ASIA & THE PACIFIC POLICY STUDIES
Australian National University
Australian Government
Department of Foreign Affairs and Trade

Asia & the Pacific Policy Studies, vol. 1, no. 1, pp. 127–143
doi: 10.1111/j.2050-2680.2013.00004.x

Original Article

Reflections on Energy Security in the Asia Pacific

Ian Cronshaw and Quentin Grafton*

Abstract

This article reviews key past trends in energy security from the perspective of both International Energy Agency members and the Asia Pacific over the past 30 years, and assesses future energy risks. Developments in energy efficiency, unconventional oil and gas, and stationary renewable energy sources are highlighted. Lessons learned from past policy successes and failures provide the basis for 10 reflections to promote energy security in the region.

Key words: energy security, energy demand, Asia Pacific, China, India

* Cronshaw: International Energy Agency, Paris 75737, France; Grafton: Crawford School, The Australian National University, Canberra, Australian Capital Territory 0200, Australia. Corresponding author: Grafton, email <quentin.grafton@anu.edu.au>. Authorship is alphabetical. The views expressed in this article are those of the authors alone, and are not necessarily those of the Bureau of Resources and Energy Economics (BREE), the Australian Department of Resources, Energy and Tourism (RET), or the International Energy Agency (IEA). The article draws extensively on IEA data and projections especially those contained in the IEA World Energy Outlooks (WEO) of 2011 and 2012.

> . . . ensuring sufficient, reliable and environmentally responsible supplies of energy at prices reflecting market fundamentals is a challenge for our countries and for mankind as a whole.
> [G8 Leaders' Statement on Global Energy Security, St Petersburg, 16 July 2006]

1. Introduction

The risks of disrupted energy supplies have existed for developed economies for at least a century (Yergin 1991) and have helped shape global foreign policy (Yergin 2006). Energy vulnerabilities arise because of a dependence on a small number of key energy sources, where rapid substitution is difficult or impossible, and networks that are supplied from few sellers and/or from a restricted number of locations.

The world's biggest energy supply disruption in the past 50 years was during and after the October 1973 Yom Kippur War between Egypt–Syria and Israel, members of the Organisation of Petroleum Exporting Countries (OPEC) unilaterally increased their official prices by 70 per cent, reduced production by 25 per cent and imposed an embargo on 'enemy' countries (Grafton et al. 2004, p. 211). These actions disrupted global oil markets, quadrupled oil prices and diminished energy security for all net oil-importing countries. This oil shock also resulted in a major structural shift in the world economy that lowered growth and increased both unemployment and inflation.

The risks to energy supply networks do not just apply to oil nor are they only caused by

international conflicts. Disruptions to electricity generation networks in the form of cascading blackouts have had devastating, albeit short-lived, impacts. Natural disasters, such as the Japanese earthquakes in early 2011 and their aftermath, resulted in the complete shutdown of Japan's nuclear electricity generation capacity. Hurricane Katrina in 2005 severely disrupted oil and gas production in the Gulf of Mexico, but also had a major impact on oil prices globally as it temporarily closed down key refinery facilities.

A framework for assessing energy risks and their flipside, energy security, is the four As: availability of resources, accessibility to these resources, affordability in terms of generating energy flows from energy supplies, and acceptability in terms of social and environmental concerns (Asia Pacific Energy Research Centre (APERC 2007; Kruyt et al. 2009).[1] A similar list has been developed by Elkind (2010), who substitutes accessibility with reliability, defined as a robust and diversified energy value chain, and replaces acceptability with sustainability that he defines as energy systems that have a low impact on environmental quality. Three complementary perspectives to the four As on energy security include robustness, or the risks from known and predictable risks that require an engineering response; resilience, which focuses on unpredictable risks that demand a systems-based and economics focus; and sovereignty, which concerns itself with the actions and intentions of countries in the energy supply chain that is in the domain of international relations and global governance (Cherp & Jewell 2011).

The Asia-Pacific region is particularly vulnerable to energy supply risks as many countries are highly dependent on energy imports (Cherp et al. 2012), and major developed economies, such as Japan and Korea, are almost totally dependent on imported energy sources. The trend is for increasing dependence for major energy-producing countries in the region, such as China and India, as a result of the rapid growth in their economies. For instance, China is already the world's largest coal importer, is likely to become the world's largest oil importer before 2020 (International Energy Agency (IEA) 2012a, p. 119), and its gas imports are expected to account for more than 40 per cent of its gas demand in 2020 (IEA 2012a, p. 147). Unsurprisingly, China's quest for energy security is an important influence in terms of its 5-year plans and its international relations (Cheng 2008). Indian energy imports, which are also rising rapidly, could overtake China as the world's largest coal importer before 2020.

In this article, we offer insights about energy security in the Asia Pacific and review widely proposed strategies for managing energy risks, including greater diversification of network supplies, increased use of renewable energy sources, enhanced energy efficiency, and a greater use of biofuels and unconventional oil and gas sources. Our analysis includes an evaluation of the policy responses to the 1970s oil shocks, an examination of the multiple dimensions of energy security, an overview of recent trends in terms of oil, gas and the power sectors, and a description of likely future trends in the Asia Pacific. Based on the success and failure of the past and current strategies to promote energy security, we conclude with 10 reflections that provide a heuristic of the possible ways to promote energy security in the Asia Pacific.

