REPORT

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Energy market reform and energy security

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The need for ongoing reform

- **Ongoing power sector reform is crucial for APEC economies. While the APEC region is, by global standards, advanced in energy reforms, there are still significant benefits to be had from further reform.**
- **At the same time as APEC economies continue the reform process, energy security is emerging as a major concern, and energy security concerns are behind a number policy decisions in a number of countries.**
- **There is a risk that if energy security is not properly understood, and if the basis of policy formulation is not sound, then the benefits of power sector reform will be jeopardised and that attempts to provide protection in the short term will come at the expense of long term growth. It is crucial that policy makers recognise that the key long term issue is resilience of the economy (or vulnerability) rather than simple measures such as import dependence.**
- **Policy action on energy security should therefore focus on this resilience, recognising that government actions should be complemented by considerable private sector involvement.**
- **One of the best things governments can do to provide resilience in the face of energy security issues is to continue the process of energy sector reform. This yields the best prospects for dealing with energy security in the long term. Many of the well recognised benefits of energy sector reform also translate to gains in energy security.**

The balancing act in energy security

- **It is not possible to guarantee energy security, or to remove all risks from the energy system. The important choice facing APEC economies is to set up mechanisms to allow the transparent choice of an appropriate level of energy security and to be very clear about where the responsibilities for providing this security lie.**

- **Energy security has a number of dimensions and changes in response to a variety of drivers. It also has both short term (proximate) and long term (ultimate) causes.**
- **Most measures of energy security (import dependence, energy intensity, diversity) provide a very partial picture of the true risks facing an economy. These standard measures need to be supplemented with a sound understanding of the economic interactions that underlie energy security.**
- **While the most appropriate policies will vary considerably from economy to economy, it is very important that policy makers understand the key tradeoffs involved. In particular, there are important tradeoffs between short term measures to provide security and long term incentives to change energy systems. There are also tradeoffs between government measures to provide energy security and approaches that can be developed and adopted by private markets.**
- **In all economies there is considerable scope for the government to provide an enabling environment for the development of efficient markets, the adoption of research and the development of new energy systems. Key to this enabling environment is ongoing progress in energy market reform.**

Conclusion: energy security requires continuing reform

- **Energy security is a serious ongoing challenge to APEC and other economies. But far from implying a need to slow the process of energy reform, the challenge of energy security suggests that the reform process needs to be accelerated.**
- **Energy reform cannot, of course, guarantee energy security always and everywhere. But dealing with energy security will be even harder without ongoing energy reform. While reform cannot guarantee short term availability, and while it cannot prevent supply disruptions (particularly of primary energy), it will make a significant contribution to the long term determinants of availability and affordability, and to the ultimate resilience of the economy.**
- **The discussion in this paper suggests four broad implications for policy makers.**
- ***First*, it is very important to understand the underlying nature of the energy security challenge. Related to this is the need to distinguish the short term and long term determinants of energy security and to measure energy security in an appropriate way.**

- ***Second***, an appropriate way of thinking about energy security is in terms of the vulnerability or resilience of the economy, particularly in terms of the generation, distribution and use of energy.
- ***Third***, policies targeted at increasing resilience (or reducing vulnerability) will have the greatest long term effect on energy security. Other policies run the risk of either masking necessary structural changes or resulting in unexpected side effects.
- ***Fourth***, further progress on energy reform is a major component of increasing the resilience of the economy.

1 Introduction

In most APEC economies, energy and power sector reforms of various kinds have taken place in recent years, and APEC itself has taken a leading role in providing information and support for energy reforms. Reform, however, is an ongoing project and is never really finished. In recent times, a number of challenges to the overall reform agenda have emerged. One important challenge is ongoing concerns about energy security.

Expected strong growth in energy demand, rising oil prices and uncertain supply in key energy exporters (most of which are outside APEC) has led to continued concerns about energy security. While these concerns are not new (they have been continually in play since the 1970s or earlier[1]), the clear need for ongoing reform in the energy sector and the emergence of greenhouse concerns tightly linked with the dominant sources of energy in APEC economies have given energy security additional impetus in recent years.

While providing energy security is often seen as a role of government, there are crucial interactions between energy security and the efficient operation of energy markets. In the ongoing energy reform agenda, it is important to ensure that energy security is not the excuse of inefficient regulations of various kinds. Rather, addressing energy security effectively actually requires that energy reforms continue.

Achieving energy security is not costless. Indeed, full security is simply not possible. But there is a great deal that policy makers can do towards choosing an appropriate balance between private and public responsibilities for energy security and in selecting policies that allow for short term security without compromising the long term economic flexibility that is the only durable source of security.

A key choice facing APEC economies is their approach to ongoing energy reform (with the substantial and demonstrated benefits that this can bring), to the sorts of policy interventions that are often made in the quest for energy security, and to the concerns of climate change.

To make these choices, and to ensure ongoing benefits from reform, it is important that policy makers are clear about:

- the nature of energy security

[1] In 1865 (before the petroleum age) WS Jevons was concerned about the 'probable exhaustion' of the coal which fired the British economy.

- the costs and tradeoffs involved in achieving it
- the appropriate balance between government actions (through interventions in energy markets) on the one hand and the security and risk management activities that emerge as a result of free interactions in competitive energy markets on the other.

There is an ongoing trend for reform of energy markets within APEC, and where pursued these reforms will continue to bring benefits to all APEC economies. However, if the tradeoffs involved in seeking energy security are not properly understood, there is a risk that energy security measures may reduce some of the long term benefits of reform. Where an appropriate balance is made, however, long term energy security and reform can go hand in hand.

