sentence."[60]

- Voluntary, self-auditing or third party certifications are incorporated, where appropriate, into monitoring and enforcement programs to make the programs cost effective.

A growing number of economies are placing greater emphasis on encouraging voluntary compliance as part of a monitoring and enforcement program. Many industries and individual facilities have recognized the value of proper environmental management and have developed their own standards and programs for protecting the environment. Internationally, the International Standardization Organization has developed a set of standards for an environmental management system known as "ISO 14001."

These voluntary standards and monitoring programs can be a valuable supplement to an enforcement program and can be used to identify candidates for incentives. For example, the Environmental Leadership Program described earlier in this chapter requires that participants have an environmental management system.

Implementing ISO 14001 may become an easily verifiable standard to demonstrate existence and effectiveness of an environmental management system.

Case Study: ISO 14001

ISO 14001 is a consistent, internationally recognized model for environmental management.[61] *The goal of ISO 14001 is to protect human health and the natural environment through the application of systematic management principles to environmental issues by business, industry, service organizations, and government agencies.*

The environmental management system includes:

- *environmental policy;*
- *planning processes;*
- *implementation and operational activities including provision of training;*
- *checking and corrective action activities such as monitoring, audits, and preventative and corrective action plans; and*
- *management review of system.*[62]

[60] Bureau of National Affairs (1995), "Government Sets Up Committees to Impose Fines on Industrial Polluters," *International Environment Reporter*, July 12, 1995, pp. 547-548.

[61] Fredericks, I., McCallum, D. (1997), *International Standards for Environmental Management Systems: ISO 14000*, Discussion Paper, www.mgmt14k.com/ems.htm.

[62] Davis, Ann (March 1996), "ISO 14000 Just a Few Months Away", *Canadian Environmental Regulation and Compliance News*, L. Earl, editor, Toronto, Ontario, pg. 994.

ISO 14001 could be applied to environmental monitoring and enforcement of electric generation facilities in APEC member economies in several ways. For example, ISO 140001 provides standardized monitoring requirements that could be adopted by member economies. In fact, some APEC member economies (including Mexico, Japan, Thailand, and Indonesia) have, or are considering, giving some procurement preferences to ISO 14001 certified companies as a low cost means of promoting effective environmental management.[63]

Adoption of ISO 14001 could be used as an enforcement tool. Recently, a chemical manufacturing firm in Alberta, Canada, was fined for exceeding emission standards set by Alberta's Environmental Protection and Enhancement Act (EPEA). An additional part of the penalty orders that the firm become certified under the ISO 14001 environmental management systems program.[64]

ISO 14001 could also be used beneficially to increase flexibility in complying with regulatory requirements. For example:

- "EPA is exploring this application of ISO 14001 in pilot voluntary projects under the Environmental Leadership Program and Project XL;
- EPA's Water office has drafted an alternative permit writer's guidance to encourage the issuance of flexible permits with reduced mandatory monitoring and reporting requirements for facilities with good performance and verified environmental management systems; and
- Some EPA Regions and a number of States, through the Environmental Council of States, have also expressed an interest in this application of ISO 14001."[65]

Adopting international, voluntary environmental monitoring and compliance requirements, such as ISO 14001, promotes investment by international investors because these requirements would be consistent across international boundaries. In addition, these voluntary programs tend to be flexible, allowing greater freedom in choosing monitoring and compliance mechanisms, as long as standards are met. Investors can more easily demonstrate compliance and may receive an extra public relations benefit from these voluntary efforts.

APEC member economies may also benefit from the use of ISO 14001 and other voluntary initiatives because less government oversight of facilities is required, while still protecting the environment.

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63 Copperthite, Charlotte H. (March 1997), "Does ISO 14001 Certification Add Value to a Multinational Company?", *26th Annual Conference on Environmental Law: New Directions in Environmental Management and Policy—Beyond Command and Control*, American Bar Association.

64 Earl, L., editor (February 1996), "Alberta Chemical Company Ordered to Get ISO 14001 Certification", *Canadian Environmental Regulation and Compliance News*, Toronto, Ontario, pg. 976.