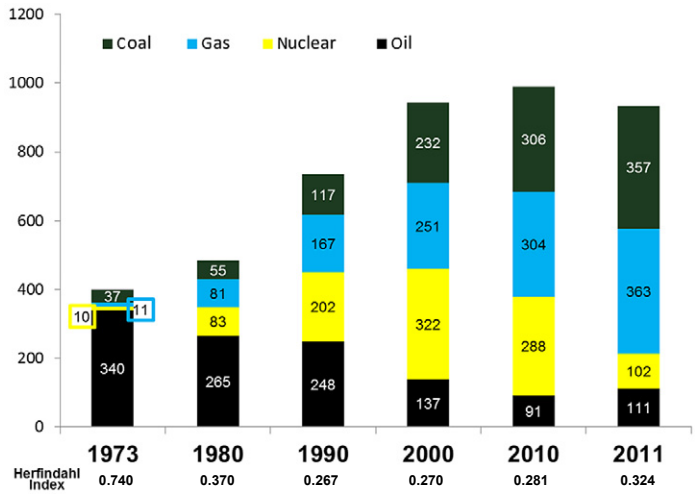
2. Responses to Past Energy Crises

In 1973–1974, and again in 1979–1980, global oil supplies were disrupted and oil prices rose dramatically. At the time of the first shock, members of the Organisation for Economic Co-operation and Development (OECD) consumed three-quarters of global energy production, and derived just over half of their total energy from oil.[2] As a result of the oil price shocks and deliberate government policies,

1. Sovacool and Brown (2010) compare indicators of energy security of OECD countries, and find that Demark and Japan had the greatest improvements in security over the period 1970–2007, while the United States and Spain had the greatest decline in security.

2. IEA member countries are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Netherlands, New Zealand,

Figure 1 Japan's Electricity Generation Fuel Mix 1973–2011



Notes: HHI = Normalised Herfindahl–Hirschman Index that has a value between 0 and 1.0. A value of 1.0 would indicate that only one fuel source provides 100 per cent of the energy inputs.

Source: IEA (2012b).

dependence on oil declined, especially in stationary energy generation, and local energy production rose. Over the 1970s and 1980s, energy intensity measured by energy consumed per value of output in larger OECD economies, and especially oil intensity, fell sharply as a result of structural adjustment and improvements in end use energy efficiency.

2.1 Diversification and Substitution

One of the most important tools to adapt to the 1970 oil crises was active policies of substitution and diversification in the power sector, driven by rapid oil price rises, fully transmitted to the sector, and in some cases active intervention. For instance, France was able to reduce oil use in its power sector by 90 per cent over the period to 1990 by increasing its nuclear power generation some 20-fold. Japan reduced its oil use in its electricity generation sector from more than 70 per cent in 1973 to less than 10 per cent in 2010, while more than doubling power output, through rapid diversification into nuclear, then coal, and gas (see Figure 1). Italy dropped its oil use from 70 per cent to just 6 per cent in its electricity generation sector over the period 1973–2010 using natural gas as the major replacement. All of these changes were actively managed by national governments.

2.2 Removal of Price Controls and Subsidies

The removal of price controls and subsidies on domestic oil and natural gas production in many OECD countries was a key and successful response to the oil crises. This encouraged more efficient end use of these commodities, plus stimulated hydrocarbon production in economies as different as United States (Alaska), North Sea (United Kingdom, Norway, Netherlands, Denmark) and Australia. Subsidy removal and higher energy taxes stimulated investment, and market reforms encouraged infrastructure expansion in gas.

Government initiatives in terms of energy efficiency programs, mandatory standards for appliances and vehicles, and the promotion of best practice in building construction also contributed to lower growth in energy demand.

Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States. OECD member countries comprise all IEA members, and in addition include Estonia, Iceland, Israel, Mexico and Slovenia.

Research and development programs helped accelerate these changes, increased fuel economy in vehicles and contributed to advances in coal mining techniques (such as long-wall mining), and also the development of lower polluting combustion technologies.

2.3 International Cooperation and Energy Security

As a direct response to the first oil crisis, OECD countries formed the IEA in 1974 to promulgate energy policy best practice, and to coordinate oil stock releases. Its formation recognised that individual country actions to seek new supplies at times of market shortfall would result in self-defeating price spirals. IEA collective response actions are designed to mitigate negative impacts of sudden oil supply shortages and have been deployed in 1991, 2005 and 2011.

Over time, energy security has become less focused on oil and has come to include gas and electricity security. As power supplies have become more dependent on gas, and the share of energy fuel imports has risen in many countries, gas security has received more policy attention. This has been accentuated by European gas supply crises, first in 2006, and then more severely in January 2009 with the disruption of gas from Russia.

2.4 Electricity Networks

The extreme dependence of developed economies on continuous power supplies is illustrated by the disruptions caused by blackouts (Farrell et al. 2004). For example, the January 1998 Eastern Canada ice storm caused power outages to 1.6 million people and was Canada's most expensive environmental disaster. City blackouts in major cities, such as New York, in 1977 and 1990 generated large costs, while regional blackouts, such as that occurred in northeast United States and Canada in 2003, or disruptions due to extreme weather events such as Hurricane Sandy in 2012, cost billions.

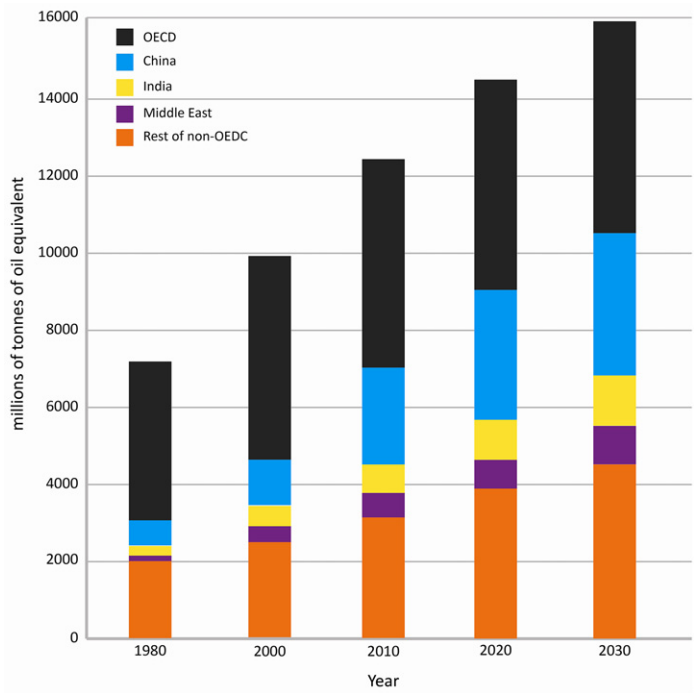
Critical to enhancing resilience of power systems is to manage generation and transmission networks as complex systems and to operate them at below their critical loadings (Dobson et al. 2004). It has been argued that the resilience of electricity generation networks can also be enhanced by distributed generation (Kahn 1979; Lovins & Lovins 1982) and by higher shares of intermittent renewable sources (wind, solar). Such approaches, however, require greater interconnection, power storage or enhanced demand-side responses. While improved power storage for intermittent energy sources will assist, and is under development, at present higher shares of wind and solar capacities in electricity grids are managed by increased capacities of back-up plants. Typically, these back-up plants are powered by natural gas that creates additional risks should gas supply networks be disrupted.