This paper examines some of the issues and tradeoffs involved. Section 2 begins by considering the nature of energy security and noting the important influence that the way in which energy security is conceived and measured has policy approaches. Section 3 notes that while there is a role for government in energy security, energy security needs to be addressed in functioning markets in order to avoid some of the unexpected side effects of government intervention. Section 4 considers the benefits of energy reform and the way in which these provide a solid framework for dealing with ongoing energy security concerns. Section 5 concludes.

2 *Energy security: its nature and measurement*

What is energy security?

While energy security is a very common phrase, it does not have a single common definition. There are however, a number of common elements that emerge in discussions of energy security.

One definition is that energy security is the

> ability of an economy to guarantee the availability of energy resource supply in a sustainable and timely manner with the energy price being at a level that will not adversely affect the economic performance of the economy. (APERC 2007)

Related to this is the idea that

> energy security refers to the adequate and reliable supply of energy at reasonable prices in order to sustain economic growth. (Hogan et al 2007)

Both definitions note the strong link between energy use and economic growth and recognise the potential for sharp increases in energy prices to impose costs on the economy and to potentially affect economic growth.

Both definitions also include an idea about the physical *availability* of primary energy resources (in particular coal, oil and gas) combined with the *affordability* of that energy source.

The physical availability of an energy source has two components. First, the extent to which reserves are known about and feasible to extract. Second, the extent to which these resources are accessible. Accessibility clearly has a strong affordability component. Many resources are accessible without being cost effective.

Affordability also has two components: the ability of the economy to purchase energy without jeopardising other economic activities and second, the extent to which the use of a particular energy resource has long term implications (in particular, environmental implications).

Affordability and availability are clearly closely related, but in terms of the economic impact of changes in energy security, it is affordability, or price, that ultimately determines economic outcomes. The effect on increases in energy prices also depends on the *vulnerability* of the economy to short or long term energy price changes.

In the short term, an economy is vulnerable if it is dependent on a narrow range of energy sources and is unable to switch away from the energy source whose price is increasing. In the long run, an economy remains vulnerable if it is unable to improve its flexibility to substitute between energy sources or it is unable to increase its ability to generate and implement new forms of energy. These various aspects of energy security are summarised in table 2.1.

2.1 Three elements of energy security

	Availability	***Affordability***	***Vulnerability***
Availability	Refers to the physical availability of a particular primary energy source, for example, the known reserves of oil or gas. Also refers to the ability to access these reserves. This may be limited, for example, by market barriers, infrastructure requirements or political constraints.		
Affordability	Affordability and vulnerability are linked in that there is often a tradeoff between the two — many resources are available in some sense but are simply to expensive to extract or transport.	Refers to the ability to purchase or afford the available energy resources. This includes, for example, the ability to mobilise investment funds for exploration, development and infrastructure construction.	
Vulnerability	Vulnerability and availability are linked in that the economy's adaptation to a particular energy shock may depend on the availability of other sources of energy. In the long term, availability is also itself driven by the previous responses to energy price changes.	Ultimately, affordability is driven by the underlying growth and productivity of the economy. A strong and flexible economy is better able to afford and invest in a variety of energy sources.	Refers to the economic impact of an energy security shock through the resulting increase in energy prices. This depends on the overall flexibility or resilience of the economy, in particular the ability to substitute between energy sources and between energy and other key inputs. In the long term it also depends on the ability of the economy to undergo structural change and mobilise research into different ways of doing things

Security in energy consumption

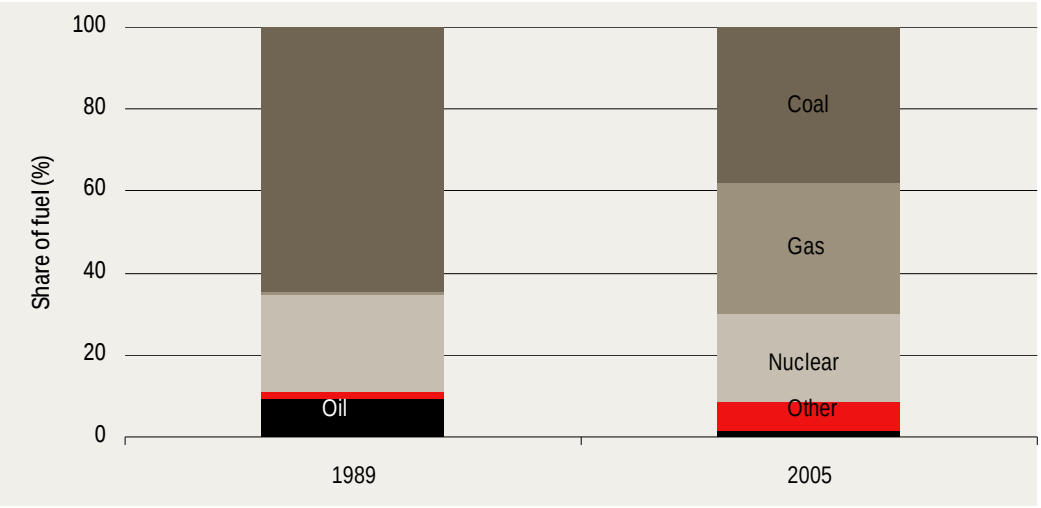
Energy security is not just a feature of primary energy supplies and may vary along the energy chain. Electricity generation, for example, may not be secure from the perspective of some users if there are capacity constraints within electricity generation, even though there may be no insecurity in the primary energy source (for example, coal or natural gas). Recent events in some energy markets have indicated that there is the possibility of energy security concerns throughout the energy supply chain.