65 Hennelly, Debra Sabitini (March 1997), "Implementing the ISO 14001 Environmental Management Systems Standard in the United States: Potential Legal Issues", *26th Annual Conference on Environmental Law: New Directions in Environmental Management and Policy—Beyond Command and Control*, American Bar Association.

10. IPP PROCESSES

10.1 Background

THE structure of the electricity market is changing in most APEC member economies. The direction of change is towards more openness, including participation by more companies, especially private sector ones. This trend has member economies looking to private sector investors, independent from the vertically integrated utilities, to provide some of the additional electricity generation capacity they need. These suppliers are often called Independent Power Producers, or IPPs.

APEC sponsored a study of best practices in IPP procurement processes.[66] This report complements the IPP practices study by focusing on how economies can achieve both their environmental goals and their investment goals. This chapter identifies good practices with respect to the environmental aspects of the IPP process.

The economies most actively turning to IPPs tend to be those with the greatest need for new capacity, or those which have moved farthest to a competitive market structure for electricity generation. In the former category are China, Indonesia, the Philippines, and Thailand. In the latter category are the United States, Australia, and New Zealand. In most cases, under a competitive market structure, the potential developer is responsible for gauging the market and determining whether or not to build. Although many analysts believe that most economies will move to such a market structure in the future, very few have done so to date.

Most economies will continue for some time to have an electricity supply industry consisting mainly of large vertically integrated companies. In those economies that have a single entity supplying electricity, usually either a government department or an integrated state-owned electrical utility, the integrated utility is strongly involved in acquiring new power from private developers.

[66] Norton Rose and Worley International (1997), *Developing Transparent, Efficient and Effective Procurement Processes for Power Infrastructure in APEC Member Economies*.

The entity or a government agency decides that new capacity is needed and a request for proposals (RFP) for the needed power is issued. Once they are received, the competing bids are evaluated and those chosen are invited to negotiate a contract to sell the power (a power purchase agreement or PPA) and build the plant. Alternatively, developers who discover an opportunity may make an unsolicited proposal to the electricity supply entity.

IPPs can help host economies meet both environmental and infrastructure investment goals. They help meet environmental goals by using current, efficient technologies for electricity production. They also operate the plants efficiently, keeping conversion efficiency high. The more efficient the production, the lower the emissions associated with a given amount of electricity. IPP developers indicate that they expect their facilities to meet World Bank guidelines, even if the World Bank did not finance the project and even if the Bank's guidelines were more stringent than the economy's own. Meeting the current World Bank guidelines would, they said, reduce the chances of expensive retrofits at a later date.

They also expect that their lenders will insist that they meet the World Bank guidelines. Lenders fear the adverse outcomes from building a facility that does not meet environmental standards. The lender could receive negative publicity if the facility causes identifiable pollution or health hazards. The cost of retrofitting mitigation technology could make the project uneconomic, which could lead to default. Neither the lender nor the developer wants to risk such consequences. The prudent course is to build to a recognizable standard, even if it is more stringent than the current rules the host economy requires.

IPPs also help meet electricity investment goals by relieving the government or its agencies of the requirement to raise capital for new electricity generation. Faced in the late 1980s with daily brownouts and other indications of severe electricity shortages, the Philippines relaxed monopoly regulations and invited IPPs to enter. The response was rapid and large, and the economy now does not have a power shortage. Thailand had a very strong response to its initial RFP, issued in 1994. It was offered almost 40,000 MW of total capacity, significantly more than the 3800 MW it had sought. Its target is being revised to 5800 MW of new capacity by 2003, which will constitute over 15% of the total system capacity.

EGAT's (the Thai utility) most recent power development plan allocates a large fraction of the planned new capacity to the private sector. That allocation reduces EGAT's capital expenditure needs from $5 billion per year to $2 billion per year in the period from 1997 to 2001.[67]

The host economy may have other energy-related goals in addition to providing for new electricity supplies. The relation between the IPP and the host economy's other goals is complex, because these goals may relate, either directly or indirectly, to the environmental and investment goals. Two examples of these are energy security and location of generation facilities.

