

**CROSS-BORDER POWER REPORT: EXECUTIVE SUMMARY****Extract from project EWG 03/2001T: “Addressing the Barriers to the Interconnection of Power Grids in APEC Member Economies”**

In early 2001, the Energy Ministers of the 21 APEC member economies called for a report on how to overcome barriers to cross-border power system interconnection. Resourceslaw International of Australia, in association with the Centre for Energy Petroleum and Mineral Law and Policy (CEPMLP) of the University of Dundee, Scotland and Bardak Energy and Management Services of Australia (“the consultancy”), was appointed by the APEC Secretariat in July 2001 to prepare this report.

**A Century of Achievement in Interconnection**

Interconnection of separate electricity supply or power systems has been an intrinsic feature of the electricity supply industry (ESI) since the very beginning of electricity supply over a century ago. The physical interconnection of power grids enables the integration of the entire power systems of which the grids themselves form part. There have been two main objectives: the first to form larger and more robust power systems and the second to exploit the diversity of power generation forms.

Many power systems have also become interconnected across international frontiers. This was usually the result of a confluence of two factors: an international frontier delineated by a major river; and the cooperative development, by the nations on each side, of a hydroelectric power generation scheme from which each side could draw its energy supplies. The Niagara Falls Scheme between the United States and Canada was one of the early examples.

The progressive interconnection of power systems and consequential expansion of the availability of electricity has brought great benefits to many economies. The special place of electric power was acknowledged, in early 2000, by the National Academy of Engineering of the United States when it compiled a list of the 20 marvels of science and engineering that had exerted the greatest influence on the quality of life in the 20th century. The first item on the list was electrification. It surpassed the importance of marvels such as aeroplanes, spacecraft, electronics, computers and communication, none of which can operate without electric power.

Public utilities, wherever they have been allowed to operate on pragmatic principles free of political restraints, have a long history of achievement in delivering the benefits of modern and reliable electricity supply to the communities they serve. Today, with advances in network technology, many more economies now have the opportunity of developing cross-border power system interconnections, even interconnections under the sea.

**Heightened Enthusiasm for International Cooperation in Energy Markets and for Development of Regional Interconnections**

From around 1991, following the end of the Cold War, it became a popular realization that the competitive forces released by energy market liberalization and private sector capital could be utilized in the development and enhancement of electricity generation, transmission and distribution infrastructure.

Since the mid-1990s, the ESI has been undergoing a momentous period of transition and reform. Many old fears and political rivalries have begun to dissipate. This has resulted in an

unprecedented level of enthusiasm for international cooperation in energy markets and, in particular, for the development of regional interconnections. Within APEC member economies, this heightened enthusiasm has catalyzed power system planners to examine or re-examine the potential of many cross-border power system interconnection projects.

Interconnection can bring great economic and technical benefits to the interconnected power systems; it provides the participating economies with significant power trading opportunities. Contrary to what some might fear, interconnection enhances power system security by reducing the vulnerability of an otherwise isolated power system to many events of *force majeure* which fall outside the control of transmission system operators, such as storms, sabotage or even terrorist activity.

One of the main objectives of many present-day interconnection projects is to take advantage of low-cost hydroelectric power in remote areas of one economy by transporting it to consumption centers in regional economies. This is the case with, for example, the Southern African Power Pool and the Greater Mekong Subregion Project, both of which are described in this report.

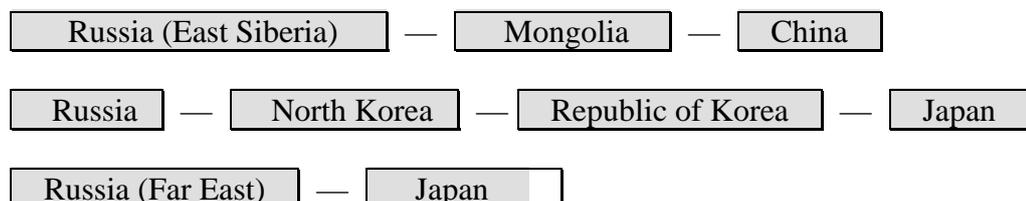
This heightened new enthusiasm for international and regional cooperation in the ESI is by no means confined to APEC member economies — it is almost universally shared. New regional proposals abound in Europe, Asia, Africa and North and South America.

