# Strategic Framework for Energy Security in APEC: An Update

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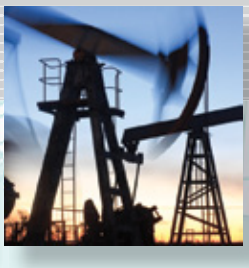
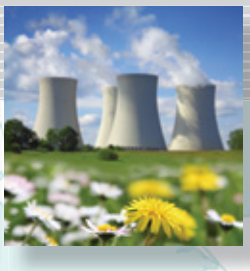

## I. Preface

In 2008, the APEC Business Advisory Council and the National Center for APEC commissioned the East-West Center to do a study[1] (hereafter the 2008 Study) of energy security in APEC that could be used to develop a strategic framework for action. The study, *"Strategic Framework for Energy Security in APEC,"* outlined four themes to regional energy security: expand and diversify supply of energy resources; manage energy demand through conservation and efficiency; promote efficient energy markets; and clean energy use and technological innovations. Today, energy security—defined as access to reliable, affordable, and environmentally sustainable supplies of energy—is still a top priority in Asia and the Pacific. Now amid elevated and volatile energy prices, the threat of inflation in some countries, and deflationary debt traps in others, it is important that some of the key elements illustrated in the 2008 Study be revisited. It is even more critical for the APEC community to identify priorities and implement policies that help expand and diversify its energy supply, strengthen regional energy security, and reflect the critical role of energy demand in fueling the region's economic vitality.

This study will provide APEC Leaders with a revised strategic framework to advance policy development and implementation and align the Leaders' multiple goals for energy and develop a long-term integrated strategy with measurable objectives for improvements in the areas of energy security, efficiency, and technology innovations.

The focus of the study—energy security—has many intertwined dimensions, particularly for a group of economies as diverse as APEC. As such, energy security should be broadly defined to include economics (adequate supply), market (free flows and minimization/removal of barriers), geopolitics (access to resources), efficiency (demand management and conservation), environmental (clean fuels), and other dimensions. While a regional strategy for enhancing national and regional energy security could touch on literally hundreds of topics and tactics (such as increased oil stockpiling, bilateral energy cooperation, and free trade agreements), this report focuses on areas where efforts by APEC could have the largest effect on improving long-term energy security.

As we did in the 2008 Study, the framework presented in this updated report continues to restrict itself to four broad objectives that seem both most urgent and most underdeveloped:

- Objective No. 1: Expand and Diversify Supply of Energy Resources
- Objective No. 2: Promote Conservation and Improve Efficiency
- Objective No. 3: Promote Open and Efficient Energy Markets
- Objective No. 4: Clean Energy Use and Technology Innovation

Policy recommendations for each objective are included at the conclusion of the report.

[1] See K. Wu, F. Fesharaki, T. Hosoe, D. Isaak (2008), *Strategic Framework for Energy Security in APEC*, East-West Center, Honolulu, Hawaii.

## II. Background

The 2007 Darwin and 2010 Fukui Declarations on energy security are fundamental cornerstones of the APEC energy agenda. Individual economies have and can continue to lead critical components of this agenda: Singapore (efficient energy market), Japan (efficient use of energy), the United States (energy demand management), Russia (expansion of energy supply), and Indonesia (diversification of energy sources). As the hosts of the APEC Leaders' meetings of the recent past as well as through 2013, these economies offer unique opportunities to address the policy issues underpinning these four themes. The APEC agenda on energy security and sustainable development will move forward substantially if each of the four themes and related issues can be turned into policy actions and implemented over the coming years. In the meantime, any framework to enhance energy security in APEC will have to recognize these dual mandates without giving priority to one over the other.

### *A. History of Energy Policy Discussions within APEC*

Since the latter part of the last decade, APEC Leaders and Energy Ministers have addressed the issue of energy security on numerous occasions. The reality facing the APEC community and the world at large in terms of current and future energy demand and supply has also help put energy security on the center stage for future energy development in the region.

As noted in the 2008 Study, the issue of energy security has been consistently highlighted as a concern by APEC Leaders since 2004. In 2007, Energy Ministers met in Darwin, Australia where they "determined the challenges of energy security and sustainable development should be based on well-functioning markets that are progressively characterized by free and open trade, secure and transparent frameworks for investment, market-based price signals, market transparency, good governance and effective competition." They also recognized the need to accelerate the development of clean and efficient energy and to devise methods to reduce greenhouse gas emissions, including the facilitation of clean technology use and trade within the region, thus creating, a multifaceted challenge of ensuring energy security in the region amid increasing demand, stagnating supply, and emissions constraints.

This initiative was expanded in June 2010 with the Fukui Declaration. Specifically, the ministers focused on energy intensity, natural gas production, energy-efficiency, low emission power sources including renewables, nuclear power, and fossil fuels with carbon capture and storage, renewable energy technologies, and bioenergy for electricity and biofuels for transport, and how to diversify their energy mix and limit carbon emissions. Additionally, the ministers emphasized increased use of cost-effective carbon capture and sequestration (CCS) and smart grid technologies, including advanced battery technologies for highly-efficient and cost-effective energy storage.

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### *B. Current Energy Situation and Future Growth*

The APEC region is poised to emerge as the most dynamic economic region of the 21st century. Thus it is no surprise to see a large and growing demand for energy to support this growth. Despite the presence of resource-rich economies such as Russia, Canada, and others, the APEC region is the largest net energy importer in the world and will remain so for many years to come.

In late 2008 and 2009, the global financial crisis temporarily slowed down the demand for energy resources in the APEC region and the world at large. Since then, the world economy has been in the process of recovering, led by developing Asia, particularly China and India. However, the recovery has not been stable and challenges remain high amid volatile and high energy prices.

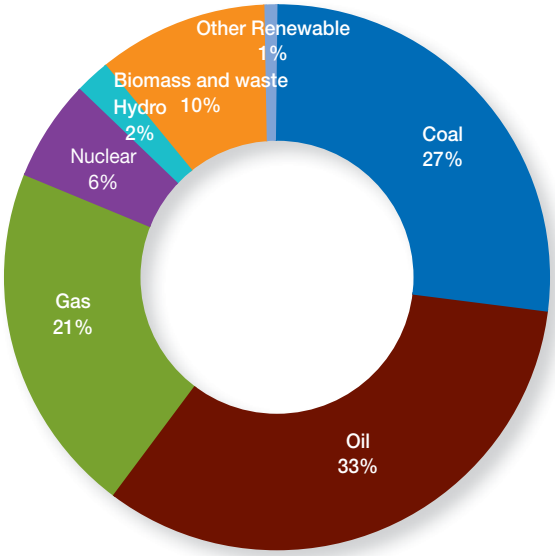
From the depths of the great recession, a new financial order has emerged, marked by growth from the developing world, particularly those within Asia and the Pacific. 2010 marked the second largest energy demand increase in 30 years. And, for the first time in modern history, demand shifted from West to East and North to South.

2011 has been characterized by emerging realizations of our era. The Middle East and North Africa turmoil represents the instability—of the largest oil supplying region upon which APEC is particularly dependent; natural catastrophes in Japan represent the inherent risks in nuclear power; and, the subsequent European reaction (Germany and Switzerland) that led to nuclear power decommissioning will have lasting pressures on demand and hence fossil fuel prices.

However, as the world economic growth transitions from the developed to developing economies, the proportions of energy supply is transforming as well; albeit at a much slower rate. Nevertheless, the trend until 2030 is evident. In its 2010 annual report,[2] International Energy Agency (IEA) projected under its "New Policy Scenario," which assumes more aggressive policies are put in place, that total energy demand will increase at an average annual growth rate (AAGR) of 1.2% between 2008 and 2035, of which the AAGR for fossil energy (coal, natural gas, and oil) use is projected to increase by 0.8%. Under this scenario, the share of fossil energy is forecast by IEA to decline from 82% in 2008 (Figure 1) to 74% in 2035 (Figure 2). In IEA's most aggressive scenario of "450 ppm Scenario," where an energy pathway limiting the concentration of greenhouse gases in the atmosphere to around 450 parts per million of $CO_2$ equivalent (ppm $CO_2$ equivalent), the share of fossil energy is forecast to go down to 62% by 2035 with a negative AAGR. However, if none of the aggressive policies are taken, the fossil energy's share could stay as high as 79% under IEA's "Current Policies Scenario," where the AAGR of the fossil energy use is on par with the overall energy demand growth. In other words, if nothing is done aggressively to contain the $CO_2$ emission growth, the world energy demand will be driven and dominated by fossil energy.

