Strategic Framework for Energy Security in APEC

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Introduction

Demand for energy resources is projected to continue to outpace growth of supply in the APEC region in the near future. With the likelihood of high prices (despite recent drop associated with depressed demand for energy resources over this period), and economic slowdown in developed economies, it is now more critical than ever to reach a consensus on, and begin implementing, policies to address the gap between supply and demand, strengthen regional energy security, and understand its relation to regional economic vitality. Since 2004, the issue of energy security has been consistently highlighted as a concern by APEC Leaders. In 2007, an additional dimension was added to the energy debate by the Leaders. It included the need to facilitate 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.

The purpose of this brief is to provide a strategic framework to advance policy development and implementation throughout APEC, to create alignment among the Leaders' multiple goals for energy, and to develop a long-term integrated strategy with measurable objectives for improvements in the areas of energy security, efficiency and technology development.

In the next four years (2009-2012), APEC meetings will be hosted by economies that play key roles in the energy sphere:

- ***Singapore - the trading hub of the Asia Pacific for petroleum products;***
- ***Japan - the most efficient user of energy of developed APEC economies;***
- ***United States - the current largest consumer of energy in the world and the member economy capable of having the greatest impact on demand; and***
- ***Russia - an important global energy producer.***

In a region as complex and diverse as APEC, a strategy for enhancing national and regional energy security could touch on literally hundreds of topics and tactics. The framework presented in this paper restricts itself to four broad themes that seem both most urgent and most underdeveloped:

A. Expand and Diversify Supply of Energy Resources

- *Expanding the use of natural gas*
- *Reconsidering nuclear power*
- *Increasing access to conventional resources*

B. Manage Energy Demand by Promoting Conservation and Improving Efficiency

C. Promote Efficient Energy Markets

- *Removing barriers to the free flow of goods and services in energy*
- *Studying the futures market*

D. Clean Energy Use and Technology Innovation

- *Expanding the use of clean coal*
- *Expanding the use of renewables*

There are other obvious issues impinging on energy security in the region that are not discussed as part of this proposed framework (for example, increased oil stockpiling), either because they have been examined at length over previous decades, or because they do not seem to be of APEC-wide interest. These four themes are not intended to be exhaustive, but instead to suggest the areas where efforts by APEC could have the largest effect on improving long-term energy security.

Under the discussion of each theme, explicit questions are raised for policymakers to consider in grappling with the topic and in proposing the best means for APEC to address the problems at hand.

A. Expand and Diversify Supply of Energy Resources

It is very important for APEC economies to work together to expand the supply of energy resources. Diversification is another key issue as well. The diversification efforts focus largely on the reduction of the dependence on oil. As such, the expanding uses of natural gas, clean coal, renewables, and reconsideration of nuclear power are all viable options. The discussions of clean coal and renewables, however, will be done under a separate theme of clean technology innovation later on.

Expanding the Use of Natural Gas

Natural gas provides a clean and efficient alternative to oil in a wide variety of uses, from fueling centralized power generation down to meeting home cooking needs. Since gas must be kept under pressure, however, it presents special transport and storage problems, and has tended to be used first near centers of production. While oil-import facilities are relatively cheap and can be scaled from tiny to large, the infrastructure required for long-distance movement of gas, whether via pipeline or LNG (liquefied natural gas), 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. The scale and the possible political risks are both substantial.

The establishment of international gas transport infrastructure, be it pipelines or LNG terminals, invariably requires the involvement of government. In the least interventionist of cases, this might mean involvement in the permitting and routing process, but often establishing international gas trade includes governments as parties in the negotiations themselves. Since lack of infrastructure is one of the principle barriers to increased gas trade, APEC governments who wish to expand the role of gas ought to study and confer on how infrastructure can best be expanded.

Perhaps the largest impediment to increased gas trade, however, is the immaturity of the international gas market. One of the biggest problems with the gas market is a lack of liquidity. 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 too 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. (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.)