The dynamics of energy security

Energy security need not remain constant over time. Energy security will respond to a variety of factors over time, one of the most important ones being the reaction of the economy to previous energy shocks and energy price increases. Research indicates, for example, that one of the effects of the sharp oil price increases in the 1970s was an increase in research and development (R&D) to find more energy efficient ways of doing things (Popp 2002). This 'induced' R&D led, for example, to more energy efficient vehicles and an increased ability to substitute between energy sources. This increased substitutability is, in effect, an increase in energy security because it has reduced vulnerability. Thus, a long term increase in energy security can be a direct response to an apparent reduction in energy security at an earlier time.

Market reforms have also changed some aspects of energy security. Chart 2.2 illustrates, for example, that in the United Kingdom privatisation and reform of the energy sector led to a greater balance in the supply of primary energy to electricity generation. While this diversity of supply is an imperfect measure of energy security (see below), it does illustrate how rapidly things can change over time.

2.2 UK fuel input for energy generation: before and after reform



Data source: Ingham et al (2006).

Proximate versus ultimate sources of security

The ultimate or long term sources of energy security may be quite different to the immediate or proximate short term sources of energy security. Each of the three factors of availability, affordability and vulnerability has a short term and a long term counterpart as illustrated in table 2.3.

The key lesson here is that, while immediate security issues are concerned with physical availability and initial impacts of energy supply shocks, ultimately these effects are determined by a variety of economic factors, which together affect the flexibility and responsiveness of the economy to changes over time.

2.3 Proximate versus ultimate energy security

	Availability	*Affordability*	*Vulnerability*
Proximate or immediate security issue	Current physical availability and accessibility of energy source.	Current willingness to pay within the economy for energy of particular types.	Diversity of energy sources, short term ability to switch, energy share of production and consumption and so on.
Ultimate or long term security issue	Effort devoted to developing new energy sources. Depends on incentives and investment for long term rewards.	Long term structural change in the economy, overall economic growth driven by productivity growth in all areas of the economy.	Long term ability to create incentives to increase ability to switch between energy sources, to continue to experiment with and develop new energy sources and to undergo structural change.

Measures of energy security

There are a number of quantitative measures of energy security that are typically used to indicate whether energy security is likely to be of concern for a particular economy. These measures and some key issues around their use are summarised in table 2.4.

A number of issues arise when considering these measures and, in particular, when using them for policy analysis. These include:

- the diversity of energy security rankings that emerge from the measures;
- the inability of the measures to account for second round effects;
- the potentially perverse or unexpected outcomes that could result from narrow policy based on a single measure;
- the need to capture the true risk facing an economy; and
- the need to account for economic interactions and economic resilience in a measure of energy security.