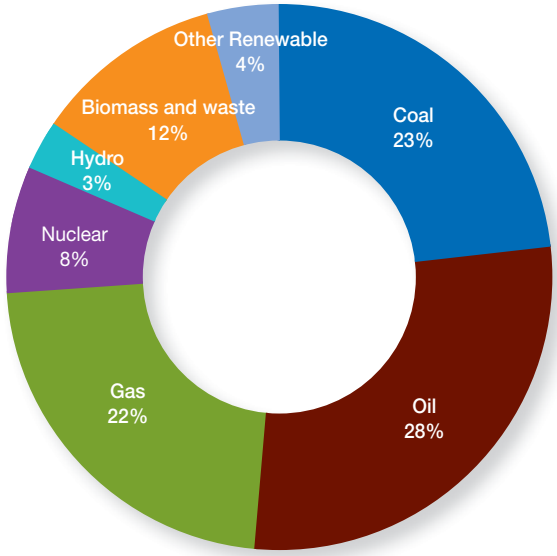
[2] See IEA, 2010, *World Energy Outlook 2010,* Paris, France.

**Figure 1**
**Structure of Primary Energy Consumption of the World**




Total consumption: 12.3 billion (2008)
Source: IEA (2010).

**Figure 2**
**Structure of Primary Energy Consumption of the World under IEA's New Policy Scenario**




Total consumption: 16.7 billion (projected 2035)
Source: IEA (2010).

Under any circumstance, fossil energy still plays a leading role for the next two decades and beyond. Notably, petroleum will be used for an increasing transportation sector as well as power generation and feedstock for the petrochemical and industrial sectors. In order to mitigate risks and facilitate a smooth transition to a secure energy future, the APEC community must hedge against volatility and supply disruptions in the short and medium term, and ease supply and demand tensions by developing new and diversified sources of energy and decreasing energy intensity in the long term.

However, the next two decades will be accompanied by depleting traditional reserves, which will require the discovery of new sources that will likely be smaller and less economical to produce; in essence, the age of easy oil is over. Consequently, the price of nonrenewable energy will rise as demand increases due to increased population and standards of living worldwide and as reserves become smaller and more difficult to bring to market. This leaves policymakers with a daunting task of balancing escalating demand with the reality of limited oil supplies.

Needless to say, we are not necessarily running out of our conventional energy resources; they are merely becoming more expensive to produce. The conventional oil sources are complemented by unconventional supplies such as tar sands and oil shales. What offshore and unconventional resources both have in common is a high capital cost and operational difficulty.

Unconventional resources are estimated to be much larger than conventional oil resources and will play a major role in the future energy supply. The rate at which they are produced will be determined by economic, environmental, and technical variables. Notably, technologies that provide more efficient extraction, carbon capture and storage (coal-to-liquid plants), and the addition of biomass to feedstock will be in high demand.

Technology will play an important role in bringing resources to the market. Innovations will improve the size and recovery rates of existing resources and will attempt to solve the unconventional production problem. This however, requires extensive research and development, intellectual property rights, technological adaptations from other industries, and commercial timing.

Energy security is predicated upon a greater diversity of the energy mix. Ultimately, more renewable energy sources will emerge, but will remain in modest proportions compared to fossil fuels. Thus, over the next two decades, we will

continue the transition to a more diversified energy supply base consisting of fossil fuels (coal, natural gas, oil), nuclear power, biofuels (trees, shrubs, culture and animal waste, agriculture), and renewables (solar, wind, hydro, geothermal). The potential for renewable energy is extensive and these sources, along with fossil fuels are part of the answer to a secure and sustainable energy future. However, due to their capital-intensive nature, development is dependent on substantial government financial support and technological innovation, a complementary combination of public and private sector investments and collaboration. Energy efficiency will also be an important part of the energy security and diversification of the fuel mix.

Energy security is also conditional upon the availability of necessary resources. It is estimated that there are 1.2 trillion barrels of oil that can be extracted, refined, and delivered *with current technology.* Among current reserves, 75% are held by Organization of Petroleum Exporting Countries (OPEC), which are inherently unstable societies. This political dimension creates additional supply instability as experienced by the recent turmoil in North Africa and the Middle East. Although the events had a relatively small effect on physical supply, the psychological effect was substantial and was reflected in crude prices. Similar events are troublesome for the Asia and Pacific region, which is heavily dependent on the Middle East, a region that will continue to be characterized by instability and uncertainty. Thus, expensive production accompanied with Middle East instability will continue to raise oil prices. This will ultimately stimulate the necessary amount of exploration and production as well as increase financial interest in alternative energy sources such as natural gas, renewables, nuclear power, and biofuels.

The natural gas market is growing much faster than oil, because it is currently the best option for energy security and environmental concerns. Also, it is a component in a variety of uses ranging from heating, power generation, and agricultural fertilizer. The economics of the natural gas market are governed by the geography and proximity to market. In Asia and the Pacific region, prices have been determined by long-term contracts as a function of the price of oil. As a result of their link to oil prices, natural gas prices tend to be volatile by nature. This occurs because of the lack of an established regional natural gas commodity exchange. Thus, without a secured sale price through long-term contracts (typically 20-25 years), producers cannot ensure product sales or obtain the project financing necessary for developing their resources. Essentially more growth, investment, and interconnection are needed, which can be partially accomplished through a regional futures market.

Considerable achievements in technology have enabled a renaissance in the US natural gas exportation and production (horizontal wells and hydraulic fracturing for gas shales). Energy Information Administration (EIA) of the US projects that shale gas production could account for 46% of all US gas production by 2035.[3] In addition, EIA sponsored a study[4] that estimates the presence of about 5,700 trillion cubic feet (tcf) of technically recoverable shale gas resources from 14 regions containing 32 provinces. Put into perspective, this estimate is nearly as much as the world's current proven gas reserves. However, technology will need to develop significantly in order to extract the full value from currently wasteful shale gas production.

[3] See EIA, April 2011, *American Energy Outlook 2011, with Projections to 2035,* Washington, D.C.

[4] See EIA, April 2011, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States,* Washington, D.C.

## III. Objective 1: Expand and Diversify Energy Supply

As we noted in the 2008 Study, it is very important for APEC economies to work together to expand and diversify the supply of energy resources. The diversification efforts focus largely on the reduction of the dependence on oil by expanding the supply and viability of substitutes. As APEC economies look to options of natural gas (including unconventional gas), clean coal, renewables, and nuclear power, it is important to note that these alternatives are not equally viable at the present time. Some may take longer and require technological progress to become possibilities. We believe these challenges can be overcome through regional cooperation. Section VI focuses on the role of clean coal, nuclear power, and renewable energy.

### *A. Expanding the Use of Natural Gas*

Natural gas is a clean and efficient source of energy suitable in a wide variety of uses, from fueling centralized power generation to meeting home cooking needs. Since gas must be kept under pressure, however, it presents special transport and storage requirements, and has tended to be used first near centers of production. While oil-import facilities are relatively cheap and can be scaled to market, the infrastructure required for long-distance movement of gas, whether via pipeline or LNG (liquefied natural gas) usually requires large investments and has a minimum economic scale. For this reason, gas projects designed for international export tend to require long-term contracts to proceed.