3. Trends in Global Oil and Energy Security

The geography and modality of global crude oil and growth in energy consumption is changing (see Figure 2). Non-IEA countries recently surpassed IEA countries in terms of oil use, and the global share of non-members will increase towards 60 per cent by 2030 (IEA 2011). Most new, non-OPEC oil output in the next 5 years will come from North America, sharply reducing its import flows.

A key trend is the growing proportion of oil refining closer to production, which will result in more oil traded as a refined product. Refinery closures in OECD countries, plus newly built elsewhere, are expected to result in four global centres of refining: the United States centred on the Gulf Coast, China, India and the Middle East. The concentration of refining capacity in a small number of locations poses additional supply risks for countries that lack capacity in oil refining. Two recent large disruptions to oil supplies related to natural disasters, the Japanese earthquake and tsunami of March 2011, and Hurricane Sandy in the United States, underline the vulnerability of energy systems. In both cases, no crude oil supplies were interrupted, butoil product delivery systems were heavily disrupted, and this in turn affected gas and power supplies.

Figure 2 World Primary Energy Demand: Per Cent Shares by Region—1980–2030



Note: Mtoe = millions of tonnes of oil equivalent.
Source: IEA (2012a).

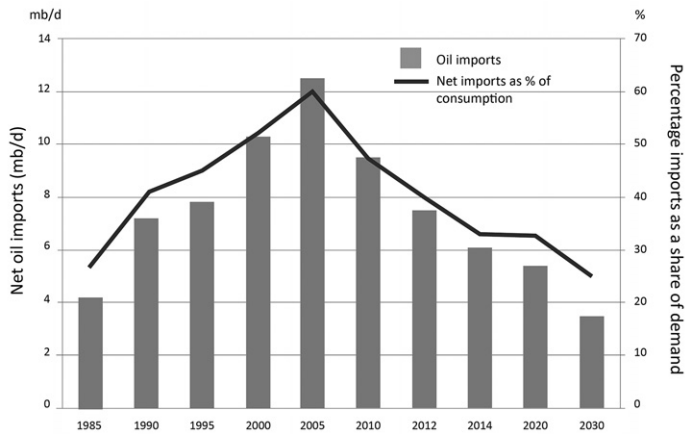
3.1 Unconventional Oil and Gas Extraction

In 2005, the United States imported over 60 per cent of its oil needs, but had already become a net oil importer back in 1950 as a result of steadily declining domestic oil output and growing domestic demand. As shown in Figure 3, since the mid-1980s, US net oil imports climbed steadily, from around four million barrels per day (mb/d) to 12.5 mb/d in 2005, with conventional wisdom predicting that the trend would continue. In reality, US net oil imports have fallen to 7.5 mb/d in 2012, and seem likely to continue to decline to average 6.1 mb/d in 2014 (EIA 2013).

Improvements in US oil security are because domestic oil and gas liquids output has grown rapidly from unconventional sources, supplemented by biofuels, totalling 10.4 mb/d early in 2013, while demand, which peaked in 2005, has continued to fall. Areas such as the Bakken Basin in North Dakota, where oil output was virtually non-existent at the beginning of 2007, saw oil production rise beyond 700 kb/d by the end of 2012. This production is based on unconventional gas production techniques developed over 20 years, but only widely deployed since around 2009. Other countries are keen to progress unconventional oil developments as an energy source, notably China, but lack the long experience that preceded the rapid build-up of gas and increasingly liquids output witnessed in North America (IEA 2012f).

IEA projections indicate that supply will continue to increase in the United States, as liquids output grows, driven by ongoing technology improvement and deployment, and high oil prices, coupled with vehicle fuel efficiency improvements, drive demand lower. The combined effect of these likely developments is that US net oil imports are expected to fall to around 5 mb/d by 2020 and 3.5 mb/d around 2030, about a quarter of the forecast demand.

Figure 3 United States Net Oil Imports as Proportion of Consumption



Note: mb/d = millions of barrels per day.
Source: 1985–2014 EIA, 2020–2030 IEA, 2012a.

3.2 Asia-Pacific Oil, Gas and Coal Imports to Grow

For countries in the Asia-Pacific region, the energy outlook is dominated by rapid economic growth that is expected to lift hundreds of millions out of poverty and increase oil and electricity use. Among the 21 members of the Asia-Pacific Economic Co-operation (APEC), oil demand is expected to increase some 30 per cent between 2010 and 2035, while electricity demand and total energy demand are projected to rise 80 per cent and 44 per cent, respectively, over the same period (APERC 2013a).[3] Greater private motor vehicle penetration, already observable in most of developing Asia, will place greater strain on regional oil supplies as oil is expected to remain the primary fuel within the APEC transport sector and should still account for a very high proportion of domestic transport demand in 2035.