[67] International Energy Agency (1997), *Asia Electricity Study.*

Energy security policies are not adopted to achieve environmental goals; they reflect the government's desire not to rely too heavily on imported fuels and to diversify the fuel source. However, the choice of fuel does have clear environmental implications, and governments may have fuel choice preferences for environmental reasons. They may prefer fuels that produce fewer emissions. Where the fuel preference is to meet environmental goals, IPP producers would rather have the preference stated as a performance criterion, leaving them to choose the most efficient way of meeting the goal, by changing fuels or by changing technology. This difference between goals behind similar policies can be indicated by statements in the RFP, so that developers can respond appropriately to meet the government's goals.

Similarly, the host government may prefer certain specific locations or regions for the IPP. The preference may reflect the need to connect to the existing or planned transmission system. The IPP may be required to locate only where it can readily access the transmission system with the least cost. The government may also prefer locations for environmental reasons such as keeping new facilities and their emissions away from areas or cities whose air quality is heavily impacted by existing facilities.

IPPs can accommodate such government preferences. However, the process must be clear so the developers can respond properly to the government's preferences. The RFP process should state such preferences and indicate how the responses will be evaluated.

Many IPP developers actively search for appropriate investment opportunities in all areas of the world. To meet electricity investment goals by getting supply from IPPs, economies need to make the prospect attractive.

Good practice in the environmental aspects of the IPP process will help to attract capital, IPP investors report. IPP investors have indicated that environmental standards and permit requirements are considered a normal part of the approval process, and are not seen as especially burdensome in some APEC member economies. They also indicated that in some economies, simply identifying the approvals required can be time consuming and costly.

These considerations of the interaction between the IPPs and the government's goals can be seen in the IPP process. In the RFP stage, environmental considerations include the amount of information on environmental processes that is available to bidders and the amount of environmental analysis needed for the RFP response.

In the proposal evaluation stage, the issue is whether and how environmental concerns are incorporated in the evaluations. In negotiating a PPA, the environmental concerns are the PPA's provisions relating to environmental performance of the IPP and its allocation of environmentally related risks, including risk sharing between the buyer and the IPP.

This section relates to the environmental aspects of an IPP power procurement process. The relevant stages are the RFP process, the evaluation of the competing proposals (or the unsolicited proposal), and the negotiation and signing of the PPA. This section considers how environmental considerations are addressed in each of these stages, what principles apply for identifying good practices, identifies good practices, and give some examples of good practice. Many of the principles and practices are also applicable to unsolicited proposals; the applicability will be clear from the analysis. The IPP processes study considers these stages more generally. Some of the good practices identified there also apply to the environmental considerations in the process.

The process of environmental approvals, for the IPPs and any other project, is covered in section six.

10.2 Principles for Good Practice

Transparency — Transparency requires that evaluation and approvals processes have clearly stated rules and criteria. For the environmental aspects these should be stated so that external observers, including the IPP proponents, can understand the process to be used in evaluation and, after the fact, can understand how the evaluation decisions were made.

Predictability — IPP proponents should be able to expect that, if they comply with the relevant permitting requirements, they will be able to obtain construction and operation permits.

Consistency — In those parts of the evaluation process which are affected by environmental considerations, including those affected by the cost of meeting environmental standards, all contenders should be subject to the same environmental standards.

Open information — The prospective buyer should make available to the prospective seller the information needed to assess properly the cost, complexity and timing of the environmental aspects of the design and approvals process, if its project is selected. Such information would typically be contained in the RFP.

Proper allocation of risk — The principle is that risks should be allocated to the party best able to control the risk. Environmental risks include the risk of failing to meet environmental standards in the permitting stage, failing to meet environmental standards in the installed facility, failing to meet environmental performance standards during operation, and unexpected changes in environmental standards.

10.3 Good Practices

- All environmental approvals processes should be clearly set out in the RFP.