#### Asia Pacific Gas/LNG Demand Prospects

In 2010, natural gas' share of primary energy consumption in the Asia-Pacific region was only 11%, which is much lower than the estimated global share of over 23%. This shows that while Asia dominates with 60% of the world's LNG market trade, gas is still a small part of the fuel consumption pie which is dominated by coal (52%) and oil (28%). While this is predominantly due to the distance between demand centers and supply sources, it once again highlights the growth potential of natural gas as Asia continues to develop its appetite for the fuel.[5]

The "Big 4" gas consumers in Asia in 2010 were China, Japan, India, and South Korea. China saw gas demand hit 10 billion standard cubic feet per day (bscf/d), nearly doubling the combined gas consumption in South Korea and Taiwan. Japan comes in second with around 9 bscf/d. By 2030, Chinese gas demand will represent more than one-third of Asia Pacific's gas demand, up from about one-fifth in 2010.[6]

The mismatch between gas use and supply by the "Big 4" Asian gas consumers is expected to widen as gas demand outpaces growth in gas production. Japan and South Korea scarcely have indigenous gas supplies and will become more heavily dependent on imported gas sources, while India and China still have domestic gas sources to turn to. As Japan and South Korea are not expected to assume pipeline gas imports, these two countries will depend on LNG to meet their rising requirements. Imports are also expected to make up an even larger share of China (45%) and India's (34%) natural gas supply by 2030. Only China currently imports gas via LNG and pipeline gas.[7]

LNG imports accounted for some 36% of the Asia-Pacific region's total domestic natural gas supplies in 2010 and this share is expected to continue to rise in the coming years as growth in LNG demand outpaces growth in domestic gas supplies. Imports in 2011 are expected to increase by over 15% for the year thanks to increased demand across the board, especially from Japan. Although South Korea and Taiwan will show impressive growth, Chinese and Indian LNG imports are tipped to increase by 38% and 41%, respectively, for the year largely due to the start-up of new LNG import contracts and ramp-up of existing ones. Combined, these countries could constitute over 25% of total Pacific Rim LNG trade by 2020, up from 13.5% in 2010.[8]

By 2030, Asia Pacific LNG demand could exceed 290 million metric tones (mmt), approximately half of the region's total marketed production. Growth will be driven by countries like China, India, and new markets where regasification facilities are already under construction such as Thailand, Singapore, Indonesia and Malaysia.[9]

#### Unconventional Gas

Higher natural gas prices and advances in technological know-how in recent years have made unconventional gas production—namely, shale and coal bed methane (CBM) gas—more economically viable. Unconventional gas prospects are poised to play an increasingly important role in the future gas supply mix of many countries, thereby transforming the total supply picture. The breakthrough in unconventional gas

[5] See BP Statistical Review of World Energy, June 2011

[6, 7, 8, 9] See FACTS Global Energy Database, 2011

across America has led to many discoveries and developments now taking place in Asia, Europe, the Middle East, and selected African countries, whether it is shale gas, CBM, tight gas, or gas hydrates. In the APEC region, Australia's unconventional CBM now account for over 40% of the country's future LNG export capacity. China which is one of the biggest importers of conventional gas is now realizing the huge potentials of its CBM and shale gas resources.

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**US Shale Gas Developments**

The US has been at the forefront of the unconventional gas revolution. In the context of overall domestic gas supply, unconventional gas accounted for about 31% of total US gas supply in 2010, with shale gas alone accounting for about 23% of total supply. Its share will increase significantly in the coming decades according to EIA. The growth in US gas supply as a result of increased shale gas production has had a dramatic effect on LNG imports. As recently as a few years ago, everyone from independent consulting companies to the US government to the oil companies themselves were forecasting a significant increase in the US LNG imports. That means LNG once destined for the US market is likely to go to higher value markets around the world, as long as the US gas prices remain relatively soft given the domestic supply position.

The shale gas revolution has had a profound effect on the US gas supply and lessened the need for LNG. This bodes well for other LNG importing nations as investments made by producers for the additional bi-directional facilities will mean that gas exports would be directed outside of the US.

**Other Developments on Unconventional Gas**

Unconventional gas projects are in their infancy in Asia, but the outlook seems promising. China is leading Asia's prospective unconventional gas development. For example, the aforementioned EIA study puts China as having the largest total recoverable shale gas resources (1,275 tcf) in the world. Though still in early stages, China, as well as Asia as a whole, could reap significant rewards from unconventional gas developments going forward. If Asia can replicate what has happened in the US, there will be major implications for the global LNG market. It is too early to determine how large an impact shale gas will have on Asia's gas balance, given that a surge in unconventional output could potentially back out LNG from the largest regional market in the world; the situation bears close monitoring.

For China, under our best-case scenario, total unconventional gas (CMB and shale gas combined) is forecast to account for 15% of China's domestic gas production by 2020 and 21% by 2030 as a result of promising foreign investments and government-backed policies for CBM. India hopes to see CBM production reaching 130 million standard cubic feet per day (mmscf/d) by 2012, but for this to happen, energy companies in India need to develop the slated gas grid that will improve connectivity amongst producing states to end-users.[10]

From a supply point of view, unconventional gas to LNG supply projects are forecast to have more significant impact on the international level of gas supply from 2015/2016 onwards. The three likely supply projects from Australia for unconventional gas-based LNG will add significantly to the LNG market. This is a huge step for the LNG industry, as the success of these projects will set the benchmark for future unconventional LNG supply projects around the world.


[10] FACTS (2011) ibid

## Key Issues on Gas Trade in the Region

APEC gas markets are generally less developed than regional oil markets. Investment costs have deterred lower-income countries seeking rapid economic growth from developing their gas infrastructure. Similarly, regional exploration and production has focused on oil development.

The lack of infrastructure (LNG importing terminal facilities, storage, trunk and distribution pipelines) is one of the key impediments to expanding gas use and trade. China, for example saw a 7-fold increase in gas consumption over the last 15 years, closely related to the addition of more than 30,000 km of pipeline networks. In addition, new LNG receiving terminals constructed in the last couple of years have enhanced the use of natural gas in the coastal regions. The establishment of international gas transport infrastructure, be it pipelines or LNG terminals, invariably requires the involvement of government. APEC governments who wish to expand the role of natural gas need to study and confer on how infrastructure can best be expanded.

Another issue impacting gas trade in the region is the fact that domestic gas prices in several countries in Asia are regulated to benefit specific end-use sectors. Excessive government intervention in natural gas pricing has discouraged exploration, development, and production of natural gas in many Asian countries, and affected the ability of industries in specific sectors to pay international prices. Where gas/LNG imports costs are higher than the gas retail price, this may yield negative returns to gas suppliers as the differentials may initially be borne by suppliers, ultimately discouraging gas imports. On the flip side of the coin, the opposite may hold true for exports where producer/suppliers find greater incentive to export to higher paying international markets (like in the case of Malaysia and Indonesia). With global oil and gas prices (especially for contracts indexed to oil) forecast to continue climbing in the coming years, gas markets will come under greater stress if adjustments are not made to address these price disparities in the wake of rising gas demand.

The immaturity of the international gas market, relative to the oil market is another key impediment. At the risk of perpetrating a pun, one of the biggest problems with the gas market is a lack of liquidity, particularly in Asia. For gas projects—especially LNG projects—to find financing, it is typically necessary for all or most of the gas to be presold in long-term contracts. Cargoes and contracts are traded on a small spot market, but today's market is thin for prospective new buyers or producers to feel certain that they can obtain or dispose of a percentage of their requirements outside of long-term contracts as the main expansion in the spot market has come not from suppliers who have built extra capacity, but from capacity left when long-term contracts have expired.

We continue to believe that a futures exchange in a commodity requires that someone provides liquidity, ensuring that buyers can be matched with sellers, and that contracts not liquidated before the market closes can be physically delivered. Market mechanisms in gas have yet to become as sophisticated as in oil, but reliable forms of trade in pipeline gas have developed in North America and in Europe. In Asia, where LNG dominates the international trade in gas, the market remains quite underdeveloped. Establishing an Asian futures market would make it easier for projects to go ahead without needing to establish contracts for their full volumes, and for buyers to enter the market, committing to greater volumes than they might need. Establishing a functional futures market for gas—or oil for that matter—is not an easy task in Asia as it requires the participation of important parties, particularly energy suppliers. Traditionally, Asia's LNG business model has been based on producer-consumer relationships. Some of the existing Asian markets of energy trading are struggling to gain acceptance and more studies on demand, supply, market structures, and government policies are needed before any futures market for gas is ever considered in the Asian region of APEC (see *Studying the Futures Market* under Session V).