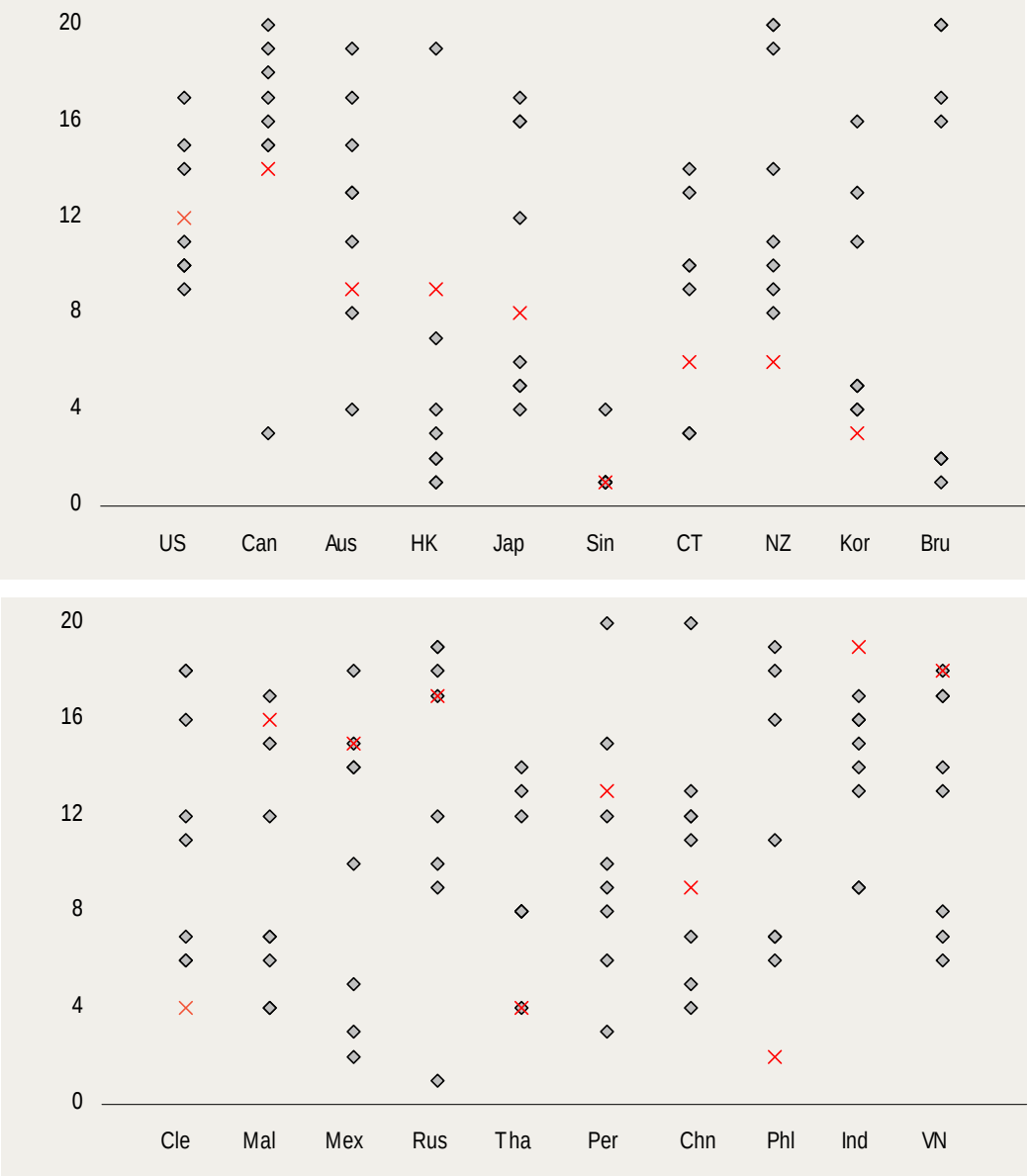
2.4 Measures of energy security

Measure	*Definition*	*Issues*
Energy intensity	Ratio of energy consumption to GDP. In some cases measured as the share of energy value added in GDP.	It is generally presumed that a higher energy intensity implies less energy security. However, the simple measures of energy intensity (physical energy use per unit of GDP) gives no indication of the relative economic importance of energy. Economic measures of intensity (share of energy value added in GDP) do provide a relative sense, but by themselves do not provide an indication of the economic vulnerability of the economy.
Self-sufficiency or import dependence	Share of imports in total primary energy consumption.	Higher import dependence is presumed to imply lower energy security. The relevance of this measure depends very much on the context. For some economies, imports are in fact the only means to provide energy security as domestic production is not an option. Attempts to eliminate import dependence may be more costly than the dependence itself.
Oil dependence	Share of oil in total primary energy consumption. Can be defined as share of oil from a particular source (for example, the Middle East).	This measure provides a snapshot of the current importance of a single source of energy. As with the other measures, however, it does not provide any indication of the economic vulnerability of the economy to an oil price change. Versions of the measure looking at dependence from a particular source provide no indication of the ability to switch sources
Diversification of energy	The extent to which energy sources are concentrated in a limited number of sources. Can be measured in a variety of ways.	It is presumed that the less diverse the sources of energy, the less energy secure is the economy. This measure does not typically account for the correlation between the risks to different energy supplies. For example, oil and gas prices are highly correlated, so that apparent diversity between oil and gas in primary energy use does not in fact constitute diversity ina risk sense.

Diversity of rankings

These various measures give a very wide range of rankings when compared between APEC economies. This is illustrated in chart 2.5, which shows that a particular country's ranking (high or low energy security compared with other APEC economies) varies considerably with the energy security measure used. Aside from the other difficulties in interpretation discussed below, this illustration suggests that these various energy security measures are highly contextual and that there is no single measure that provides a complete picture of energy security for a particular economy. The underlying problem here is that the various simple measures do not adequately capture the underlying economic interactions that surround energy security.

2.5 **Range of rankings based on different energy security measures** [a]



[a] The security measures used are: energy intensity; oil and energy self sufficiency; oil share in total primary energy consumption; a diversification index as defined as the sum of the squared market share; energy diversity defined using a Shannon diversity index; net energy import intensity weighted by consumption intensity of each energy source; the share of energy that is non-carbon based. In addition, the red crosses show a ranking based on the effect on the economy of an oil price increase.

Data source: Hogan et al (2005), APERC (2007).

Second round effects

An issue with all of the common measures of energy security is that they do not provide any way of accounting for the interactions that influence energy security. For example, the energy security of a particular economy within APEC depends not only on the actions of that economy, but also — through trade and investment linkages — on the actions of other economies (within as well as outside APEC).

Even an economy with low energy intensity may be indirectly exposed to energy insecurity if it trades heavily with other economies that are energy intensive.

Indeed, because of the many trade and investment linkages between economies, a simple measure of energy security such as import dependence may be quite misleading. Measures to reduce import dependence will not necessarily reduce the price impacts of energy shocks in the world economy. This is because energy prices are transmitted very rapidly around the world. When energy prices increase, there is pressure for all prices to go up — this includes domestic as well as imported energy. Despite the level of import dependence, domestic prices will also increase.

Unexpected outcomes

Basing policy measures on a single energy security measure such as import dependence will not necessarily result in an increase in energy security. An example of this is policy in the United Kingdom, which, from the 1950s, focused on one aspect of energy security: reduction of import dependence through the support and protection of the British coal industry. This policy was ultimately uneconomic and did not actually increase energy security. Rather, it gave significant power to coal unions whose strike actions reduced energy security for consumers (see Ingham et al 2006).

Fully accounting for risk

Diversity measures of energy security are designed to indicate the extent to which concentration on a narrow set of energy sources provides a diversification risk to an economy. However, these measures generally do not account for the correlation of risk that may exist between elements of an energy portfolio.

For example, an equal share of primary energy from each of oil and gas would be generally considered to be more 'secure' than dependence on oil alone. However, for a variety of reasons (including the general framing of gas contracts), oil and gas prices move very closely together. If the price of oil increases, so will the price of gas. This means that the price effects of shocks to the oil market will also result in price shocks to gas markets. From the point of view of the energy consumer, these risks are correlated, and diversity of energy sources alone does not eliminate the risk.