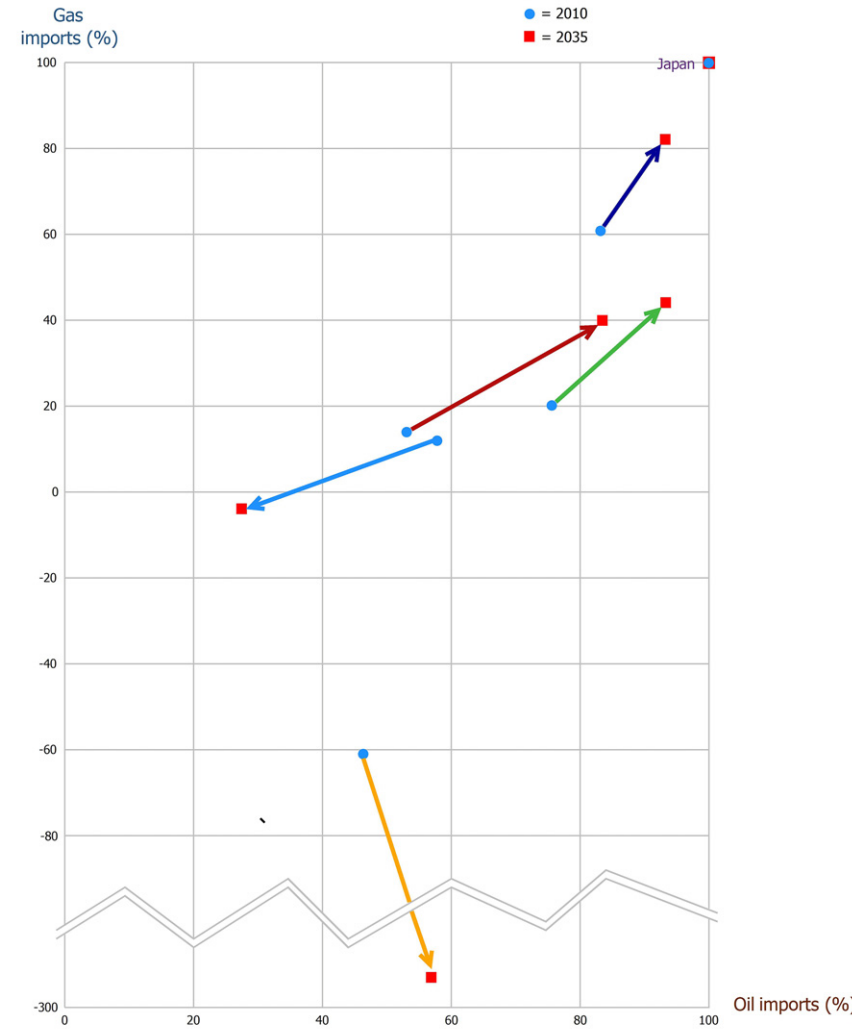
Related to large increases in energy demand in many emerging economies in the Asia-Pacific region, oil import dependence is projected to grow (see Figure 4). In China, for example, just over half of consumption is met from imports, and this is expected to be more than 80 per cent by 2035, while imports are expected to meet 40 per cent of its gas needs by that time (IEA 2012a), with some forecasts as high as 60 per cent (APERC 2013b). Similar trends can be seen in all major energy users such that oil imports into APEC countries are projected to grow by more than half between 2009 and 2035 (APERC 2013a). In particular, India is expected to have 90 per cent oil import dependence before 2035. Association of Southeast Asian Nations (ASEAN) member states will see increasing oil import dependence from around 35 per cent to more than 70 per cent over the next two decades, although they should remain, in aggregate, net gas exporters.[4]

China and India have rapidly emerged also as large coal importers, initially of coking, but increasingly thermal coal. Although the share of total use of these coal imports is relatively small, the volumes are large. Increasing energy imports can be seen in almost all energy-consuming regions, with the exception of North America, the Middle East and Russia.

3. APEC economies include Australia, Brunei Darussalam, Canada, Chile, China, Hong Kong China, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, The Russian Federation, Singapore, Chinese Taipei, Thailand, United States and Vietnam.

4. ASEAN member states include Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

Figure 4 Trends in Oil and Gas Dependency in Selected Economies 2010–2035



	AUSTRALIA		EU		INDIA		CHINA		USA		JAPAN	
	2010	2035	2010	2035	2010	2035	2010	2035	2010	2035	2010	2035
Gas Imports %	-61	-293	61	82	20	44	14	40	12	-4	100	100
Oil Imports %	47	58	82	92	74	92	52	82	58	28	100	100

3.3 Interregional Gas and Coal Trade Will Grow

Long-distance gas trade is likely to grow, with pipelines transiting multiple countries or via long seaborne routes. Interregional gas trade should account for around a quarter of global gas use by 2035, up from less than one fifth today. For Asia, such interregional trade will rise to 30 per cent of gas demand compared with 6 per cent today (IEA 2011, 2012a). More than 40 per cent of China's gas demand is expected to be sourced via long distance trade, while India will import nearly half its gas demand via long-distance trade.

Liquefied natural gas (LNG) is expected to account for a growing share of interregional trade. Total LNG trade can be expected to

approach 500 billion cubic metres (bcm) before 2020, up from 230 bcm in 2008 as a result of massive output increases in Qatar and Australia. North American LNG supplies to the Asia Pacific are expected from 2016 onwards and will diversify gas supplies in terms of origin, pricing and market liquidity (Bureau of Resources and Energy Economics 2012).

Increased coal imports into Asia by seaborne routes are expected over the next two decades. China emerged as a large coal importer only in 2009, after being a large net exporter as recently as 2005. Coal imports in 2012 of about 235 million tonnes (Mt) were the largest ever recorded by a single country, but still represent less than 10 per cent of Chinese coal demand (Cronshaw 2013). The IEA anticipates that Chinese efforts to improve energy intensity, and to diversify its power sector, are likely to reduce its thermal coal imports over the medium term. Nevertheless, coal will still dominate and is expected to account for over half its electricity generation by 2035 (APERC 2013b). India has also seen a rapid rise in coal imports that now account for about one sixth of its domestic demand, up from very low levels only 5 years ago. This increasing import trend is expected to continue (The Energy and Resources Institute 2013), and before 2020 India could become the world's largest coal importer.