Finally, a crucial factor which could make or break gas trade is the involvement and policies of governments. The establishment of international gas infrastructure (be it pipelines or LNG terminals), and the feasibility of trade between certain countries invariably requires the involvement of the government. In the least interventionist of cases, this might mean involvement in the permitting and routing process. In some cases, it may also mean direct

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investment or financing by the government, especially for mega projects. Very frequently, the establishment of international gas trade includes governments as parties in the negotiations themselves. Some examples of principle barriers to increased gas trade stemming mainly from the direct involvement or policy implementation by governments include—gas allocation policies such as the domestic market obligation(DMO) in Indonesia which essentially restricts exports of natural gas to a certain extent; lack of free trade agreement (FTA) between the US and many countries in the region that could prevent the movement of more LNG from the West to East; regulated price regimes which have made gas imports unattractive; etc. Governments who wish to expand the role of natural gas need to be prudent with their trade, legal, fiscal, and policy frameworks to ensure a competitive and conducive environment is structured.

### *B. Increasing Access to Conventional Resources*

No one today would dispute the notion that nations have sovereignty over their natural resources; this principle has been well-established since the 1960s. While there is no question that a nation has the right to exploit domestic energy resources through whatever mechanisms they see fit—including national monopolies on exploration and production (E&P)—restricting resource access to specially selected groups can have adverse consequences for the producing nation.

The oil crises of the 1970s and early 1980s were the heyday of the national oil companies (NOCs) as a model for resource development. Considering that NOCs owned 89% of the global oil and natural gas resources in 2007, according to Energy Intelligence, energy security, future supplies, and policy issues can be understood analytically only if we understand the behavior of NOCs.

Today, NOCs come in different forms and with different national objectives—both commercial and non-commercial. Some are major hydrocarbon exporters, while others are major importers. Some have an operating environment similar to that of a private firm, with Malaysia's PETRONAS being a good example. PETRONAS is wholly owned by the government but operates like a commercial entity, as lack of protection has kept PETRONAS as professional and business-like as any international company. They compete with foreign companies, even within Malaysia. Competition can make NOCs grow stronger and can help them reach out into the international arena, which can increase a nation's energy security. In other words, lack of competition can lead to overstaffing, undue levels of political influence in business decisions, and various kinds of corruption.

Although estimates of prospective resources vary, many analysts believe that today, the majority of unexploited oil (and to a lesser extent, gas) lies in areas that are not open to competitive E&P. This not only lowers the supply of oil on the overall market, but also risks that the oil in such areas will be underexploited, either through lack of efficient discovery, or through suboptimum production techniques. Opening exploration areas to foreign participation can draw in capital and also pull in the most sophisticated E&P technologies—including highly proprietary techniques that are available from only a few companies. Both the international market and the owner of the resource benefit from competitive bidding on resources.

## IV. Objective 2: Promote Energy Conservation and Improve Efficiency

As we noted in the 2008 Study, promoting energy conservation and improving energy efficiency have long been priorities in many APEC economies. These efforts have been largely driven by high energy prices or price spikes; however, most of these gains remained in place when energy prices fell again.

The importance of energy conservation and efficiency has been emphasized by the APEC Energy Ministers. In their May 2007 Darwin Declaration, the APEC Energy Ministers regarded improving energy efficiency and conservation central to the region's sustainable development of energy in the long term. In the energy workshop focusing on 'Low Carbon Paths to Energy Security' held in Fukui, Japan in June 2010, efficient use of energy and cleaner energy supply were discussed in the context of enhancing energy security and boosting growth and lower emissions.

Improvement of energy efficiency leads to less use of energy while providing the same amount of products and services. Energy efficiency benefits include emission reductions, lower energy intensity, and more availability of energy for other projects or industries. While the benefits are substantial, the costs for certain energy efficiency improvement measures are high and increase over time as lower cost options for efficiency gains are taken. Striking a balance between improving energy efficiency and maintaining healthy economic growth is an important consideration.

Energy efficiency is critical to APEC energy security since the region includes the world's three largest energy consuming economies—China, the US, and Russia. Adding Japan, Canada, and South Korea, six APEC economies are among world's top ten largest energy-consuming countries. Yet, energy efficiency achievements in APEC vary widely from economy to economy. Based on conventional exchange rates, for instance, China's energy intensity (amount of energy used per unit of GDP) was five times as high as Japan's and three times that of the US in 2009. Still, the energy intensity in Russia is slightly bigger than China's. Many developing economies like China and some developed economies such as the US and Canada have huge room to improve energy efficiency.[11]

There is still ample opportunity for increasing conservation around the region. The Japanese are, of course, famous for items ranging from low-power-use electronics to high-efficiency electric motors. The disastrous earthquake and tsunamis in early 2011 have given Japan impetuses to use energy more efficiently while conserving energy at the same time. Indeed, in an effort to conserve energy and help out earthquake/tsunami victims, the Japanese used 15% less electricity in April 2011 compared to a year ago.

Many countries have energy and efficiency programs in place, but the best practices developed in one economy do not necessarily apply or flow to another. This is particularly true in the industrial and commercial sectors, where the measures adopted by a particular business may remain unknown to similar businesses in other countries.

Even if knowledge and transfer of best practices are not an issue, the barriers to applying them result from various organizational and institutional behaviors that may hinder the adoption of best practices. In some cases, it is represented by market failure, like principal-agent problems afflicting landlords and tenants over efficient home appliances. In other cases, the application for certain best practices of energy conservation may not make sense for business, at least until carbon taxes or very high energy prices have a major impact on companies' bottom lines. On the positive side, however, as APEC moves toward the harmonization of standards across economies, both consumers and manufacturers will benefit.

Energy efficiency must be measured by end-use if it is to be meaningful. APEC should consider sponsoring a program to determine best practices by end-use, and to promote exchange on conservation issues. Saving energy is not as glamorous as procuring additional supplies, but it usually costs less, and has an even greater effect on energy security.

Addressing the rising demand for oil in APEC in the context of energy efficiency is important, particularly among the developing economies. Improving transportation efficiency will be the key in achieving the goal of managing transportation fuel demand. In this regard, APEC economies should work more closely on developing fuel standards for the automobile industry. Cooperation is also very much needed in APEC on alternative fuels, such as biofuels and electricity (for electric cars).

[11] BP (2011) ibid, IMF World Economic Outlook Database, April 2011, FACTS (2011) ibid

Conservation services are generally viewed as a local rather than a global business. Nonetheless, much energy conservation expertise is transferable, and APEC members should do all they can to ensure that these kinds of services can be provided across borders without encountering barriers, such as quotas and tariffs, etc.

Finally, it should be mentioned that many consumers, including consumers at the industrial level, are unenthusiastic about making investments in energy savings unless the payback is quite rapid. This is a place where governments can help by getting utilities involved in rebates and financing for well-established energy-saving investments. Since this can forestall additional expenditures on fuel and investment in generating capacity, providing utility-based financing and expertise can be very cost effective.

Efficient operations of the energy market remain a key to minimize the cost of any transaction.

## V. Objective 3: Promote Open and Efficient Energy Markets

Efficient operations of the energy market remain a key to minimize the cost of any transaction. Many economies, particularly those of the developing world, have incurred high cost for energy market operations as a result of excessive regulations, government intervention, price controls, and other regulations that create market distortions. APEC economies have to work harder to address issues related to market distortions and promote open and efficient energy markets.

### *A. Removing Barriers to Trade and Investment*

In 2011, the APEC Energy Working Group released *Reducing Trade Barriers for Environmental Goods and Services in APEC Economies.* The report found due to dissimilar economies and standards, regional applicability of various labeling schemes varied. Furthermore, obstacles remain due to unsupportive domestic policies, except for in Australia and New Zealand.

Barriers should be removed to allow the free flow of goods and services, and investment.

Overall, barriers should be removed to allow the free flow of goods and services, and investment. This topic has already been and will be touched upon elsewhere in this report, including the matter of clean coal technology, renewable energy development, conservation services, and access to resources. Here we underline some of the steps APEC members may wish to undertake to lower barriers to trade in this vital area.