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 never 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. APEC should study the possibility of establishing an Asian futures market in gas. This could make it easier for projects to go ahead without needing to establish contracts for their full volumes, and also easier for buyers to enter the market, committing to greater volumes than they might need.

Reconsidering Nuclear Power

After the Three-Mile Island incident in the United States in the late 1970s, nuclear construction in America first slowed and then halted altogether. The 1986 Chernobyl disaster, which released 200 times more radiation than the atomic bombs dropped on Japan, left hundreds of cities and villages in Ukraine and Belarus uninhabitable and further slowed world enthusiasm for nuclear power. And, although Japan has forged ahead with its nuclear expansion, even that major program has been slowed and has faced internal opposition in the wake of a series of accidents in the 1997-2007 period.

In addition, time after time nuclear power programs have been used as cover for secret weapons programs. Of the five states that developed nuclear weapons outside the original Non-Proliferation Treaty (NPT) "nuclear weapons states," all of them—Israel, India, North Korea, Pakistan, and South Africa—acquired them under the guise of a peaceful nuclear-electric program. (Of these, of course, only North Korea was a signatory to the NPT. This fact has been used both as an argument that the NPT works and as an argument that it does not.)

Despite the problems with plant safety and concerns about proliferation of nuclear weapons through power programs, nuclear electricity seems to be poised for a comeback. In the face of global warming, many long-time environmentalists have publicly reversed their long-standing opposition to nuclear power. Others, who opposed nuclear powerplants on economic grounds (nuclear plants often underperform compared to their planned capacity and expected hours of operation per year), admit that at today's energy prices, nuclear power now looks attractive. Moves from coal or oil to natural gas only slow the pace of the increase in global warming. Nuclear power joins solar, wind, and geothermal as one of the power sources which emit zero greenhouse gases.

Major gains in the safety of nuclear powerplants have been made by designing the next generation of plants to be *less efficient.* Although this statement seems puzzling at first, it is true. The designs developed in the 1960s and 1970s were aimed at producing power as cheaply as possible, to compete with then-cheap coal and fuel oil. To achieve high efficiencies, nuclear plants were designed to operate near the limits of what engineering could achieve, which meant the largest reactors using the highest possible temperatures for circulating water. Lowering these temperatures makes both accidents (which are uncommon) and forced shutdowns (which are quite common) far less likely.

Smaller reactors operating at lower temperatures also allow the use of so-called "passive" designs. In traditional nuclear plants, the temperatures are so high, and the heat load from the reactor so great, that cooling water must be actively pumped through the system, and any failure of the pumping system (or loss of power to the pumping system) is an emergency. In passive designs, the cooling water circulates under its own natural physics, with the hot water rising, exhausting its heat, and then once cooled returning under gravity flow. The entire "control room" of a passive-design reactor can fail without affecting the cooling of the system.

The "new design philosophy" calls for maximal simplicity. This is a radical turnabout from the past. Traditional nuclear reactors are among the most complex systems ever built, and it is unsurprising that some element of "operator error" is frequently implicated in accidents. To achieve high efficiencies and avoid shutdowns, the criterion for shutdowns were complicated and near limits that risk accidents. New designs shut down on easy-to-understand criteria, and far sooner, even if running would be 'safe' by engineering criteria. To take a single example, old reactor designs shut down when the fuel rod power density exceeded 5.5 kWh per foot of rod; new designs shut down at 4.0 kWh per foot, even if engineering considerations would allow them to run at 5.5 kWh. These result in less power output and possibly in greater time offline, but the increase in safety is believed to be enormous.

As mentioned above, new reactor designs in the United States are smaller than in the past. Part of the reason is to lower the cooling load, but another is a marketing issue. Standard reactors were typically designed to run at 1,200 MW (though they were often 'derated' once they were brought into service). Derating capacity was often used as a dodge to make nuclear power look as if it were more efficient than it was. A plant would be sold as a 1,200 MW facility, but then be derated to, say, 1,050. If the average output of the plant was 945 MW, then the operator could claim it ran at 90% of its 1,050 MW capacity; but in reality it only ran at 78% of its 1,200 MW design capacity.