THIS includes stating whether an Environmental Impact Assessment is required and what its contents must be. It also includes reference to applicable laws, regulations and practices with which the IPP must comply in order to get construction and operation permits. The RFP contains all the information the proponent needs to evaluate the costs and risks of meeting environmental objectives, or it tells the proponent where such information can be found. The process will work better if the proponent has information on the standards to be met and the process which will determine if they are met.

Case Study: Standards in Thailand's RFP

In the RFP for electricity in Thailand, an Appendix clearly sets out the local environmental standards that the IPP must meet. These include effluent standards for both air and water. Standards for air emissions include 14 substances. The standards also include ambient air quality standards and specify a method of measurement. These specifications allow the IPP developer to design a proposal that will meet the standards.

Price is an important valuation factor, but there are also non-price factors, which often refer to environmental criteria. In good practice, such non-mandatory environment-related preferences are explicit and embodied within objective evaluation criteria with explicit weighting factors. Preferences for location based on environmental criteria are included in the explicitly stated and weighted factors. Preferences for fuels are also explicitly stated with the weight to be given them in evaluation.

Case Study: Evaluation Criteria and Weighting in Thailand's RFP

In its RFP, EGAT (Thailand) specified that fuel and fuel diversity would have a 4% weighting in the evaluation. The RFP stated that EGAT prefers to have fuel diversity and also gives priority to fuels that are environmentally clean. The RFP also ranks fuels in the order of preference, starting with non-conventional energy and ending with orimulsion fuels. EGAT also specified locational preferences and assigned a 6% weight to them. The evaluation criterion was proximity to EGAT transmission lines or to major load centres.

- The risk related to environmental standards and environmental performance should be allocated to the party which can best control it.

The risk of change in environmental standards after the signing of the PPA should be allocated to the government, which should allow the price to rise if environmental regulations are tightened. The risk of failing to meet environmental emissions should be allocated to the developer. A similar issue occurs when utilities and IPPs agree to a tariff prior to final approval of an EIA. If EIA approval is conditional on additional mitigation efforts not included within the agreed upon tariff, then further tariff negotiations should be allowed.

Case Study: Allocation of Environmental Risks in RFPs

Several economies have issued RFPs that explicitly address the risk of changing environmental standards. Since environmental standards are under control of the government, the risk associated with changes in them should be borne by the government. In several economies, the government has explicitly stated that it will allow changes in the tariff to accommodate the costs of such changes.

In Thailand, for example, the RFP states the allocation of risk for changes in environmental standards. In Indonesia, the risk of changes in environmental standards is included with such other government-oriented risks as changes in tax regimes. The Republic of Korea, Mexico, and Chinese Taipei all make the allocation of risk explicit in the standard PPA.

These provisions allow changes in the prices paid to the IPP in the event that the environmental standards are made more stringent after the price has been agreed upon. Risks that are under control of the operator, such as risk of high operating costs and the costs associated with failure to meet environmental performance standards, are assigned to the operator.

- Any fuel quality restrictions specified in the RFP should allow IPPs to meet environmental standards by upgrading lower quality fuels or by fuel switching.

Allowing the IPP investor to choose fuels, rather than focusing on the choice of either a more expensive fuel or a more expensive cleanup process to meet the same environmental goals, can make the process more cost-effective. The investor is then able to balance the costs of several different ways of meeting environmental standards and can choose the one that is most effective from the investor's standpoint.

- If the avoided cost of the SOE is used as a price cap for IPPs, the avoided cost used should be for facilities which meet the same environmental standards as those required of the IPPs.

In some cases, the avoided cost of the SOE is used as a benchmark against which the IPP proponents will be measured. Price is one of the measures; if the IPP cannot produce the electricity more cheaply than the SOE, then the preferred option may be that the SOE builds the generation capacity. If the IPP is to be held to that cost standard, it should be on a comparable basis; that is, the IPP should not be forced to meet a more stringent environmental standard than the SOE, and then be penalized because it has higher costs as a result.

A similar practice is that all IPPs are held to the same set of environmental standards as set out in the RFP. This ensures that no IPP wins a contract by proposing lower environmental standards. IPP proponents, therefore, do not have incentives to propose facilities with lower environmental performance.