*Reduction in tariffs and harmonization of import policies*. Monitoring the conditions of energy-related trade regulations in APEC economies with an eye to eliminating barriers and harmonizing practices ought to be an ongoing task within APEC. Baseline studies should be supplemented with regular updates. This could serve not only to encourage government policies to converge on a common practice, but could also help potential exporters and importers understand the trade issues they will face in each market.

*Harmonization of environmental specifications*. The APEC economies are as diverse a group as can be imagined, and there is no reasonable one-size-fits-all approach to specifications on traded energy such as refined products. Nonetheless, the profusion of constantly changing standards can create an oft-unnoticed barrier to trade. When an economy chooses an unusual specification not used by other economies, this not only cuts the fungibility of the product, but also tends to raise the price of the niche-specification product to the importer. Moreover, with climate change taking up much concern, policy issues of carbon-content taxes on imports (and hence forms of protectionism) and carbon trade need to be examined seriously to harmonize environmental specifications within the APEC region.

*Recognition of the singular importance of energy technology trade*. Customs and import authorities are by their nature conservative bureaucracies. They are expected to enforce rules, not pursue their interpretation of the national interest. But in many cases, needed technology imports in the energy sector can find themselves either excluded, or enmeshed in customs disputes, with parts sitting on the dock while contractors wait at job sites. The first step in resolving these sorts of problems is formal recognition that energy technology has a special role in national security. Beyond this, individual nations may wish to consider giving some sort of fast-track import authority to their Energy Minister, or design some other means for expediting trade in energy technology.

*Removing investment and other market barriers*. Despite the fact that many APEC economies openly welcome foreign and private investments in the energy sector, barriers—explicit or implicit—do exist to hinder such investments. The investment and other market barriers include various constraints to access: restrictions on visas, workforce controls, nationalization issues, local content regulations, cabotage, undue influences by NOCs/regulators, domination of NOCs in key energy sectors, and numerous other issues.

### *B. Phasing Out Inefficient Fossil Fuel Consumption Subsidies*

APEC made commitments in November 2009 to phase out inefficient fossil fuel consumption subsidies. This mirrored the September 2009 G20 commitments on the same subject. Inefficient fossil fuel consumption subsidies tend to distort markets in various ways, encourage wasteful consumption by concealing the true costs of fossil fuel, hasten decline of exports, encourage smuggling, threaten energy security by increasing imports, discourage investments in infrastructure and create barriers to clean energy investments, and increase emissions and exacerbate pollution.

The IEA defines an energy subsidy as "any government action directed primarily at the energy sector that lowers the cost of energy production, raises the price received by energy producers, or lowers the price paid by energy consumers." Fossil fuel subsidies result in inefficient allocation of energy resources, create market distortions, and fail to accomplish their objectives. These subsidies directly violate the requisite for efficient energy markets, efficient energy products, diversified energy resources, and technological innovation.

Potential objectives of subsidies may include: boosting domestic supply, rebuilding national resource wealth, alleviating energy poverty, protecting the environment or protecting employment. However, evidence shows that fossil fuel subsidies merely distort markets by manipulating supply and demand forces, thereby discouraging energy diversification, increasing consumption and therefore, increasing $CO_2$ pollution. In fact, all of these are very real causes of energy insecurity.

In addition, governments that import energy and provide subsidies could save a tremendous amount of money by phasing out fossil fuel subsidies. These governments will benefit in the short run and long run by saving money on imports, saving money from eliminating subsidies, and encourage national interest in efficiency, energy technology, and diversification.

In short, the elimination of inefficient fossil fuel subsidies is an extremely critical issue. For developing economies like Indonesia, and even for middle-income developing countries such as Malaysia, it is absolutely critical that resources and fuels are priced appropriately, not only to alleviate their weak fiscal balances, but also to constrain consumption growth by market pricing. Inefficient fossil fuel subsidies exist not only in developing economies but also in developed economies.

### *C. Studying the Futures Market*

The creation of an international futures market in gas was discussed in a previous section of this report. Today, with most oil prices already linked to the futures markets of New York or London, some believe that increases in price and increases in volatility are the result of speculative activity. Some blame the high price on everything, from the high price of food to the fluctuation of currencies on futures market speculators. It is important for policymakers and industry participants to understand the important role that futures markets play in price discovery and risk management, and the need for liquidity in these markets. Speculators are participants in these markets, and their activity should not be singled out without also taking into account global events, policy actions, or the myriad of supply and demand factors which may also impact the price and volatility of commodities in world markets.

In the 2008 Study, we stated that we do not believe that futures markets raise oil prices to artificially high levels on any prolonged basis. It should be noted that among many leaders in the OPEC nations, the belief is that the futures market has kept prices artificially low for decades. We do believe that the futures market tends to increase price volatility, but over a shorter period than in their absence. We asserted "this volatility over a short term is preferable to prices that are too high or too low over longer periods, as these would result in larger economic dislocations because they seem to be more permanent and are more likely to cause incorrect decisions about major investments." The implication was the presence of a trade-off between price stability and price accuracy in the question of whether to have or not have a futures market.

The main use of the futures market is for price discovery and hedging by oil companies and end users, who use various tactics to manage their risk of price fluctuations, and by hedge funds, that are often hedging currency risks or hedging exposure in other commodities. For the sophisticated risk manager, futures contracts are a form of insurance against disastrous movements in price, and by taking complex countervailing positions, they can keep their actual revenues within an acceptable band no matter what the market does. In this system, speculators inject capital and information into the system; their positions are actually a form of data on where people expect prices to move. Some of these are experts taking into account detailed data on reserves, production, and demand, while others are simply betting. But, in either

case, they are taking positions, backed with their own money, about where they expect the price to settle, and this is a vital component of price discovery.

As described above, at the writing of the 2008 Study, the lingering effects of the global financial crisis were acute and severe. Crude price volatility reflected rapidly changing and contrasting views. Nearly three years later, price volatility has subsided, but the challenge for healthy markets remain. The world faces the long-term effects of the crisis through lost economic potential in terms of high unemployment, limited credit availability, and slower growth. These effects are felt dramatically different across the globe, but one area of potentially wide-ranging consequences is in financial regulatory reform. In particular, the Dodd-Frank legislation that became law in the US in 2010 requires overhauling over-the-counter (OTC) futures trading by bringing much of the activity onto exchanges. The exact rules and regulations continue to be teased out through the American system, but given the depth and breadth of the US derivatives markets, the potential impact on other markets is apparent. Given the uncertainty over this process at the time of this writing, and in all likelihood at the time this report is distributed, it is not possible to prescribe policy recommendations other than to be flexible and cognizant of developments. It is important for policymakers however, as they implement reforms of derivatives markets, not to impede risk management of end users and not to make risk management prohibitively expensive. Regulations that make hedging a hedge-able risk more expensive will only create more risk for the economy—that would be an unfortunate outcome of regulation designed to reduce systemic risk.

## VI. Objective 4: Promote Clean Energy Use and Technology Innovation

Like energy efficiency and conservation, clean energy use has been given a high priority in APEC. In its May 2007 Darwin Declaration, the APEC Energy Ministers stressed the importance of clean energy use repeatedly in the following context:

- Development of clean energy is important for APEC's long-term energy future;
- Development and deployment of cleaner and more efficient technologies are important for the need to address environmental challenges;
- Cleaner power generation technologies—including renewables, clean coal, natural gas/LNG, and for interested economies, nuclear power technologies—can provide for more secure, diversified systems of energy supply, and use with lower carbon emissions.
- It is important for APEC to further contribute to policies and technologies that promote the development of cleaner energy and the improvement of energy efficiency, thereby enabling economies to meet increasing energy needs with a lower environmental impact and to address climate change objectives.

Clean energy encompasses a wide spectrum of options. Two of these are identified here are most relevant to the APEC-wide applications, namely, use of clean fuel and renewable energy. Though not covered in this report, moves toward "zero emission" power generation and smart grid in Asia, development of advanced technologies for the transportation sector (hybrid, plug-in hybrid, EV, fuel cells, etc.), and their implication to energy security are also important in terms of clean energy development as well the impact on oil demand growth.