Large reactors were also intended to improve economics, but single plants of 1,200 MW present problems for utilities. The first is uncertainty about demand forecasting—how soon will the system be able to absorb 1,200 new megawatts? The second is the size of the utility grid: in small systems, the loss of power from a single facility of this size can take down the whole grid. The third is financial, and has become especially acute with the credit crunch: who can afford to borrow to build megaprojects? Many of the manufacturers are now pushing designs of half the traditional size, units of 600 MW. There are far more possible markets and sites for 600 MW plants than for their 1,200 MW ancestors.

New nuclear-power designs promise to be far safer than traditional designs, and will also be easier to build, operate, and finance. Coupled with the advantages of zero emissions of greenhouse gases and fuel supplies that need not be imported on a continuous basis, nuclear power looks more attractive than at any time in the past.

The problems of fuel disposal, however, remain unresolved. Even in the longest-standing nuclear-power nation, the United States, debate drags on about the formally adopted underground storage plan. To add to these complications, terrorist strikes against nuclear targets—an event once regarded as somewhat improbable—now seem altogether too likely. And while the nuclear plants themselves can be hardened or protected in various ways, the inevitable nuclear waste becomes vulnerable during transportation for disposal; indeed, some analysts now believe that the transport of nuclear waste is a far more risky proposition than the ongoing operation of the powerplants.

The role of nuclear power in the region's future deserves wide-ranging discussion and debate. When fervent environmentalists come out in favor of nuclear power, and newer designs emphasize safety over economic performance, it is time to revisit the issue. But the risks of proliferation, the problems of waste disposal, and the issue of protecting both plants and wastes from possible terrorist attacks provide some very daunting challenges.

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. Although the sudden expansion of the role of NOCs can be seen as a needed corrective to the abuses of foreign ownership earlier in the 20th century, NOCs' monopolies can have distinct disadvantages.

Opening exploration areas to foreign participation can draw in capital and also pull in the most sophisticated E&P technology—including highly proprietary techniques that are available from only a few companies. While there are service companies that offer to perform advanced E&P on a work-for-hire basis, not all companies are equal in expertise, and it is worth noting that a company has less incentive to perform at its most innovative if it gets paid regardless of its success in finding oil.

One of the most successful of the NOCs, and a model widely admired, is Malaysia's Petronas. But Petronas is so successful precisely because it has always had to compete with foreign companies, even within Malaysia. (The US spawned many of the world's most successful multinational oil companies, and all of them were created in the most competitive environment possible.) Lack of protection has kept Petronas as professional and businesslike as any international company.

Lack of competition can lead to overstaffing, undue levels of political influence in business decisions, and can encourage various kinds of corruption. Competition can make NOCs grow stronger, and can help them reach out into the international arena, which can increase a nation's energy security. To take the case of Petronas again, in addition to the 15 crudes and condensates and the gas the company produces in Malaysia, Petronas has also participated in upstream oil and gas developments in 25 other countries, and now owns substantial shares in the production of recent oil fields in Chad, Indonesia, Sudan, Vietnam, and

Mauritania. In addition, Petronas also owns joint ventures overseas in refining and petrochemicals.

While other NOCs (especially those from some of the cash-rich Middle East oil exporters) have also expanded overseas, few have expanded as effectively, shrewdly, and comprehensively as Petronas. Many analysts, both inside and outside the company, attribute this to years of competition (and joint-venture projects) with the likes of Shell and ExxonMobil. Malaysia's energy resource base is enviable but not huge; but Petronas' expansion overseas has greatly enhanced that nation's power over energy resources and energy trade.

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. Both the international market and the owner of the resource benefit from competitive bidding on resources.