There may also be some unexpected correlations in risk between apparently diverse sources of energy. For example, the long drought currently in place in Australia has led to a significant reduction in the output from the Snowy mountains hydroelectric scheme. The same drought, however, has also led to reduced availability of cooling water for some inland coal-fired power stations. Thus, two quite diverse sources of energy have been influenced by the same underlying risk factor.

Need to capture the underlying responsiveness of the economy

A fundamental feature of energy security is the underlying resilience of the economy, or the ability of the economy to adjust in the short, medium and long term to changes in energy availability and energy prices. This underlying ability is not well captured in the typical measures of energy security; at best, they each provide a snapshot of one particular aspect of energy security.

An alternative approach to measuring energy security is to use more detailed economic information to construct a 'resilience' measure of the economy. There are many ways in which such a measure could be constructed, and an appropriate measure depends very much on the context at hand.

An alternate measure: the flexibility or resilience of an economy

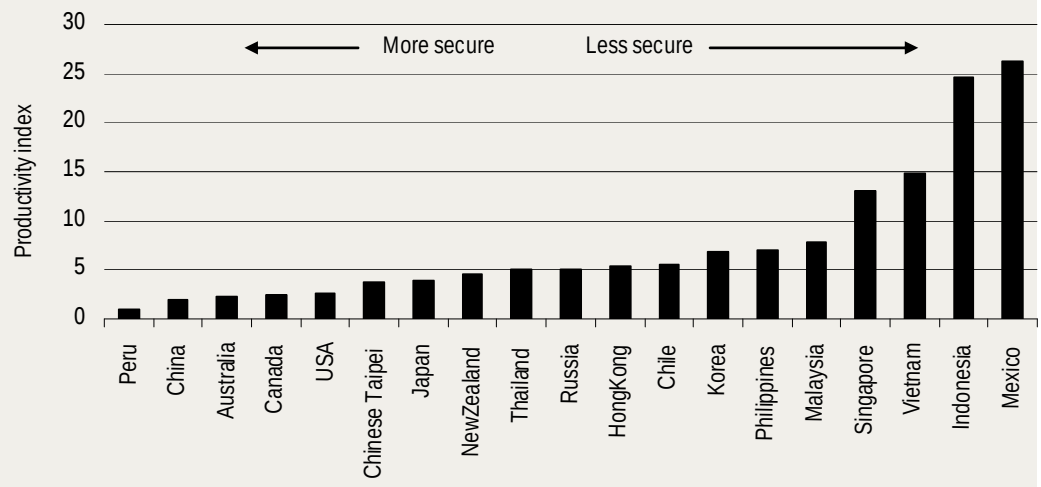
Chart 2.6 illustrates a measure of energy security based around the resilience of an economy, taking into account a full range of second round economic effects. The resilience measure used is *the productivity improvement (in energy production and use) required to offset the effect on national income (GDP) of a shock to energy prices.* This measure is estimated using model based simulations and so is able to account for second and third round effects.

The measure is expressed relative to the smallest required productivity improvement (in this case Peru, defined as 1.00). The chart shows, for example, that economies such as Peru, China, Australia, Canada and the USA require a relatively small productivity increase to offset the effects of an energy price shock. These economies would be relatively secure or 'resilient' to an energy price shock.

Other economies such as Singapore, Vietnam, Indonesia and Mexico require a considerably larger productivity increase to offset the effect of an energy price shock.

The measures presented in chart 2.6 are certainly not definitive and should be seen as purely illustrative. They are important, however, as the underlying logic behind the measure is designed to capture a range of economic interactions — both within and between economies — that are missing in most measures of energy security. Further, the measure has the advantage of forcing the focus of attention to the key underlying determinants of energy security rather than the proximate measures. In the long term, it is these underlying determinants that must be the focus of appropriate energy security policies.

2.6 **Illustrative 'resilience' measure of energy security** Productivity increase needed to offset an energy price shock



[a] The chart shows the productivity improvement required in each country in order to offset the effect of an oil price increase (in the case of net oil importers) or in order to achieve the same effect as the oil price increase in the case of a net exporter. The productivity increase is expressed as an index with Peru (the lowest) set at 1.00.

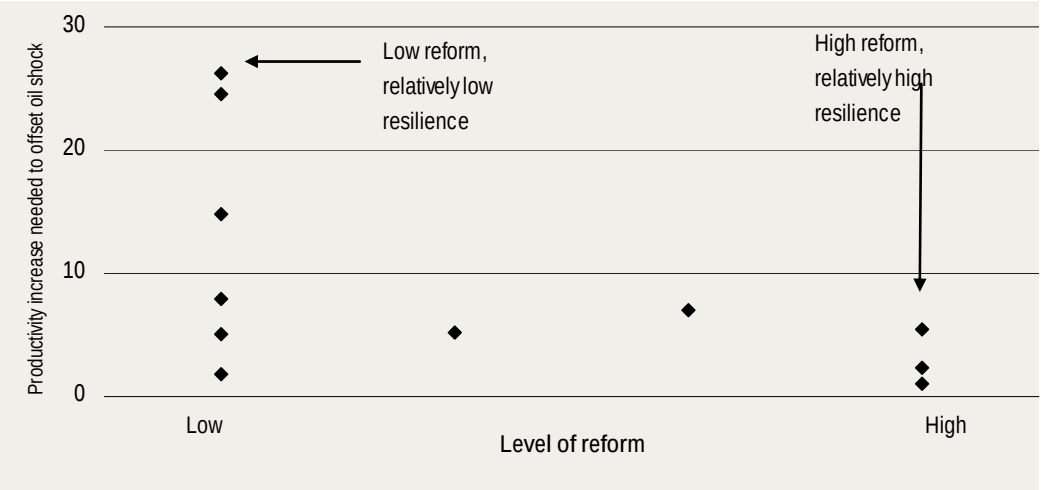
Data source: CIE estimates based on data in Hogan et al 2005 and simulations with the GTAP model.