### *A. Expanding the Use of Advanced Coal Technologies*

Coal resources are plentiful, and, in comparison to gas and oil, relatively cheap. Although reserves of good-quality coal are not available in every country, it is a widespread resource, and many exporters stand ready to expand production capacity if import demand increases.

Since the Fukui Declaration, one study "Technology Status and Project Development Risks of Advanced Coal Power Generation Technologies in APEC Developing Economies" has identified risks and barriers to clean coal technology and recommended policies to facilitate the proliferation of this technology. However, major risks and barriers include lack of investment, uncertainties with new technology, lack of managerial experience, and environmental awareness.

The benefits of this technology include lower unit heat rates (thus, higher overall efficiency and less emissions per unit of power), local employment opportunities, and eventual technology transfer. Disadvantages included

higher installation costs, lack of experienced workforce, lack of critical spare parts, and lack of a historical database on operations/maintenance and engineering. Therefore, in order to diminish these disadvantages, economies will need to have a well-planned and well-executed manpower training program, spare parts inventory program, paid membership to fossil-based management information system network, and access to expatriate consultants in the early stages of operation. As in gas, the transport infrastructure can be a major barrier to expanded coal trade and use.

Although new coal technologies are often far more efficient and are always far less polluting than traditional coal technologies, coal use still releases more carbon dioxide than the use of other fossil fuels. Considerable research is being devoted to the problem of carbon sequestration (also referred to as CCS, carbon capture and storage), but the engineering is still in such early stages that no one is certain what approach or approaches will be best, nor what the costs might be (though one widely quoted study estimates it adds 35% to the capital cost of a plant). In addition, CCS parasitic power losses from running the equipment can be quite large (20% or more), eliminating many of the gains from advanced technologies. Payback times for CCT will probably need to be spread over a plant's primary lifetime, suggesting an investment that must be recouped over 20-30 years.

Most analysts believe that CCT will have a role to play in the world's future energy supply. But any investor considering a power plant based on clean coal faces huge uncertainties in the area of climate change legislation.

Some of this uncertainty might be alleviated by carbon emissions trading—especially in cross-border trading. Since carbon dioxide is a global rather than local issue, arguments for a multinational or international trading scheme are strong. Based on experience in Europe, however, stringent measures would have to be enacted; some experts contend that the price of carbon dioxide credits would have to double or triple before CCS becomes economical. In any case, an emissions-trading market could encourage investment in CCS technologies. Absent of that, no investor wants to risk plant shutdowns or massive additional capital investment because standards change. Buying emission credits in future years is an unknown operating cost, but it is on a smaller and less concentrated scale than the need to suddenly invest hundreds of millions of dollars in CCS because of unforeseen changes in emissions laws.

Moreover, almost any specialized, capital-intensive technology like CCT will face various kinds of import barriers in at least some economies. If clean coal is to provide a substantial alternative to oil, barriers to imports of CCT equipment need to be dismantled wherever they are found.

### *B. Managing Energy Use through Technology Innovations*

In a broader sense and for fossil fuels in general, technology can unlock resources, lower emissions, and improve recovery rates. This is evident in the areas of enhanced oil recovery, development of unconventional gas, development of oil sands and shale oil, expanded use of supercritical and ultra-supercritical coal-fired plants for power generation, future application of carbon capture and sequestration, and zero-emission or near zero-emission power plants.

Perhaps the most unpredictable and overlooked variable in energy forecasts is the impact of technology. The future of the energy industry will be determined by the rate of change of innovation. Ultimately, that depends on proper market prices, research and development, and government investments. Ideally, the price of technology will decrease and the price of $CO_2$ emission will increase. Thus, if the price of energy is not suppressed by fossil fuel subsidies, developing new technologies that lower emissions, improve recovery rates, and unlock resources can become economical.

As discussed previously, fossil energy will continue to play a leading role in global energy demand through 2035 under any scenario. However, fossil fuel production is becoming characterized by a decline in conventional resources; of the

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existing conventional reserves, nearly 75% are held by OPEC countries and national oil companies (NOCs). Therefore, international oil companies (IOCs) are compelled to explore new terrain in remote locations and complex geologies such as offshore Greenland and Brazil, the North Sea, Siberia, and the Caspian region.

Unconventional resources such as ultra deepwater, arctic oil drilling, oil shales, oil sands, and conversions (coal-to-liquid, gas-to-liquid) also have a huge potential in supplying the future energy needs. However, these methods will require profound technological development in order to extract the full potential from the resources. Fortunately, such technologies are already in operation such as hydraulic fracturing and horizontal drilling; nevertheless, there is substantial room for improvement. One of the highly anticipated technologies is nanotechnology, which will allow greater precision and efficiency throughout operations.

As the largest contributor of emissions, the power sector is the primary focus in energy efficient initiatives. A radical transformation to low carbon technologies that remain efficient, affordable, and reliable is required to alleviate environmental pressures. However, international financial, regulatory, and technical collaboration is necessary in order to succeed. Government mandates such as discouragement of fossil fuel usage by making $CO_2$ more expensive will be especially important in facilitating technological innovation.

### *C. Nuclear Power's Role in the Region*

The 9.0 magnitude Great East Japan Earthquake followed by tsunamis on March 11, 2011 in Tohoku had a widespread effect not only on Japan's energy industries, but also on long-term policy implications globally.

The ongoing nuclear crisis at the Fukushima Daiichi nuclear power plant[12] highlighted to the general public the potential dangers associated with Japan's ambitious nuclear power targets[13] and its preparedness for catastrophes. While the threat to public health is the immediate and top concern, the situation has worldwide policy implications as many countries have begun reevaluating the role of nuclear power in their economies. There is no doubt that the Fukushima crisis has made energy security challenges more complex than ever, not only for Japan, but also for the rest of the world.

The APEC Energy Ministers' consensus on nuclear power was summarized in the June 19, 2010 declaration "Fukui Declaration on Low Carbon Paths to Energy Security: Cooperative Energy Solutions for a Sustainable APEC."

"A growing number of interested economies are using nuclear power to diversify their energy mix and limit carbon emissions. These economies are reaffirming their international commitment to safety, security, and non-proliferation as the fundamental elements for the peaceful use of nuclear energy. We therefore need to assess the emissions reduction potential of nuclear power in APEC. Solid financial frameworks, as well as cooperation among member economies and with relevant multilateral organizations, can help to support new nuclear power plant construction consistent with this commitment."[14]

For many economies, including Japan, nuclear power development has been an essential means of ensuring a stable energy supply and accommodating environmental issues such as global warming. Nuclear power continues to provide safe, clean electricity generation with more than 440 reactors operating worldwide. However, the key elements of nuclear energy policies after the Fukushima disasters have shifted to safety and emergency management, and public acceptance.

Despite the Fukushima disasters, within APEC, policy support for nuclear power in some economies (including South Korea, China, and the US) continues. Many other economies, who own nuclear power plants, are likely to continue their programs, but at a slower pace. While some Southeast Asian economies, who had expressed interest in building nuclear power plants, will take more time to conduct

[12] Tokyo Electric Power Co. owns the 4.7-GW Fukushima Daiichi nuclear power plant in Fukushima Prefecture. They have two more nuclear power plants, the 4.4-GW Fukushima Daini plant in Fukushima Prefecture and the 8.2-GW Kashiwazaki-Kariwa plant in Niigata Prefecture. Of the total 9.1 GW capacity in Fukushima Prefecture, 6.4 GW were in operation at the time of the March 11 earthquake/tsunami. It has been officially decided that four units (Fukushima Daiichi 1-4) will be dismantled and it is reasonable to believe that the remaining six units (Fukushima Daiichi 5-6 and Fukushima Daini 1-4) will be out of circulation indefinitely.