Within APEC member economies, five cross-border interconnection projects (perhaps more accurately described as groups of projects) were reviewed by the consultancy. They are listed in the table below.

<b>TABLE 1: POTENTIAL POWER SYSTEM INTERCONNECTION PROJECTS IN APEC ECONOMIES REVIEWED BY THE CONSULTANCY</b>										
<b>The ASEAN Interconnection Project</b>										
<p>The ASEAN interconnection project was conceived more than 40 years ago, and three interconnections are already operational among ASEAN economies:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 5px;">Lao PDR</td> <td style="text-align: center;">—</td> <td style="border: 1px solid black; padding: 5px;">Thailand</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">Malaysia</td> <td style="text-align: center;">—</td> <td style="border: 1px solid black; padding: 5px;">Thailand</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">Malaysia</td> <td style="text-align: center;">—</td> <td style="border: 1px solid black; padding: 5px;">Singapore</td> </tr> </table> <p>The ASEAN project holds significant promise for another 11 interconnections in the coming years. The project is described in appendix 1.</p>		Lao PDR	—	Thailand	Malaysia	—	Thailand	Malaysia	—	Singapore
Lao PDR	—	Thailand								
Malaysia	—	Thailand								
Malaysia	—	Singapore								
<b>The Greater Mekong Subregion (GMS) Interconnection Project</b>										
<p>The GMS consists of six economies: Cambodia, Lao PDR, Myanmar, Yunnan Province of China, Thailand and Viet Nam. However, Cambodia, Lao PDR and Myanmar are not members of APEC.</p> <p>The subregion is well endowed with low-cost hydro resources, such as those in Lao PDR, Myanmar and Yunnan Province. A new interconnection project in the GMS, described in appendix 2, offers great promise for future cross-border power trade. It is supported strongly by the Asian Development Bank.</p>										

### The Three Northeast Asia Interconnection Projects

In Northeast Asia, there is a relatively recent proposal for a ring of three integrated power grids which could eventually be formed along the following major routes:



An alternative route from Russia into North Korea could be through China. The three projects are described in appendix 3. They are highly significant in political and economic terms although they must at this time be considered some time away. Mongolia and North Korea are not members of APEC.

### The North America Interconnection Projects

By contrast with Asian economies, the US and Canada have enjoyed the benefits of interconnection for a century and there are established procedures in place to implement new proposals. There has also been some limited low voltage interconnection between the US and Mexico during this period. There is significant potential for further substantial enhancement of interconnections between the US, Canada and Mexico. Some of the current projects are described in appendix 4.

### The Chile-Peru Interconnection Project

There is also potential for future interconnection between Chile and Peru, the only two members of APEC in South America. The Chile-Peru project is described in appendix 5.

## Overcoming the Barriers to Interconnection

Chapter 1 of this report makes what the consultancy believes to be an imperative case for cross-border power system interconnection and for increased cooperation and trade among the interconnected power systems.

There are no universal standards for investment in interconnection projects and there are no universal safeguards for investment protection. It is emphasized that interconnection projects have widely varying characteristics which need to be addressed on an economy-specific and project-specific basis, sometimes even on an investor-specific basis. The main drivers of interconnection projects are economic and sometimes the commercial imperatives of a particular project, assuming it is technically feasible, can be strong enough for a particular investor to accept the risk of otherwise formidable investment barriers.

In recent years, two factors have been crucial to the process of ESI reform within individual economies and to international cooperation in energy markets. The first factor has been the increased openness and transparency of what goes on in the ESI. It is now obvious to more and more people how the ESI actually operates and this has helped to build public confidence in the reform process.