The question that naturally arises concerns what policies need to be set into place in order to ensure the long term ability of the economy to adjust to energy shocks.

Resilience and reform

Chart 2.7 takes this illustration a little further by looking at the link between resilience and the level of power sector reform within an economy. While it is difficult to strictly categorise the level of reform, as the chart illustrates there is a broad tendency for higher levels of reform to be associated with higher resilience to supply shocks.

2.7 **Resilience and the level of reform**



Data source: CIE estimates.

3 Why energy security needs markets

Whose responsibility?

There is a very common view that the responsibility for energy security within an economy rests with government. At some extremes, it is suggested that governments need to maintain control of energy markets in order to ensure energy security. There is some evidence that in some economies there are pressures for increases in government involvement in the energy sector (see, for example, Evans 2006). In this sense, market reform and energy security are seen as opposing, and the need for energy security is seen as an argument for slowing market reforms.

However, the underlying problem is different to this simple dichotomy between 'the market' and government.

Dealing with energy security involves a series of tradeoffs as complete energy security can never be attained (or at least not at any feasible cost). Put another way, risks to the energy system cannot be eliminated. Rather than attempting to eliminate risk, it is very important that policy approaches to energy security are clear about:

- the true costs involved in providing energy security
- the amount of energy security that is appropriate for the economy
- who is best placed to most efficiently provide energy security or, more specifically, what is the appropriate division between private 'market' provision of security and public provision of security.

Put another way, a key policy question is about who is best placed to manage long term energy security risk? Can it be managed by individual actions in competitive markets or should it be centrally managed by the government?

Security mechanisms in competitive markets

Competitive markets have a variety of mechanisms for dealing with risk in general and with energy security in particular.

Security as a product attribute

Security of supply is an important product attribute and, where consumers are willing to pay for additional security, suppliers have a strong incentive to provide it.

In a competitive market, willingness to pay for security and the cost of supplying security are matched so that the amount provided broadly reflects aggregate willingness to pay. In general, those who are affected the most by supply disruptions will have the highest willingness to pay for security and so efforts to provide security will be focused on these consumers first. Consumers who are not prepared to pay for additional security, but are happy to live with the potential for short term disruptions are not required to pay for security that they do not value. A range of empirical studies have indicated that consumers are, in fact, prepared to pay for security attributes of energy systems (see, for example, Longo et al 2006 and the other studies cited therein).

Insurance and forward markets

Insurance and forward (futures) markets are key mechanisms used by competitive markets to deal with security issues. These markets do not eliminate risk, but they provide options for market participants to manage the various risks in the energy system. Because different consumers have different risk profiles and abilities to accept risk, various forms of insurance markets provide gains by allowing consumers to trade these risks. Insurance markets, of course, are not perfect and may not always perform as well as would be wished. They do, however, provide more options and flexibility.

Response to price signals

Over the long term, a major means by which competitive markets provide security is by sending price signals to both consumers and current and potential producers. If, for example, there is a shortage in a particular energy market, then there will be a tendency for the price to increase. This sends an initial signal to consumers that they should try to economise on the use of that energy source. At the same time, the price increase will tend to encourage suppliers to increase supply, or investors to enter the market to provide new capacity.

Because supply and demand may not be immediately responsive to price changes in the short run, the long term power of these price signals is often misunderstood. The changes in energy efficiency that followed the oil price shocks in the 1970s illustrate the long term effects of price signals to both producers and consumers. However, where price signals are masked by government measures of various kinds, adjustments do not take place, making the adverse impacts of a shock much greater than they would otherwise have been.

Current government policy mechanisms

There are a variety of instruments available to governments to address energy security — particularly in the short term — and most governments have in place a

variety of approaches to address energy security. Various measures take place at the APEC level. Some of the current measures are set out in table 3.1.

3.1 Government energy security measures currently in place

Key measure	*APEC-wide initiatives*	*Individual economy measures*
Stockholding and emergency responses	Regular reporting of stockholding and emergency measures to APEC Energy Working Group	Strategic Petroleum Reserve in the United States. Similar reserve in China. Oil stockpiles in Japan.
Information provision	Joint Oil Data Initiative: improved provision and reliability of oil market data	
	Real Time Emergency Information Sharing (RTEIS)	
	APEC Gas Forum	
Demand side management (energy efficiency measures)	APEC Energy Ministers endorsement of standards and labelling	Most economies have energy efficiency programs of some form.
	Energy Standards Information System	
Diversification targets and subsidies to alternate supplies		Nuclear power programs at various levels in the United States, Japan, Korea, Canada, Chinese Taipei, China, Mexico and Russian Federation.
		Renewable energy policies in most economies. Mandatory renewable energy targets in Australia, New Zealand, Philippines, Thailand, Singapore and China.
Investment incentives	Best practice guidelines and training programs	
R&D and alternative fuels	APEC Biofuels Task Force	Programs in most APEC economies. Includes, for example, grants to renewable energy in Australia and the US.

Sources: APEC Energy Working Group 2007,

Most APEC economies have specific measures in place for addressing energy security and there are some very strong APEC-wide initiatives in place. Some of these measures have a relatively short term focus, designed to deal with immediate disruptions to primary energy supplies. Such measures — such as stockholding and emergency information sharing — are important in crises, but do not deal with the long term determinants of energy security.