[13] Currently, Japan has 55 nuclear power units that provide 49.6 GW of capacity, almost 30% of Japan's power needs under normal circumstances. The Japanese government set ambitious targets to increase the share of nuclear power generation many years ago. This strategy aimed to achieve Kyoto climate change goals and diversify Japan's energy mix away from oil, thereby reducing its energy reliance on the Middle East, where over 85% of Japan's total crude oil imports come from. The government targets before the Fukushima disasters called for nuclear power to comprise 50% of the country's total power generation by FY2030. To achieve this, Japan would need to build 12-14 additional nuclear power units and boost the utilization ratio of operating units to 85-90% from the pre-disaster level of around 70%.

[14] http://www.mofa.go.jp/policy/economy/energy/pdfs/emm_declaration201006.pdf

nuclear power safety reviews, other smaller economies will reevaluate the need for nuclear power.

Final decisions regarding the use of nuclear power lie with the sovereign power, but the exchange of knowledge and experience, particularly in evaluating the safety risks to nuclear reactors, among APEC is something that can strengthen international ties and security. There is an opportunity for transfer of knowledge related to designing, safety/security, and emergency response from economies with deeper experience with commercial nuclear power to economies that are just establishing nuclear power programs.

The set of problems that caused the crisis for the Fukushima Daiichi plant are believed to be site specific and there may be risks for other reactors located in high risk seismic regions exposed to tsunamis in other economies. More generally, the disaster highlighted the risk that may come from the coincidence of events that have low probabilities. While the specific circumstances may be different, based on the problems experienced at the Fukushima Daiichi nuclear power plant that lost electricity connection to run water pumps to cool the reactors and eventually lost internal safety controls, *disaster response protocols* are very important. Policymakers are urged to do a better job of establishing best possible practice for safety and emergency management.

The real challenge for Japan and other economies that have or are considering nuclear power is to create truly independent regulatory and licensing authorities that operate in an open and transparent manner. Japan's structural issues in its regulatory system became evident after the Fukushima disasters. Essentially, Japan is considered to have no independent checks and balances. Japan's nuclear power safety regulatory body, the Nuclear and Industry Safety Agency (NISA), belongs to the Ministry of Economy, Trade and Industry (METI) who devised an energy policy that has long promoted nuclear power as the best solution to Japan's energy-sufficiency and environmental goals. METI's nuclear power promoter-regulator conflict, however, makes Japan an unusual case. The US successfully split the promoter and regulator functions between two agencies: the US Department of Energy promotes nuclear power, while the Nuclear Regulatory Commission (created by Congress) is in charge of safety issues.

The problems of nuclear fuel disposal remain unresolved. Even in the US, the longest-standing nuclear power nation, the debate drags on over the formally adopted underground storage plan. And while the nuclear power plants themselves can be hardened or protected in various ways, the inevitable nuclear waste becomes vulnerable during transportation for disposal. The Fukushima incident clearly illustrated the risks associated with fuel in storage pools requiring long-term cooling. Alternate technologies that do not require active cooling (such as dry storage) are readily available and the Fukushima event will most likely accelerate their use. It must be emphasized that it is essential for all economies that are considering expanding or starting their own nuclear power programs to plan their waste disposal/storage and fuel recycle programs simultaneously.

The economies considering nuclear power will likely continue with their plans as nuclear power can offer an attractive source of base-load power generation for rapidly growing economies, in terms of reducing carbon emissions and fuel imports.

In summary, despite the Fukushima crisis, many economies are expected to continue their nuclear power programs but at a slower pace. The economies considering nuclear power will likely continue with their plans as nuclear power can offer an attractive source of base-load power generation for rapidly growing economies, in terms of reducing carbon emissions and fuel imports. Furthermore, for many who host nuclear power plants, a combination of employment and contribution to the local infrastructure relating to the nuclear power industry plays an important role in their economic activities.

There is a dire need for an integrated energy policy that is grounded in a new post-Fukushima reality. Such an energy policy will require a reassessment of all kinds of renewable energy, including nuclear power, and a review of future energy use in APEC. The role of nuclear power in the region's future deserves wide-ranging discussion and debate. This is an opportunity for APEC to take lessons that can be learned from the Fukushima incident and determine the best practice for nuclear power safety and emergency management.

### *D. Expanding the Use of Renewables*

Renewable energy sources cover such a diverse range of technologies that it is difficult to generalize about them. Most, though not all, renewable energy projects are characterized by a smaller scale than most fossil fuel projects (though some—such as central-station solar power, some biofuel projects, and many geothermal projects—are comparable to fossil fuel plants). Many small-scale uses of renewable energy go unrecorded. To the commercial energy system, stand-alone renewable energy systems look like conservation.

To date, most APEC economies have focused on applying their own renewable energy capabilities to their own resources and needs. While this is understandable, some of the most technologically advanced nations, such as Japan and South Korea, have the fewest opportunities for accessing renewable energy, if nothing else because of lack of space. Partnerships between economies might offer whole new vistas for development of alternative energy.

Over the years, a great deal of renewable-energy interest in Asian countries has focused on small-scale, low-tech projects, with an emphasis on providing power or fuel for remote and impoverished locations. While this is laudable, it does little to affect the overall issue of energy import dependence. It may be time to re-examine the possible role of renewable energy on a regional rather than national basis. Rather than looking at what individual countries can do to exploit their own alternative energy resources, the goal should be to identify resources that could be tapped—no matter which economies provide the expertise and technology.

Ideally, the renewable energy industry should look much like other energy industries. Engineering skills, capital, and manufacturing capabilities should be drawn from the best sources, regardless of national boundaries, and projects should be built at sites where they have the best economics. Conventional energy systems are already manufactured on this basis, but renewable energy is still more restricted in focus. The goal should not be "technology transfer" but rather the creation of ventures that can make a significant contribution to energy supply. When new energy supplies are brought to market, no matter where, they ease the pressure on energy supplies in international trade.

As in many other areas, priority should be given to the removal of barriers that slow the import of needed technology or act to raise its costs. A standing committee to identify possible commercial potentials and barriers to commercialization and trade may be a first step in increasing this form of cooperative development.

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There are also developing techniques in renewable energy technology that should be closely monitored by policymakers. One area where rapid change is possible is in biofuels. At present, biofuels seem to present an ethical dilemma, as the feedstocks to make them are foods: carbohydrates from grains or tubers (ethanol) or oils from plants such as soybeans or canola. But this could change; there are significant advances being made in bioconversion of inedible plant waste or grasses (cellulosic ethanol). In addition, biofuels from algae may be far more productive than biofuels from crops—estimates run as high as 30-100 times more productive per unit of land area. And, although investments are higher than for farming, land unsuitable for other purposes can be used for algal diesel, and such projects need not tax water resources, either, since many of the species of interest live in salt-water. The first algal biodiesel plant (which is based on salt-water species) began production in April 2008.[15]

This is an example of why it is vital for decision makers to follow the research in these areas closely, as major breakthroughs and novel approaches are constantly emerging. As mentioned above, there has been considerable concern over the ethics of producing biofuels at a time when food prices are soaring. Some have urged governments to take a position condemning or even banning biofuels. But adopting blanket anti-biofuels policies runs the risk of banning fuels made from waste or algae along with those made from food

[15] Under the APEC Biofuels Task Force initiatives, a project on the resource potential of algae for biofuels was approved in May 2009. The project, entitled "Resource Potential of Algae for Biodiesel Production in the APEC Region," attempts to assess the amount and location of algal biomass suitable for the production of biodiesel. See http://www.biofuels.apec.org/pdfs/meeting_201004_kualalumpur.pdf.

crops. If policies are adopted strictly on the basis of current commercial technologies, the policies may discourage the development of new technologies with unforeseen possibilities that could be of immense benefit.

To expand renewable as well as alternative energy use, the issues of scale and commercial viability are important, which may be barriers to innovation and new technologies in the energy markets. Even under the most aggressive scenarios, projections are that alternatives cannot meet more than a small fraction of total demand because of the economic realities. There is no doubt that continued research and development (R&D) of new energy technologies is important for growing global economies over the long term. Despite the need for more R&D for renewable and alternative energy—we need them all, there is no silver bullet—it is important to note that technologies that can be commercialized without significant sustained government subsidies have the greatest chance of being economically viable. Under its 12th Five Year Plan, China is promoting technologies and policies aggressively for renewable and alternative energy. Their efforts may lead to scalability but the market has to eventually take over to sustain any renewable and alternative energy developments.