In summary, the Asia Pacific can expect to see a rapid growth in the proportion of oil, gas and coal needs that are imported, generally over longer distances, both overland and seaborne trade. While defining energy security in terms of a single metric is inappropriate (Kruyt et al. 2009), greater import dependence will bring increased risks to the region.

4. Alternative Fuels, Renewables and Energy Efficiency

Three recent developments in terms of energy systems include the growing importance of alternative fuels, stationary renewable energy sources and energy efficiency. These developments have been supported by governments for both climate change mitigation purposes and to enhance energy security.

4.1 Alternative Fuels

Oil dominates road, sea and air transportation. The use of alternative liquid fuels, either gas to liquids, shale or coal to liquids, or biofuels, remains relatively small, although biofuels have grown to around 2 mb/d of liquid fuel use, or around 1.8 per cent of global oil use. The United States accounts for around half this total, while Brazil and Europe represent much of the remainder. About three quarters of biofuels are in the form of ethanol, made from sugar, corn or other agricultural sources.

In non-OECD Asia, China is the major biofuels producer, with around 50 kb/d of output, mostly ethanol. Indonesia and Thailand are also major producers, and Indonesia is a large biodiesel producer, based on palm oil. By 2020, biofuels output in non-OECD Asia could grow to around 200 thousand barrels per day (kb/d) from its current 120 kb/d, providing a useful supplement to crude oil demand that is expected to reach 24 mb/d (IEA 2012b, 2012e). Further growth in biofuels will require greater deployment of non-food feed stocks from agricultural wastes, such as straw, corn husks, or non-food crops, such as grasses. To date, progress in this technology has been slow, and will probably depend on North America and Europe demonstrating its feasibility. In Asia, agricultural residues are already widely used as traditional biomass energy sources, and arable land is both limited in supply and already used intensively. This limits the prospects of growth in the first or second-generation biofuel production in the region.

4.2 Renewable Energy

It is widely believed that renewable energy sources can increase energy security because they reduce the need for imported fuels. Nevertheless, the integration of a greater share of renewable power sources into power grids, such as hydro, wind and solar, creates new challenges because they are dependent on time of day and variable weather conditions (IEA 2013, p. 7). For example, where hydroelectric power dominates, such as Brazil,

New Zealand, Norway and Tasmania, or where interconnection is either impractical or not available, the reliability of the power grid can be compromised in periods of low rainfall. Solar and wind generation also require back-up power in the form of energy storage, fast 'start-up' through electricity generated from gas turbines, by greater spatial integration of renewable supplies, and more responsive demand, such as through smart grids.

In some jurisdictions, capacities of renewable energy sources are such that they can meet 100 per cent of demand for periods of hours or even days, but when wind or solar are unavailable, power reliability is ensured by back-up generation. In turn, back-up power helps determine the reliability of the whole system. Where such power is delivered by a reliable domestic source, the system can be secure. If delivered by systems that depend on imported marginal gas or oil sources, the power system will only be as secure as those supplies.

4.3 Energy Efficiency

The United States shows that increasing supply, coupled with efficiency policies, such as vehicle efficiency standards, can substantially reduce oil dependency. Energy efficiency alone, especially over the short to medium term, however, cannot eliminate energy risks. For example, Japan is one of the world's most energy-efficient economies, but is virtually 100 per cent dependent on imported energy.

Increased energy efficiency in electricity generation can help manage peak demand. These peaks may only arise for less than 100 hours per annum, but still can impose severe technical strains on electricity generation systems to deliver a high-quality power supply, and are frequently associated with short-term blackouts. Peak demand also places severe financial strains on network costs, raising system investment demands in both generation and distribution in ways that raise electricity prices for all consumers.

Policies that effectively reduce peak demand, through more efficient building design, more efficient appliances, peak 'shifting' with smart metering and arrangements with large users to switch their time of usage, can markedly improve network security and lower network costs. Such measures can also improve gas system reliability because gas is often the fuel of choice for generating peak power. While energy efficiency can generate security gains, it is just one of a suite of appropriate instruments, supplemented by traditional risk management tools of diversification of supply and routes, redundancy, and enhanced network resilience.

5. Energy Risk Factors

Oil markets have been globalised for decades, and any major supply or demand shocks quickly become global in scope and impact. As a result, the cooperative security mechanism of the IEA's stock release program was created, and subsequently refined. Oil stocks held in IEA countries now amount to some 4.1 billion barrels, of which 1.5 billion barrels is government stock held exclusively for emergency use (IEA 2012d); the United States alone holds around 700 million barrels of crude oil in its Strategic Petroleum Reserve. These very large IEA oil stocks are capable of supplying 2 mb/d for 2 years, or 4 mb/d for 12 months, and represent a large supply security buffer given that global oil demand is around 90 mb/day.

IEA member countries are well aware of the growth in oil consumption in non-member countries, and the need to involve other nations in collective security measures. Emergency response simulation exercises, a key tool for developing and maintaining expertise to meet oil supply disruptions, have since 2002 included participation from China, India and some ASEAN countries. Any actual use of emergency stocks, as occurred in 2005 and 2011, involves close coordination with major oil-producing states and with major oil users not in the IEA.[5] Cooperative security arrangements facilitated by the IEA include ways to improve the quality, completeness and timeliness of oil market data, and to enhance market transparency and market functioning—key

5. IEA members in the Asia Pacific are Japan, Korea, Australia and New Zealand.

actions agreed to by G8 leaders in 2006 to improve global energy security (see Appendix 1).

5.1 Gas and Coal Security

An examination of recent supply crises highlights some valuable lessons in terms of gas and coal security. In the case of North America, some 20 per cent of its gas supply was disrupted for several months as multiple hurricanes, starting with Hurricane Katrina at the end of August 2005, affected gas production, pipeline infrastructure and power supplies which underpin gas delivery. Nevertheless, despite the disruptions, the integrated and efficient North American gas market responded surprisingly smoothly to this supply problem, with strong price signals that resulted in storage drawdowns and fuel substitution, especially in the power sector.