Key questions to be addressed:

- ***What are the options for sharing gas transport infrastructure between importing countries? How can pipeline security be enhanced?***
- ***How can APEC governments help foster a successful international commodity exchange in natural gas? Are there risks to changing LNG from a bilateral contract good into a generally traded commodity?***
- ***What are possible solutions to the problems of nuclear-waste disposal? Are there regional or multilateral solutions that would be better compared to the unilateral (store one's own waste) or bilateral (return the waste to the fuel producer) approaches?***
- ***How real are the risks that nuclear facilities, nuclear-waste storage sites, or nuclear-waste shipments might become targets for terrorism? If the risks are real, what can be done to mitigate them? What roles might APEC cooperation play in mitigation?***
- ***How many prospective exploration areas in APEC economies are off-limits to competition? How much potential resource is tied up in such areas?***

B. Manage Energy Demand by Promoting Conservation and Improving Efficiency

Promoting energy conservation and improving energy efficiency have long been the priority in many APEC economies, partly because high energy prices or price spikes have driven conservation and efficiency efforts forward. Most of these gains remain in place when energy prices fell again.

The importance of energy conservation and efficiency has also 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.

Still, there is 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, while the Chinese have made great strides in the manufacturing of important energy-efficient appliances, notably refrigerators and water coolers. In the US, EPA certification of consumer equipment on a comparable basis allows buyers to compare annual energy use and costs before purchase. But the best practices developed in one country do not necessarily flow to another. This is particularly true in the industrial and commercial sectors, where the measures adopted by a particular sort of business may remain unknown to similar businesses in other countries.

Energy efficiency must be measured by end-use if it is to be meaningful. US EPA and various agencies in other nations track energy efficiency in various end-uses and industries, but there is only limited technical interchange on this topic on an international basis. 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.

Conservation services are generally viewed as a local rather than global business, and there is some sense to this; a Swedish firm specializing in winterizing homes might not have applicable expertise for residential energy saving in, say, Bangkok. 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.

Finally, it should be mentioned that many consumers, including consumers at the industrial level, are unenthusiastic about making investments in energy 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.

Key questions to be addressed:

- ***How can APEC collaborate on ensuring that all end-uses move toward best practices? How can information on conservation best be shared between consumers in member economies?***
- ***Is saving energy given the same priority in APEC plans and forums as procuring new supplies? How can government best act to encourage private investment in conservation?***

C. Promote Efficient Energy Markets

Efficient operations of the energy market remain a key to minimizing 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 efficient energy markets.

Removing Barriers to the Free Flow of Goods and Services

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.

Harmonization of tariffs and 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. APEC is as diverse a group of economies 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 a country chooses an unusual specification not used by other countries, this not only cuts the fungibility of the product, but also tends to raise the price of the niche-specification product to the importer. For example, if standard diesel sulfur specifications for products sold out of Singapore are 0.25% and 0.05%, adopting a new specification of 0.12% will only complicate the market by creating a new grade that few can produce and that only one economy wants to import.

The APEC economies will not share identical specifications for traded energy for decades, if ever. APEC economies should discuss and examine their environmental strategies in this area so that they can agree at least on the long-term path and on sets of increasingly stringent specifications that harmonize with one another even when they are not identical.

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. (Witness the fact that when countries have trade sanctions enforced against them, defense and energy technologies are usually the first items on the list.) 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.

Studying the Futures Market

The creation of an international futures market in gas was discussed in a previous section of this paper. Today, with most oil prices already linked to the futures markets of New York or London, many people have become suspicious that the run-up in prices is the result of "speculators" making the market more volatile. Everything from the high price of food to the fluctuation of currencies is blamed on futures-market speculators.

Because emotions run high on this topic, it is the obligation of the authors to make their biases clear before proceeding: 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 (Organization of Petroleum Exporting Countries) nations, the belief is that the futures market has kept prices artificially low for decades.

We do, however, agree that in the short term, the futures market increases price *volatility.* Economists describe a futures market as a means of 'price discovery'. In situations where the market is receiving mixed signals about the supply and demand of a commodity, wild fluctuations can be expected. During the Asian Financial Crisis of 1998, oil supply appeared to be more than adequate, and suddenly demand in the vigorous Asian economies collapsed. The response of the futures market was for the price to plummet—the general feeling was "too little demand, too much oil, and too long until economic recovery." Prices for Dubai crude went as low as $10 per barrel.