### *E. Smart Grid, Intellectual Property Rights, and Other Issues*

There can be a long list of other issues to address to promote clean energy use and technical innovations. A few areas are singled out below that we deem important but it is by no means an exhaustive effort to cover all topics.

*Development of smart grid technologies*. Smart grid technologies are being promoted by some APEC economies and considered in others. This is a step in the right direction as development of smart grid technologies may potentially advance renewable energy use and improve energy efficiency. The Fukui Declaration from the 9th Energy Ministers Meeting, June 2010, states that "smart grid technologies, including advanced battery technologies for highly-efficient and cost-effective energy storage, can help to integrate intermittent renewable power sources and building control systems that let businesses and consumers use energy more efficiently, and they can also help to enhance the reliability of electricity supply, extend the useful life of power system components, and reduce system operating costs." The Energy Working Group of APEC has since started an APEC Smart Grid Initiative to evaluate the potential of smart grids to support the integration of intermittent renewable energies and energy management approaches in buildings and industry.

*Protection of intellectual property rights (IPR)*. This is really one of the key issues. Developed and developing economies should discuss and agree on issues related to IPR. Multilateral international framework should focus on this issue and play a role to promote the discussion. IPR is important for creating incentives for inventors and innovators. However, IPR should be such that incentives for further research and development are not blunted by over-generous protection for IPR. There should be a balance. Ultimately, transparent strong protections will promote innovation in all economies.

*Expanded use of electric vehicles:* Electric vehicles (EVs) have the potential to transform transportation and energy sectors. Electrification of vehicles has the potential to reduce oil dependence and improve energy security as well as lower emissions, but they will also create greater demands on energy supply and energy infrastructures. Incentives will be required to put public and private charging infrastructure options in place to support the adoption of EVs. EVs will demand energy infrastructure changes in model building codes, as well as smart grid technology coupled with appropriate utility rate structures to optimize charging times for vehicles, and to reduce potential stresses on the grid.

## VII. Conclusions and Policy Recommendations

Energy security has multiple dimensions. First and foremost, energy prices need to reflect their true cost so as to rationally impact consumer behavior. This will not only impact consumption but it will also drive innovation. Another key element argued repeatedly by this brief is that ensuring energy security today requires a dual approach to the challenge of oil. On one hand, alternatives to oil need to be expanded and encouraged, and oil use needs to be made more efficient so as to minimize demand. On the other hand, governments need to help ensure high levels of oil production and efficient and smooth trade in oil, both to stabilize prices and to avoid disruptions. Any framework to enhance energy security in APEC will have to recognize the necessity for doing both simultaneously without giving priority to one over the other.

Policy recommendations are featured throughout the study. They are also summarized briefly as follows:

While APEC economies are already working on the components of a more secure energy future, these efforts can be further consolidated, enhanced and accelerated through:

- **Ensuring a regulatory, investment, and legal environment that encourages investment and action by the private sector.** The business community has an abiding interest in ensuring affordable and sustainable supplies of energy. As APEC explores developing an Energy Security Framework that includes regional and national integrated energy strategies and measurable objectives, it is important that goals be realistic and that policies be put in place that leverage the private capital and the expertise and dynamism of the private sector.
- **Hold an Annual Meeting of APEC Energy Ministers, with private sector participation comparable to that at the 2007 Darwin Meeting.** Energy cooperation is now such an important issue that APEC energy ministers should commit to annual meetings to insure strong oversight of previous agreements and to take further actions based on current conditions. Robust private sector input and cooperation is necessary to success. Private sector participation should be patterned after the 2007 meeting of energy ministers in Darwin, especially the integration of such entities as an *APEC Energy Business Forum and the Energy Business Network.*

In the near term, there is room for APEC economies to expand energy conservation efforts, promote renewable and clean energy resources, and take steps to increase energy productivity:

- **Expand efforts to exchange best practices, standards and technologies for improved energy efficiency.**

**a.** The exchange of information is important as energy efficient practices that are common in a sector in one economy may be unknown to the same sector in a different economy.

**b.** In order for APEC to promote energy efficiency, each economy should also consider defining a Minimum Energy Efficiency Performance Standard (MEPS) for certain carbon-intensive sectors, including electricity generation and steel industries, automobiles, home appliances and residential and commercial sectors.

**c.** Alternative energy such as hydropower, solar, wind and biomass are sustainable sources, but will need cooperative development to ensure cost-efficient deployment globally. APEC economies should promote the growth of these industries by harmonizing standards and conformance on these emerging technologies, promoting the trade of environmental goods and services and adopting policies that encourage investment and reflect market dynamics.

- **Facilitate the use of all viable energy sources by playing a constructive role in reducing barriers to energy investment and trade**

**a.** Natural gas is a transportable, viable energy source, particularly with the emergence of competitive shale gas, and producing economies should consider pursuing infrastructure developments to help bring these energy-dense, lower-carbon fuels to market as quickly and efficiently as possible. Streamlining permitting and routing processes will help; avoiding price controls and local content rules can also address the energy gap.

**b.** Alternative energy sources may increasingly become viable and contribute to the energy mix. Sources such as geothermal, solar, hydropower, biomass, waste and wind energy have different barriers to entry and scaling. APEC economies should promote the growth of these industries by examining domestic policies that may limit their adoption and by easing restrictions on technologies, promoting the trade of environmental goods and services and introducing incentives.

**c.** Nuclear power, notwithstanding what the world has learnt from the recent Fukushima crisis, remains a clean source of energy for economies that are able to meet safety standards set by the International Atomic Energy Agency (IAEA).

**d.** Protect energy investments through:

- **i.** Promote strong investment treaties that create secure, predictable and non-discriminatory legal environments that will encourage large investors to spend the capital required for large-scale projects.
- **ii.** Ensure that the large scale investments required for infrastructure and resource development are protected by strong investment regimes that allow for non-discrimination against foreign investors, give investors full protection and security satisfying the standards of customary international law, provide for free transfer of capital, set limits on expropriation and guarantee access to reliable third party dispute mechanisms.
- **iii.** Create a forum/venue for economies to share best practices and knowledge regarding attracting foreign direct investment in emerging technologies.

**e.** In the resource sector, producing economies should open access to foreign participation in order to attract private capital and gain access to the most suitable technologies.

- **APEC economies can encourage power generation and other industrial plants to phase out inefficient systems and adopt new low-carbon and more cost-effective technologies**

**a.** Introduce tariff-based long term incentives that support efficiency gains. Because different sectors have different needs, fuel mixes, and challenges, the idea of implementing incentives on a sector by sector basis should be considered.

**b.** In consultation with the business community, jointly develop a proposal to introduce and review on a regular basis the Low-Carbon Pathfinder Scheme, based on the multi-track approach that reflects the different environments of each economy and the major energy-related sectors. The scheme allows each APEC economy to select and prioritize its preferred options for emission reductions, energy strategy, policies and regulatory measures. The scheme of each economy should be published and reported periodically among the APEC economies.

In the long term, the price of energy should reflect the cost of energy production, extraction, and distribution. Energy consumption is subsidized in many economies. As a result, energy markets are not as efficient as they could be in influencing consumer behavior towards energy efficient products and encouraging greater private sector investments in the development of clean energy infrastructure and low-carbon technologies. APEC economies should:

- **Commit to the elimination of inefficient fossil fuel subsidies to reflect the true cost of energy.** Commitment by APEC Leaders to rationalize and phase out inefficient fossil fuel subsidies is laudable. APEC needs to establish timeframe with milestones and targets to gradually remove fossil fuel subsidies.
- **Consider removing tariff and non-tariff barriers and enhance stronger intellectual property rights (IPR) protections for low-carbon technologies and other environmental goods and services,** specifically technologies for household, industrial, transportation, smart grid and other uses. Eliminating tariff and non-tariff barriers can reduce the cost adoption and stronger IPR protection will encourage the commercialization and dissemination of new energy efficient and low-carbon technologies.


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