Other measures, including diversification targets and demand side management, have a significant long term component and are designed to contribute to energy security by reducing demand rather than by increasing the flexibility of the economy.

R&D, investment and subsidy measures (especially for alternative fuels) are designed both to increase diversity and to provide alternative long term supplies.

While the short term measures can be implemented by governments through interventions in energy markets, they are likely to be considerably more effective if the measures account for market interactions in their implementation.

The longer term measures, including demand side management and R&D programs, each ultimately require well functioning energy markets if they are to be effective and sustainable in the long term. For example, the development of alternative fuels will only lead to economywide net benefits if they are transparently priced and are seen by consumers as delivering a valuable product. Even if these alternatives can justify long term government intervention (through public good arguments such as those relating to climate change), this intervention will be considerably more effective if it is implemented by harnessing the power of competitive markets.

Tradeoffs in government involvement

The public good nature of energy security

The most frequently recognised argument for government provision of energy security is the observation that energy security has something of a public good nature. Essentially, something that one firm or organisation does to increase their own energy security may have spill over effects to other firms, increasing their security as well. From this, it is inferred that energy security will be under-provided in a competitive market, providing a role for government policy action.

As noted above, however, there are a number of mechanisms by which competitive markets are able to provide energy security. With these in place, there are a number of key tradeoffs involved in the use of direct government measures to provide energy security.

Masking of price signals

In some circumstances, increased energy prices may be trying to reflect the underlying reality about the risks associated with particular energy sources, or the costs of supply or some combination of these. Measures which try to mask or remove this price signal will have a long term consequence of either encouraging higher demand than appropriate or discouraging competing supplies.

Protection or resilience?

Closely related to this are the long term consequences of attempts to 'protect' particular energy users from price changes or underlying risks. In many cases, short term protection may lead to a long term loss of resilience within the economy. A major challenge for government involvement in security is to be able to address short

term security issues without compromising the long term ability of the economy to make appropriate adjustments in response to genuine scarcity.

Certainty in some areas but uncertainty in others

A common government energy security policy is to provide subsidies to particular energy sources in order to increase their supply and provide additional security for energy consumers. As well as providing increased security to some market participants, this approach may also provide *insecurity* for others, in particular suppliers that must compete with those receiving a subsidy.

Short term measures do not change opportunity cost

A very common short term measure for dealing with energy security is for the government to hold a strategic reserve, or strategic stocks of a particular energy commodity (particularly oil). The idea is that stocks are purchased when prices are (relatively) low and then released to key users when prices are (relatively) higher. This is intended to minimise the impact of price shocks on key users.

These short term policies can be quite costly, sometimes with an effective cost higher than the price of oil even during periods of relatively high prices (Taylor and Van Doren (2005) argue that this is the case for the US Strategic Petroleum Reserve). Further, in times of oil shortages, it can be very difficult to know exactly when, and to whom, to release oil from the reserve. If reserves are not released at an appropriate time, the overall benefits are likely to be very small.

Facilitating resilience

Although there are a number of market mechanisms for dealing with energy security, and despite the tradeoffs involved in government attempts to provide security, governments do have a potential role in ensuring a facilitating environment within which energy markets can operate.

A large part of this facilitating role is the process of energy reform that leads to the establishment of well functioning energy markets. Some of the key elements of energy market reform that provide the long term environment for a resilient energy sector include:

- the separation of the power process into generation, transmission, wholesale and retail elements — this involves the removal of vertical integration in the industry and the clear identification of elements where competition is possible;
- the elimination of monopolies in power generation, allowing competing suppliers (preferably of different kinds of energy);
- the introduction of competition into wholesale and retail power markets;

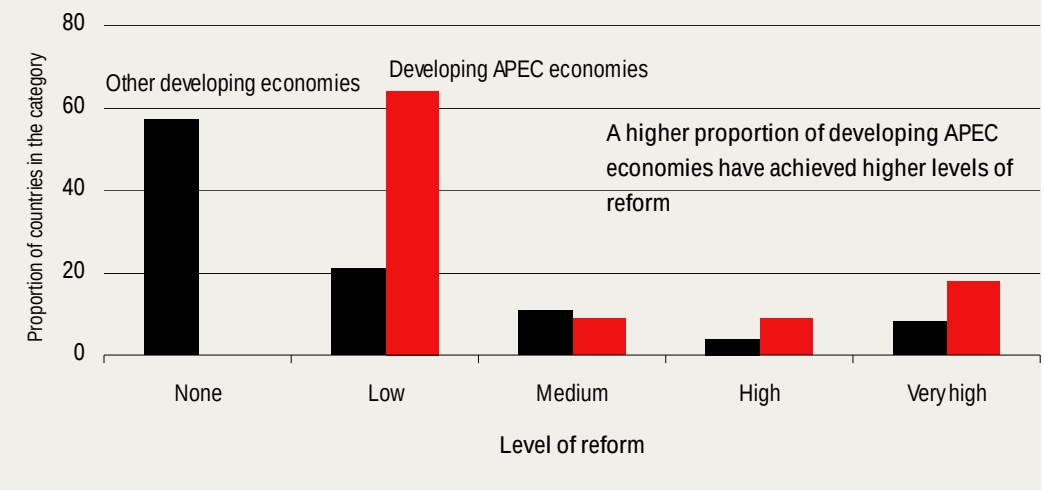
- the introduction of a competitive market for power, underpinned by appropriate institutional and regulatory arrangements; and
- where appropriate, the integration of regional power markets resulting in a national grid.