Europe, with much less dense pipeline interconnections than North America, and ones that cannot be quickly reversed for physical or contractual reasons, was especially affected by temporary gas supply disruptions in 2006 and 2009 (Elkind 2010, pp. 134–7). In early January 2009, when seasonal gas storage was under pressure and power demand was high, Russian gas supplied through Ukraine was cut. This, in turn, severely disrupted gas flows, especially to southeastern Europe. One of the biggest contributors to alleviating the supply shortage was stock drawdown in the United Kingdom, driven by rapid changes in price differentials in differing parts of the European market. Spot LNG purchases were also quickly mobilised to supply southern Europe.

Traded coal markets draw supply from key exporting countries, including Australia, Indonesia, Russia, Colombia and North America. By contrast to gas, coal markets have proven to be resilient to weather-related interruptions. In part, this is because users who rely on long seaborne supply chains routinely stockpile coal close to consumption points, which is much cheaper than storing imported gas. Where substitution of coal and gas is feasible within the electricity generation sector, coal storage can act as a buffer to possible disruptions in gas supplies.

5.2 Electricity Security

The lessons learned from the power blackouts of the early 2000s, seen in North America, Europe and Australia (Farrell et al. 2004; IEA 2005), stress the importance of timely investment throughout the energy supply chain. In particular, electricity generation investment must be matched to transmission and distribution infrastructure. Multiple sources and delivery paths as well as flexible market mechanisms that can rapidly respond to disruptions provide for greater energy security.

Greater spatial grid integration can bring important reliability and affordability benefits, but market design and control structures must match. Geographically dispersed spatial grids can also help in the integration of large intermittent renewable energy because a larger generation area can smooth out variations in wind and solar conditions while allowing for more opportunities to provide back-up power and export surpluses.

Diversity of electricity-generating options can provide greater security to gas, coal and even oil supplies, where there is the possibility of rapid fuel switching. By contrast, intermittent renewable energy sources can reduce flexibility especially if fossil fuels, such as gas, are needed as back-up. In the most secure power systems, variable renewable capacity is handled through a mixture of generating flexibility, transmission, demand-side responses and even power storage.

A major energy security challenge is the provision of peak power supply. This is because of the increasing use of high-energy demand appliances, such as air conditioners, at peak times, and because peak pricing market signals are often absent. Demand-side approaches, based on large industrial users, have proven to be a cost-effective response to these pressures. Managing peak demand also requires timely infrastructure investments and the management of electricity generation grids in ways that avoid critical loads (Dobson et al. 2004).

6. Energy Security in the Asia Pacific

In the case of oil, Japan and Korea have acted to diversify their energy sources and supply routes, particularly in the stationary sector, and notably in terms of electricity generation. They were pioneers in seaborne thermal coal trade and LNG development, underpinned by long-term contracts that were required to cover the high capital costs of supply. Both countries instituted effective energy efficiency measures, including in the transport sector, through subsidy removal and taxation, along with regulation in vehicle efficiency and household appliances. They have also participated in IEA collective actions, recognising that oil security is a global market issue, even when recent oil problems were located in the Atlantic basin. Nevertheless, interconnection in power and gas market has been slow to occur in Japan, and this has reduced its security and flexibility to natural disasters.

6.1 China's Energy Security

China is the world's largest consumer of primary energy, and has recognised that despite its large fossil fuel reserves and considerable renewable energy potential, it faces important energy security challenges (Cheng 2008). China is expected to import two thirds of its oil by 2020 and has established a system of strategic oil reserves, initially 350 million barrels of crude oil, or around 50 days of net imports by the time of its completion later this decade. Its key national oil companies (China National Offshore Oil Corporation and Sinopec) have built-up reserves and production overseas, collectively spending $92 billion since the start of 2009 on the purchase of oil and gas assets beyond China's borders. While not an IEA member, China has participated in emergency response exercises since 2002. Fuel efficiency, electric vehicles, greater mass transit and railway systems are all being pursued to lower oil use in the transport sector, although its transport energy demand is still expected to increase by almost 4 per cent per year between 2010 and 2035 (APERC 2013b).

China's power sector, the largest in the world, is overwhelmingly coal-dependent (IEA 2012c). Partly in reaction to its growing import dependence, its electricity generation sector is being diversified rapidly, although coal is still likely to account for two thirds of power output in 2020. Diversification is being pursued by expansion of non-coal energy production, including hydro, new renewable energy sources, nuclear and gas, including unconventional gas. China has also set ambitious targets to improve its energy intensity—or energy use per unit of economic output—and a carbon tax is currently being trialled for large emitters in particular locations. Despite these efforts, its energy and carbon intensity is expected to remain well above OECD best practice levels even by 2035 (IEA 2012a).

Until recently, China met all its energy needs from its own resources, but beginning with oil around 20 years ago, and then extending to gas and coal, imports are becoming much more important, with attendant security concerns. China's rapid increases in car ownership and growing per capita income will continue the trend of increased oil use and oil imports.

China is addressing its energy security challenges with vehicle efficiency standards, the promotion of alternative fuels and electric vehicles, plus crude oil stockpiling. Its electricity generation sector, long dominated by coal, features massive new builds of gas, nuclear, hydro and new renewable sources intended to reduce the growth in coal consumption. New and more efficient coal-fired plants will also enable older, smaller, less efficient plant to be retired. Nonetheless, coal will remain the dominant fuel for power generation in China for decades to come.

6.2 India's Energy Security

India is the world's fourth largest consumer of primary energy. It faces similar energy security issues to China in that it is becoming increasingly reliant on imported energy sources, especially fossil fuels. It also urgently wants to provide reliable, modern energy in the form of

electricity to a majority of its population that requires large investments to increase energy supplies and security.