The second factor has been the gradual withdrawal of government ministers from day-to-day responsibility and control and the emergence of professional and independent regulatory regimes which are required to be transparent in their decisions and legally accountable for the quality and validity of their decisions, not just to governments but also to industry participants and consumers.

Both of these factors remain pivotal to future international cooperation.

Overcoming barriers which may stand in the way of a particular interconnection project is likely to involve both macro and project-specific measures undertaken cooperatively by the participating economies, with the assistance of international institutions and technical advisors as necessary. These measures need to be tailored to suit not only the characteristics of the project but also the particular circumstances of each economy to which the project relates.

Set out below are fourteen of the most commonly encountered barriers to interconnection and a main strategy to overcome each barrier. Each main strategy is directed at accelerating the rate of investment in essential energy infrastructure in APEC member economies, with a view to enhancing their economic and social development. At the same time, each main strategy is framed with the purpose in mind of each economy being able to maintain its national power system integrity and preserve its national sovereignty and autonomy.

Because each APEC member economy is unique, not all barriers apply to each economy and each main strategy will not always be the most appropriate.

<p><b>TABLE 2: FOURTEEN BARRIERS TO POWER SYSTEM INTERCONNECTION AND MAIN STRATEGIES TO OVERCOME THEM</b></p>
<p><b>POLITICAL, POLICY AND PEOPLE BARRIERS (CHAPTER 3)</b></p>
<p><b>First Barrier: Public fears of being disadvantaged</b></p> <p>Within each economy, people have fears of being unfairly treated by the economic arrangements related to interconnection, such as losing their national autonomy or of suffering a diminution in their security of power supply.</p> <p><b>Main Strategy to Overcome: Introduce training, education and communication programs</b></p> <p>All important infrastructure programs must be implemented by a wide cross-section of the population. Training, education and communication programs are required to facilitate their involvement and nurture their support. Trade union support is always helpful if not essential.</p>
<p><b>Second Barrier: Lack of political support</b></p> <p>Without a supportive political background, the pursuit of an interconnection proposal is almost impossible.</p> <p><b>Main Strategy to Overcome: Participate in the international institutions that regulate international energy trade and investment and in regional initiatives</b></p> <p>This particularly includes participation in the Energy Charter Conference. Economies</p>

should also participate in regional energy cooperation initiatives to develop regional solutions and strengthen institutional capacity.

**Third Barrier: Lack of common policies**

If an interconnection project involves three or more economies, the lack of common policies will be an initial stumbling block.

**Main Strategy to Overcome: Develop a regional protocol and establish a regional organization**

The role of a regional organization is to coordinate and regulate the planning, development, financing, operation, and environmental management of a future interconnected system for a region. Unnecessary complexity should be avoided. Each participating economy in a regional interconnection project should adopt complementary national energy policies, with interconnection being an integral element.

**TECHNICAL AND ECONOMIC BARRIERS (CHAPTER 4)**

**Fourth Barrier: Lack of an overall plan**

Every region needs its own regional transmission expansion master plan.

**Main Strategy to Overcome: Develop a master plan to guide least-cost regional transmission development**

This should be carried out by the participating transmission system operators.

**Fifth Barrier: Incompatible technical standards**

Many power systems operate at different frequencies and voltage levels.

**Main Strategy to Overcome: Develop compatible regional operating and technical standards to maintain reliable operation**

Again, this should be carried out by the participating transmission system operators. In many cases, HVDC technology can and should be used for new interconnections. DC links may be more costly than AC links but they provide more security for each interconnected power system.

**Sixth Barrier: Incompatible transmission pricing systems**

Some national tariff structures are not fully cost-reflective. National differences lead to pricing distortions.