11. RECOMMENDED NEXT STEPS

The rapid growth in electricity needs within the APEC region presents a significant challenge to meeting environmental goals *and* electricity infrastructure investment goals. This study identifies numerous policy practices available to help ensure investments result in environmentally sound electricity infrastructure.

Achieving both environmental and investment objectives within the electricity sector will require ongoing efforts from business and government to identify and implement good practices. APEC member economies sharing their experiences with various policy and administrative practices should play an important role in those efforts.

This study provides a beginning for the necessary efforts, not the end. It suggests principles for identifying good policy practices, as well as specific good practices in six areas (energy efficiency, environmental approval processes, environmental standards, market based instruments, monitoring and enforcement, and IPP processes).

The principles are ***predictability***, ***transparency***, ***consistency***, ***efficiency*** and ***cost effectiveness***. Discussions with stakeholders and an assessment of current environmental policy practices indicate that practices consistent with these principles will serve both environmental and investment objectives.

Each policy practice that meets these principles is not necessarily suitable for all APEC member economies. Instead, the good practices identified in the study are offered as a menu of options from which member economies may identify practices that are appropriate within the unique environmental, economic, institutional and technological context of each economy.

The principles and good practices were developed specifically for the electricity sector. They are, however, highly applicable to other sectors within the power industry. Indeed, good practices within environmental approval processes, environmental standards, and monitoring and enforcement, for example, generally apply to all energy sectors, as well as other industries.

To advance the implementation of good environmental practices, we recommend the following.

1. Endorse the Principles

To meet the dual environmental and investment objectives, the principles of ***efficiency***, ***transparency***, ***predictability***, ***consistency*** and ***cost effectiveness*** should guide environmental policy practices, on paper and in practice.

As a first step in implementing the principles, it is recommended that the APEC Energy Ministers endorse the principles for the purpose of selecting, implementing and administering environmental policy practices. Ministers should also note that there are many good practices consistent with the principles available to further the achievement of environmental *and* investment objectives.

2. Review Current Environmental Practices

Member economies could review their current environmental practices in light of the principles and good practices. It is recognized that not all good practices described within this study are applicable to all member economies. Nonetheless, member economies may identify useful practices to adopt within their unique contexts.

3. Facilitate Further Dialogue on Implementing Good Environmental Practices

This study provides a foundation for dialogue between government and business, and among APEC member economies on good environmental practices. The Energy Working Group is a valuable forum to facilitate that dialogue.

The IPP study provides a useful model for continuing the dialogue. In the IPP study, a workshop reviewed a consulting study and provided valuable input and verification of principles and best practices.

The Energy Working Group could consider such a focused, international workshop as a means of:

- promoting further discussion and dissemination of good environmental practices; and
- identifying ways of overcoming barriers to implementing good practices.

Since energy agencies generally do not implement or administer many of the good practices, representatives from both energy and environment agencies, as well as appropriate energy regulatory bodies, should be encouraged to participate. Business representatives would also be essential to ensure the workshop reflects the practical concerns of investors and developers.

4. Further Document Environmental Practices

APEC has already undertaken some documentation of environmental requirements, most notably the Clean Fossil Energy Experts' Group's *Study on Atmospheric Emissions Regulations in APEC Economies and Their Compliance at Coal-Fired Plants* (January 1997). Further documentation of environmental practices in APEC member economies would serve two purposes:

- it would increase the transparency and clarity of environmental requirements, thereby facilitating investment and compliance; and
- it would aid member economies in developing their environmental practices.

Environmental assessment processes, other environmental approval processes and environmental standards for non-coal-fired plants are three areas where documentation would be most useful. Since such documentation would be useful to other multilateral organizations, co-sponsorship of a study might be considered.

The Energy Regulators' Forum has documented member economies' practices regarding other issues — for example, electricity tariffs and IPP processes during their meeting in April 1997 — and may be an appropriate venue for documenting environmental practices.