To maintain its rapid growth trajectory, India will need to increase its primary energy supply by three- to fourfold over the next 20 years (The Energy and Resources Institute 2013). Oil imports currently account for about 80 per cent of total demand and represent about one third of the total value of all imports. Increasing oil dependence is expected over the coming decade. As a response to its increasing oil dependence, India has begun to establish a strategic petroleum reserve with the first storage site of 1.33 Mt under construction, with an additional 4.0 Mt planned in the first phase of construction. By comparison, India imported over 170 Mt of crude oil in 2011–2012, an increase of 5 per cent from the previous year, while domestic oil production some 38 Mt in 2011–2012, which was some 18 per cent greater than it was a decade earlier (The Energy and Resources Institute 2013).

Efforts to expand domestic energy sources have not been wholly successful. Offshore oil production is static, gas production is more or less unchanged over the past three years, and coal output growth has slowed sharply. As a result, India is becoming increasingly reliant on fossil fuel imports. This represents an energy security challenges given that collectively coal, oil and gas account for over 90 per cent of the commercial Indian energy supply.

Coal production and imports illustrate the challenge facing India in terms of its energy security. Coal accounts for over half of India's total energy supply and is the fuel source for 56 per cent of the installed electricity generation capacity. Total coal production in 2011–2012 was some 540 Mt. While production increased by about 6 per cent per year over most the previous decade, it has failed to match the growth in consumption of over 8 per cent/year. Further, in 2010–2011 and 2011–2012, growth in coal production was much less than in previous years, and was, respectively, 0.1 per cent and 1.4 per cent. As a result, coal imports have increased rapidly, rising from about 25 Mt in 2002–2003 to some 100 Mt in 2011–2012 (The Energy and Resources Institute 2013). While India has very large coal resources or some 300,000 Mt, only 40 per cent represent reserves, and of this proportion about 60 per cent are located below 300 m, which makes these reserves inaccessible with open-cast mining techniques currently employed in India.

The most pressing energy security issue facing India is the need to match growth in demand in electricity with its generation. While installed capacity is rising rapidly, it grew some 15 per cent in 2011–2012—this increase has fallen short of planned targets while the growth in network transmission lines has been much less, or some 5 per cent in 2011–2012. Despite improvements in electricity generation capacity, a total deficit between electricity demand and supply of about 8 per cent remains. Further, and in part due to this deficit and deficiencies in network structures, in August 2012 the temporary breakdown in three of India's transmission grids caused blackouts and/or brownouts to hundreds of millions of Indians.

6.3 Japan's Energy Security

Japan's energy resources are meagre, and concern about security of supply has always been high in its energy agenda. Energy self-sufficiency is not possible, so efforts have concentrated on a range of policy measures to ensure reliable, competitively priced energy.

Diversification in the power and industry sector has been vigorously pursued, with a rapid expansion of nuclear power and coal and gas use. Nuclear power peaked in 2010 at 27 per cent of Japanese power output. Following the Fukushima accident and the subsequent closure of most of Japan's nuclear industry, official government plans are putting more emphasis on energy efficiency and renewable energy sources. In the interim, increased gas-fired power has been the most important contributor in filling the energy supply gap. Energy efficiency has also been successfully and widely implemented, with ongoing improvements in energy intensity of

around 1 per cent per year between 1980 and 2010.

6.4 Australia's Energy Security

Australia's geography precludes physical network interconnection with other markets, and its resource endowment has enabled it to develop energy-intensive industries. In particular, it has developed an important coking and steaming coal export trade and a rapidly growing trade in LNG. By 2018, Australia is likely to become the world's biggest LNG exporter (Bureau of Resources and Energy Economics 2013).

Demand for oil in Australia has increased steadily over the last decade, with three quarters of the use in the transport sector. Domestic oil production is declining and national refining capacity is falling. As a result, a greater proportion of oil and refined product demand is expected to be sourced from international sources, and in 2010–2011 over 80 per cent of Australia's crude oil and other refinery feedstock was imported. The refinery imports will be met by drawing on international oil and product markets that are increasingly centred on Asia.

A near two-decade-long ongoing program of market reform in Australia's energy generation sector has encouraged large-scale infrastructure investment, and has linked previously separate regions and provided both greater competition and increased reliability. As part of the reforms, previously isolated states, such as South Australia and Tasmania, have been connected to national energy networks, with important cost, security and price benefits.

7. Reflections on Energy Security

Countries within the Asia-Pacific region vary enormously in their energy endowments, as well as in their physical, social, cultural and economic backgrounds. Nonetheless, some observations can be made on how energy security might be enhanced in the region despite increasing import dependence in oil, gas and coal.

7.1 Energy Security Is Not Just about Oil

Increasingly, energy policy is directed at achieving a secure, reliable, competitively priced energy supply, with a sustainable impact on the environment. In many cases, policies directed at improving energy security can produce positive environmental and reliability results. For example, improved vehicle efficiency can lead to improved environmental outcomes, while potentially reducing the cost of transport in a cost-effective way. Removal of energy subsidies can result in a more efficient energy delivery system, while social impacts can be more effectively delivered in other ways. Diversification in the power sector can also increase the share of low carbon alternatives, such as hydro, nuclear and new renewable energy sources, noting that competitive markets may not always lead to low carbon outcomes in the absence of a carbon price or renewable energy targets.

7.2 Gas, Coal and Power Markets Need Attention

Gas and coal are key sources of stationary energy. Unlike oil, where substitution in terms of transport use is difficult, these fuels can be substituted readily, especially within the electricity generation sector. Increased globalisation of the gas and coal markets and their interlinkages within the power and industry sectors requires greater attention to ensure resilient and robust supply chains.

7.3 Price Is a Powerful Signal of Scarcity

Prices are a powerful signal of the value of a commodity, including its security and environmental costs. Many consumers in non-OECD countries have enjoyed subsidised prices that can result in inappropriate consumption patterns and investment choices. Where possible, subsidies and price controls for fossil fuels need to be removed while recognising social and equity concerns. To do otherwise will allow inefficient consumption patterns to continue, and stifle the long-term investment in supply

and efficient energy use that are the central features of secure, sustainable energy supplies.