**Main Strategy to Overcome: Develop compatible, mutually beneficial and impartial transmission pricing regimes to act as an incentive for regional collaboration**

“Point of connection” tariffs should be considered. This work should be carried out at

policy and regulatory levels in consultation with industry participants.

**Seventh Barrier: Incompatible electricity trading systems**

Differences in trading systems and market structures between interconnected systems can impose costs and increase financial risks.

**Main Strategy to Overcome: Allow each interconnected system (or control area) within each region to maintain a high degree of autonomy and to remain responsible for ensuring — either by ownership or contract — sufficient generating capacity for its needs**

Do not attempt to eradicate differences by sophisticated schemes such as compulsory power pooling. Trading between systems can initially take place to exchange blocks of power according to their respective costs of production with savings shared by the participants. More sophisticated and more uniform trading systems can evolve over time.

**STRUCTURAL AND REGULATORY BARRIERS (CHAPTER 5)**

**Eighth Barrier: The natural monopoly characteristics of transmission networks**

Monopolies never have to compete in a market. Without adequate regulation, monopolies tend towards higher tariffs and lower service standards.

**Main Strategy to Overcome: Structurally separate the transmission network**

Ideally, in each economy, a separate legal entity should own and operate the transmission network. Non-discriminatory, third party access to the transmission network must be made readily available.

**Ninth Barrier: Cross-border transmission congestion**

Congestion impedes cross-border trade.

**Main Strategy to Overcome: Commit to expansion of transmission capacity to meet future demand and avoid congestion**

It is essential to avoid transmission congestion and to minimize market distortions. At interconnection points, availability of capacity must be transparent and allocated to users by a regulator-approved method that is fair and reasonable to both operator and users.

**Tenth Barrier: Political or administrative styles of regulation**

Regulation by political or administrative officials tends to be unstable and unpredictable.

**Main Strategy to Overcome: Introduce professional and independent regulation**

If private capital is to be utilized, each economy must have a system of professional and independent regulation that applies to at least the domestic transmission network. This

can be achieved either by establishing an independent regulatory agency or by contractual arrangements between the government and the transmission system operator. The regulator must set transparent tariffs that are fair to the operator and to users.

Regional regulation should address the regulatory gaps.

## **TREATY BARRIERS (CHAPTER 6)**

### **Eleventh Barrier: Instability of economy-wide investment conditions**

Stable, economy-wide, investment conditions, protection against encroachment by government and transit protection are required to attract investors.

#### **Main Strategy to Overcome: Provide treaty-based multilateral or bilateral investment protection**

Treaty safeguards can minimize investment risk and provide transit protection. APEC member economies that are not already members of the Energy Charter Conference should consider participation.

## **LEGAL BARRIERS (CHAPTER 7)**

### **Twelfth Barrier: An insecure and unstable legal framework for investors**

Strong legal safeguards are almost always required by investors.

#### **Main Strategy to Overcome: Bolster the legal framework, preferably by legislation**

There are no universal standards, but four legal components are generally necessary for an adequate legal framework:

- the rule of law should be entrenched
- there should be constitutional recognition of property rights
- there should be clear procurement and contracting rules and
- there should be up-to-date and readily enforceable investment legislation.

There is a particular need for regulatory, environmental and taxation certainty. If legislation is impracticable in the short-term, legally enforceable investment agreements between host governments and investors can deal with these matters.

### **Thirteenth Barrier: Corrupt practices**

Corrupt practices are an absolute legal barrier to private infrastructure investment.

#### **Main Strategy to Overcome: Minimize corruption by all possible legal measures**

Each economy should participate in international anti-corruption conventions, enact laws to criminalize bribery and other forms of corrupt conduct and implement anti-corruption contracting rules and tender procedures.

## FINANCING BARRIERS (CHAPTER 8)

### **Fourteenth Barrier: Risk-aversity of bankers**

Bankers are always risk-averse. In particular, bankers do not like complexity and are reluctant to accept completion risk when a new interconnection project is to be developed.