5. Identify and Implement Best Practices to Facilitate Transfer of Clean and Efficient Technology

Access to clean technologies is essential to achieving both investment and environmental goals for the electricity sector. The APEC Technical Seminars on Clean Coal Technology proved valuable in disseminating information on technology options. IPPs also assist in transferring technologies to developing economies.

Our discussions with business representatives regarding environmental practices revealed that technology transfer is hindered by certain types of policies unrelated to the environment. Provisions within trade and tax policies are most important in facilitating transfers of clean and efficient technologies. The Energy Working Group could consider undertaking a detailed study on good policy practices to encourage clean technology transfers.

The study might:

- document current policies in APEC member economies affecting technology transfer;
- identify principles and good practices that facilitate technology transfer; and
- recommend ways for APEC member economies to implement good practices.

An important component of such a study should be input from business representatives and government agencies responsible for implementing practices that affect technology transfer.

6. Share Experiences on Ways to Encourage Demand-Side Efficiency as Electricity Markets Become More Competitive

As electricity sectors become more open and competitive, traditional DSM programs become less applicable. Yet energy efficiency remains a significant opportunity to help achieve environmental goals in most APEC member economies. The key issues are:

- what is the appropriate balance between investments in generating capacity and investments in energy efficiency?
- how can member economies encourage demand-side efficiency within more competitive electricity market structures?

Initial efforts — including some by the APEC Inter-Utility Demand Side Management Liaison Group — have been made to address the issue. However, competition is still new to most electricity markets, and experience with DSM is evolving rapidly. Further efforts to share experience with DSM in competitive markets are needed if the environmental and economic benefits from energy efficiency are to be realized.

The Energy Working Group could facilitate development of a better understanding of how demand side efficiency can be encouraged within the evolving electricity sectors in APEC member economies. For example, a study on best practices for energy services companies might be useful.

The following three recommendations are potentially of longer term significance, and might also be considered by the APEC Energy Working Group.

7. Assess the Potential to Reduce Air Emissions from Electricity Generation Using Market Based Instruments

Market based instruments offer significant potential to help member economies achieve their environmental objectives at a lower cost than more traditional policy instruments.

In its various forms, emissions trading has particular appeal for reducing emissions from electricity generation. Successful trading programs in the United States illustrate the potential economic and environmental benefits from these policy instruments. Yet there remains much uncertainty about the potential for applying market based instruments within other APEC economies, particularly developing economies.

Since emissions from electricity generation are a serious concern in many APEC member economies, the Energy Working Group could consider further examination of emissions trading to assess:

- the conditions for successful trading programs in the electricity sector;
- whether and how emissions trading might be applied in developing economies; and
- the extent to which emissions trading might assist APEC member economies in meeting their environmental objectives for the electricity sector.

Although there are already many efforts underway to explore activities implemented jointly (AIJ) for greenhouse gas emission reductions, consideration of potential roles for the APEC Energy Working Group in facilitating AIJ may also be useful.

8. Co-ordinate Between Energy and Environment Agencies

In many APEC economies, implementation of the good practices is a responsibility of environment agencies, not energy agencies. Therefore, co-ordination is required to ensure environmental policy practices meet both environmental and energy investment objectives.

APEC member economies could use this study as a basis for discussions between energy and environment agencies to:

- identify existing practices that may be inconsistent with the principles for good practice; and
- identify good practices that may be suitable within their economy to achieve both environmental and investment objectives.

9. Develop Future Up-Dates of the Inventory of Good Practices

There will be a need to up-date the inventory of good practices identified by this study. Good environmental practices evolve continuously.

Key drivers of this evolution include:

- growing experience with innovative environmental policies;
- market structures moving towards increased competition;
- better availability of new clean technologies and more cost-effective opportunities for environmental protection;
- changes in environmental quality due to continued economic expansion;
- international negotiations on climate change, transboundary air pollutants and other environmental issues; and
- changes in public preferences as a result of higher incomes, growing understanding of environmental concerns and other factors.

We recommend, therefore, that in five years the Energy Working Group examine the need to up-date the inventory of good practices and re-assess the good practices member economies are adopting.

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