4 *The long term: energy reform leads to energy security*

The ongoing process of power sector reform

Power sector reform is an ongoing process throughout the world and in APEC. While, in general, developing APEC economies have achieved a higher level of reform than developing countries worldwide (see chart 4.1), there is nevertheless considerable scope for ongoing reform and regulatory development in most APEC economies.

4.1 **Proportion of economies at different stages of reform** Developing APEC versus other developing economies



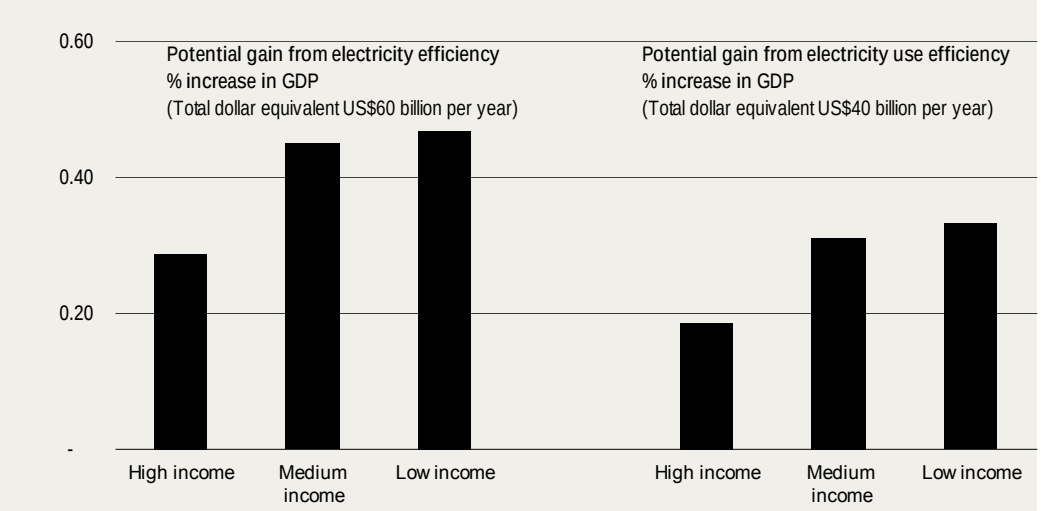
Data source: CIE estimates based on Besant-Jones (2006).

Benefits from ongoing reform

As noted above, there is considerable scope for further reform in all APEC energy markets. 'Traditional' reform in terms of moving from integrated power monopolies to competitive power markets has scope to bring considerable benefits. For example, if electricity market reforms similar to those undertaken in Australia are successfully completed in other APEC economies, then there is potential for gains in terms of annual increases in GDP both from increases in electricity efficiency and from

increased efficiency in the use of electricity. The magnitude of these gains is illustrated in chart 4.2.

4.2 **Potential gains from power sector reform** Average annual



Data source: CIE estimates based on GTAP model simulations.

This chart illustrates a number of points. First, the total potential gains are significant — in the order of US$100 billion per year, or up to one percentage point increase in GDP for some economies (compared with what GDP would otherwise have been). Second, the gains are relatively higher for the low income APEC economies.

How does reform contribute to energy security?

A number of the benefits from power sector reform that are generally understood to contribute to income and economic growth will also contribute to the economy's ability to deal with energy security issues.

Price signals to consumers

Appropriate price signals to all consumers of energy (industry and households) ultimately lead to better economywide use of resources. This has three important effects. First, this results in an increase in real income which, among other things, provides additional resources to deal with short term energy security problems. Second, providing appropriate prices to consumers also creates the opportunity to price risk within the energy market. Consumers most willing to pay for increased security will be able to do so, while consumers who do not value security as highly will not need to pay for it. Third, in times when there are inevitable shortages due to energy shocks of various kinds, transparent price signals indicate to consumers that it is important to conserve energy. In most circumstances, such rationing by price will be more efficient than administrative rationing.

The profit motive

In a competitive market, producers make money by reliably supplying to their customers. The need (and opportunity) to make a profit in a deregulated market gives producers incentive for the efficient use of inputs — in particular, finding lower cost combinations, including finding ways of dealing with short and long term security issues. In particular, it gives producers incentive to offer security as a product attribute. This is not to say that security issues are 'solved' through profit motive, but that they will be cost effectively dealt with.

Competition and costs

Competition tends to reduce costs and pass benefits on to consumers. As it is through the effects on final energy consumers that problems with energy security have an impact on economic growth, providing competitive alternatives and lower costs to consumers will help increase the overall resilience of the economy to shocks to the energy system.

Incentives for investment in generation and infrastructure

In the electricity sector, security of supply depends crucially on the existence of sufficient generation capacity, the existence of a portfolio of generation technologies to cope with variations in inputs, and appropriate transmission and distribution networks. Competitive markets, and in particular transparent costs and prices, provide clear incentives to investors to increase capacity where it is needed.

Dynamic efficiency

As well as providing energy using current technologies at low cost, competitive markets also provide incentives for innovation as firms seek new ways of making and maintaining profits (Fairhead et al 2002).

Available strategic research suggests that there are a range of feasible energy technologies that will be needed to provide energy security in the future (as well as to deal with climate change issues). These technologies include biotechnology and biomass, hydrogen systems, nuclear energy, wind and solar power, and various end use technologies (Edmonds et al 2007). The cost effective deployment of these various technologies will, in part, depend on the innovative actions of a variety of firms operating in competitive energy markets.

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