### **Main Strategy to Overcome: Demonstrate “bankability” by establishing uninterruptedity of revenue streams from transmission services and the capacity to manage all risks**

The golden rule in attracting finance is to be able to demonstrate that there is a strong and growing demand for power at the end of the line. Bankability also requires the involvement of experienced and highly creditworthy project proponents. If government entities are involved, multilateral banks and insurance agencies can provide a certain degree of credit enhancement.

We reiterate that each interconnection project is a special case with distinctive, sometimes unique, characteristics. Overcoming the barriers to any project will almost invariably require strategies and solutions to be formulated on an economy-specific and project-specific basis. The report analyzes each of these barriers and strategies in more detail. Arising from that analysis, eight policy and technical recommendations to all APEC member economies have been formulated as we outline in the following section.

### **Policy and Technical Recommendations to APEC Member Economies**

Most people prefer to make up their own minds about what to do after looking at the failures and successes of others. For policymakers who aspire to the realization of the dream of an integrated power system in the Greater Mekong Subregion or elsewhere in the APEC economies, a review of the rapid progress toward integrated, regional energy markets throughout the world is therefore particularly instructive.

Apart from this general observation, eight policy and technical recommendations of a more affirmative nature are offered by the consultancy to all APEC member economies:

### **There is no longer any need for political restraint nor is there any justification for domestic policy inertia**

The case for cross-border interconnection of power systems is clear and very well established. Cross-border interconnection, where feasible and economic, not only enhances energy infrastructure, providing economic, social and environmental benefits to the participating economies, but also enhances power system security. There is no longer any need for political restraint in relation to cross-border interconnection proposals, nor is there any justification for domestic policy inertia which may inhibit their progress.

Policy, technical, structural, regulatory and legal solutions are available to allay most public fears as outlined in this report. In particular, with proper regulation, there is no reason why foreign direct investment should not be utilized in the energy sector by host economies.

## **Continue the process of ESI reform, doing so with transparency and utilizing professional and independent regulation**

In recent years, two factors have been crucial to the process of industry reform inside individual economies and to international cooperation in energy markets. The first factor has been the increased openness and transparency of what goes on in energy markets. The second factor has been the gradual withdrawal of government ministers from day-to-day responsibility and control of the energy industry and the emergence of professional and independent regulatory regimes.

Both of these factors remain pivotal to future international cooperation. The process of ESI reform should be continued.

## **Do not confuse compulsory power pooling with power system interconnection**

Centrally controlled, compulsory power pools with common pool prices do not have to be, and are not usually, associated with power system interconnection. The two should not be confused. Compulsory power pooling is only one mechanism of promoting competition among generators and other systems of trading are available. In fact, electricity markets designed on the basis of compulsory power pooling are distinctly out of fashion.

Interconnection, on the other hand, is increasingly recognized as the vital transportation infrastructure for the integrated operation of power systems. Interconnection then opens the door to a variety of optional cross-border economic trading opportunities for the participating power systems.

## **Study what is happening elsewhere and involve key domestic stakeholders**

No barrier to a feasible interconnection project is insurmountable, given goodwill and cooperation. Policymakers and power system planners in APEC member economies should be aware of what has already happened, and is continuing to happen, elsewhere and be guided by the success of others. Then, because interconnection involves policy, structural and regulatory changes that are required to be implemented by a wide cross-section of people, all key domestic stakeholders, including trade unions, need to be involved in the change process.

APEC member economies interested in pursuing interconnection projects should closely study other regional models of collaborative success. This study might include:

- the Southern African Power Pool, a “loose pool” or trading system which is now in operation linking the power systems of 12 Southern African economies
- the proposed GMS interconnection project, which is now being formulated by the six economies of the Greater Mekong Subregion (described in appendix 2)
- the Madrid—Florence consultative process, instigated by the European Commission with the involvement of bodies such as the Council of European Energy Regulators and the association of European Transmission System Operators, which has boosted progress toward the single EU energy market and
- the recent moves in the US and Canada towards the establishment of a common electricity market, mainly led by PJM Interconnection LLC and the Midwest Interconnection Transmission System Operator Inc.