7.4 Price Signals Also Need Effective Supplementary Policies

Markets and price signals are effective at allocating scarce resources within energy systems to their highest value in use. However, externalities associated with energy use, such as carbon emissions, and actions that may not generate a return to investors, such as the provision of information or basic research on energy conservation and efficiency, are likely to be underprovided. Coordination and effective planning across competing energy suppliers and users are unlikely to be provided by market incentives alone. As a result, government policies to assist in basic research, the internalisation of external costs, information provision, promotion of energy efficiency, and coordination in investment and networks can improve energy security.

7.5 Portfolio Management Is a Key Risk Management Tool

Energy diversity is a proven approach to manage risk, coupled with measures to stimulate domestic energy output. Diversity in traditional energy sources, supply routes and mode of supply can all improve resilience in the energy sector. Non-fossil fuel and renewable energy sources have a place in well-balanced electricity mix that can assist with greenhouse gas mitigation, and also deliver important efficiency and environmental gains.

7.6 Sound Long-Term Investment Policies Are Important

Rapid growth in energy demand, and the need to rapidly augment existing supply sources and to develop new ones such as newer renewable and unconventional hydrocarbon output, argue for stable long-term energy investment policies. The long lead times for some parts of the energy value chain, such as stock building, nuclear power plants and long distance, complex gas pipeline or power transmission lines, underline the importance of sound planning and investment decision making to lower risk and to provide longer term stability. The enormous capital expenditures in both maintaining and expanding existing energy networks also demand a stable business environment so as to encourage private investment.

7.7 Weather-Related Disruptions Require Critical Infrastructure Planning

Greater connectedness poses energy risks arising from weather or natural disasters. Thus, there is a role for government in monitoring the development of oil, gas and power infrastructure, identifying weaknesses that markets may not be addressing, and strengthening such networks.

7.8 Energy Security Is Everyone's Problem

Both seaborne and overland energy trade will grow substantially within the Asia-Pacific region, including oil, gas, coal and electricity. Oil markets are already global such that a problem in one region can rapidly become a global challenge. This interconnectedness will develop for other energy sources. Thus, international collaboration will become more important in the coming decades. As the Asia-Pacific region becomes a more important refining centre, especially in China and India, the appropriate level of crude oil stocks held close to those refineries will need careful consideration.

Cooperation can provide multiple benefits for energy interconnection and transit across countries. In turn, this can empower energy investment by, for example, enabling energy supplies, such as hydroelectric power to be used across the region. The closely integrated North American gas, oil and power markets show how important transit rules can be in promoting affordable, reliable energy at a continental scale. The European Energy Charter, established in 1991 to provide a multilateral rules-based framework for Eurasian energy

transit, is a useful starting framework for cooperation in the Asia Pacific, as are the fora on energy security initiated by APEC.

7.9 Emergency Planning and Preparedness Pays Dividends

The release of oil stocks is one method of responding to oil supply crises. While the global nature of oil markets makes international collaboration essential, the use of stocks must be transparent and credible to markets if the measure is to be effective. Advanced planning and preparation on energy security mechanisms, as well as the preparation of methods to deal with disruptions in other energy supplies, are also needed. Identifying ways to rapidly lower energy demand while minimising economic damage are additional and useful tools for managing supply disruptions, as is the identification of logistic, legal and other challenges to the supply chain.

7.10 Redundancy Costs but Has Value

Numerous examples exist of markets being supplied from a single gas or power source suffering severe energy disruptions when that source fails, through network failure or by accident. The evidence is that multiple supply sources, supplied through a resilient grid, will deliver a more reliable service, and can provide a more competitive environment. These benefits help offset the additional costs associated with investments in redundancy and back-up systems.

8. Conclusions

Complete energy self-sufficiency is not an option for any country in the Asia Pacific, and increased import dependency is expected for many. Greater energy trade and physical interconnection, both within and between countries, argues for greater regional coordination and cooperation on energy security issues. An important part of this collaboration will be increased transparency in market developments, investment, production, consumption and stocks of key energy supplies.

The history of energy security shows that while oil shocks remain an important risk, vulnerabilities exist all along the supply chain, including gas and coal, and especially in electricity generation networks. The only certainty is that the energy future in the Asia Pacific will be uncertain. Technology, the increasing demand for better environmental outcomes and improved energy services will all drive global and regional energy markets in unpredictable directions. These uncertainties require approaches that support robust and resilient energy networks, and that promote flexible and resilient energy systems and markets.

Market-based approaches are required to ensure that energy prices reflect scarcity and external costs. If supplemented by carefully targeted government interventions in terms of research and development, information provision, the coordination of energy networks, and critical infrastructure planning, energy security in the Asia Pacific can be enhanced despite large projected increases in energy demand for the region as a whole.

July 2013.

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Appendix 1: Summary of the St Petersburg Plan of Action on Global Energy Security, July 2006

The G8 Leaders' Declaration elaborated seven key action areas to improve global energy security.

1. Increasing transparency, predictability and stability of global energy markets. The implementation of the then Joint Oil Data Initiative (JODI) was seen as a key practical step.
2. Improving the investment climate in the energy sector. Better risk sharing was identified, with diversification between different types of contracts.
3. Enhancing energy efficiency and energy saving. Reducing vehicle fuel demand was a high priority.
4. Diversifying the energy mix. Nuclear, renewables (including forests) and new technologies were highlighted.
5. Securing critical energy infrastructure, noted the interconnected and mutually dependent nature of critical energy infrastructure, and its vulnerability to deliberate attack.
6. Reducing energy poverty, international financial institutions were identified as having an important role in alleviating energy poverty.
7. Addressing climate change and sustainable development, reaffirmed the previous year's Gleneagles Agreement, to stabilise greenhouse gas emissions at levels that prevent climate change impacts.