**Utilize treaties, legislation and investment agreements to bolster investment security and attract affordable financing**

Investment security may be bolstered by a stable and secure legal framework. Regulatory, environmental and taxation certainty enables both equity and debt financing to be attracted on more affordable terms. APEC member economies can achieve this by utilizing inter-governmental treaties, legislation and other legal safeguards, including investment agreements between host governments and project proponents.

**Participate in the Energy Charter Conference**

It is specifically recommended, for the reasons explained in chapter 6 of this report, that each APEC member economy (in addition to Australia, Japan and Russia, which are already signatories, and China, which recently obtained observer status) should consider participation in the Energy Charter Conference either by observer status or by full accession. Some APEC member economies might instead prefer to see the development of an equivalent or similar treaty applying to the energy sector of a particular region, in which case early consultation among the relevant regional economies should be undertaken.

In the meantime, regular exchanges of views and information should be initiated between the APEC Energy Working Group and the Energy Charter Secretariat.

**Actively participate in pragmatic regional initiatives and develop regional solutions**

The most emphatic recommendation of this report is that each APEC member economy should actively participate in regional dialogue, planning, coordination, regulation and other regional initiatives in relation to any cross-border interconnection proposal in which it is interested. In doing this, pragmatism should be allowed free reign.

Because all negotiations which involve multiple parties are characteristically complex, regional initiatives need to be progressively organized, managed and institutionalized. The Madrid—Florence consultative process has worked well in Europe, and so has the GMS collaborative model in Asia. A range of practical steps can be undertaken to boost progress within the APEC region as we outline in chapter 11 of this report.

**Formulate straightforward, “no-regrets” strategies and solutions for all barriers — various options stand out**

The final recommendation of this report is that, where barriers are found to stand in the way of the development and financing of feasible interconnection projects, straightforward policy, technical, structural, regulatory and legal strategies and solutions are generally available and should be formulated and implemented. Straightforward, “no-regrets” options should always be preferred to more complex ones. In particular:

<b>TABLE 3: STRATEGIES AND SOLUTIONS WHICH STAND OUT</b>
One <b>policy option</b> stands out — transparency makes it obvious to everyone what is going on and facilitates their cooperation
One <b>technical option</b> stands out — the use of advanced transmission technology, in many cases based on HVDC systems, can provide each interconnected power system

with technical advantages and a security buffer, enabling system autonomy to be preserved

One **structural option** stands out — structural separation of the domestic transmission network enables each participating economy to specify international best practice in technical, operating and service standards for the essential public service of power transportation and enables each economy to insist on undivided accountability for compliance

One **regulatory option** stands out — a transparent and fair system of independent regulation of transmission pricing provides security and incentives for investors, at the same time ensuring that consumers are treated fairly and are not disadvantaged by monopoly pricing practices

Two **legal options** stand out —

- the first is that participation in an international investment protection treaty such as the Energy Charter Treaty facilitates each APEC member economy realizing its full potential for economic development and political influence
- the second is that the use of investment agreements by host governments can overcome many legal inadequacies provided that these agreements are fully transparent, untainted by corruption and enforceable before independent international tribunals

We are confident that the adoption by APEC member economies of domestic policies in line with these recommendations, accompanied by participation in regional initiatives and the active development of regional institutions and supporting arrangements as outlined in this report, will help to bring many needed interconnection projects closer to fruition.

Sydney, Australia

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**RESOURCESLAW INTERNATIONAL**

in association with

**CENTRE FOR ENERGY PETROLEUM AND MINERAL LAW AND POLICY, UNIVERSITY OF DUNDEE,**  
and

**BARDAK ENERGY AND MANAGEMENT SERVICES**