But the dip in price was temporary and short-lived. The collective market decided it had been wrong. There was still a solid core of demand and growth potential, the Asian economies were not as shaky as believed, and there was less oil available than it seemed—and almost no investment in exploration. By 1999, prices were near their previous 1997 levels, and by 2000, prices were significantly above their 1997 level.

In the absence of a futures market, would the drop in prices have been so sudden and so deep? Well, it might have eventually gone as deep, but it almost certainly would not have been as sudden. Nor would the recovery have been as fast. Based on past history, producers would have fought with some success to keep prices high. And this, of course, would have made the Asian demand fall further than it did, and stay down longer. In other words, it would have prolonged the length of time where prices were out of synch with reality.

To see how the world operated in the absence of a futures market, all we need to do is look at the oil price shocks that followed the Iranian Revolution. Until 1983, there was no futures market in oil, and until the end of that decade, the futures market had only limited influence on world prices of oil. In the early 1980s there were only two price-setting measures: OPEC OSPs (Official Selling Prices), and the small but important spot market (with the refining centers in Rotterdam, Singapore, and the US Gulf Coast establishing prices by bargaining for cargoes).

After the Iranian Revolution, spot market prices jumped because many companies were unable to get the crude they needed from existing contracts; therefore, they paid what they needed to in order to acquire supplies from other companies. Although OPEC attempted to thwart the spot market (since it challenged their sovereign authority over oil prices), they also watched the spot market closely. Why? Because they had no idea what the price of oil really 'ought' to be or how high it could go. The consensus at the time, though, was that there was little new oil available outside OPEC, and that demand was very unresponsive to price.

It soon became apparent that the consensus was wrong. Demand did respond—slowly, at first, and then more strongly. And new oil appeared from everywhere. The modest North Sea production increased to unexpected levels, traditional producers such as the USSR and Mexico ramped up production, and unexplored areas such as offshore India began to be developed. The turning point came in 1982, when OPEC pushed the price of the marker crude to $34/b. The spot market price for the marker (Arab Light) averaged $34.09/b in 1982, but then, with slowing demand and rising oil supply, it began to fall.

The spot market involved only a small fraction of the trade in oil. However, OPEC still wielded considerable power, and they attempted to hold the line on official prices. As spot prices eroded, OPEC producers (especially Saudi Arabia and Kuwait) cut back production again and again. But in 1985, as spot prices continued to sag, the big players abandoned their defense of prices, and the price of the former 'marker crude' collapsed to $13/b in 1986.

In 1980, the small spot market in oil believed that crude was worth more than OPEC believed, but by 1982, the forecast of the market and of OPEC had switched places. With an active futures market and a wider array of players, we believe that prices would have come down sooner and faster; we believe the world would have experienced a 2-3 year price spike rather than a prolonged plateau of high prices. We believe that economic recovery would have come sooner and that dislocations would have been less severe.

The present futures market reflects the great uncertainty we have about the future of oil supply and demand. The run-up to high prices shows that the market perceives that oil production has been pushed near to the limits of current supply capabilities, that most analysts are not optimistic about large new discoveries, that major new importers such as India and China affected the fundamentals of global demand, and that many believed the dollar, in which oil is priced, was growing steadily weaker. But recent fluctuations downward have reflected slowing demand and a grim economic outlook; upward fluctuations are partly caused by those who believe the credit crunch will slow E&P…It is a volatile market and a very rough ride, but we believe the absence of a futures market, while it would result in less fluctuation, would also result in prices that were too low for too long—and prices that would then stay too high for too long.

We feel the role of speculators in the futures market is overrated. Yes, there are investors who use the futures market much like a casino, but these people are just as likely to bet low as high. The main use of the futures market is for hedging by oil companies, who use various tactics to minimize their exposure to rapid rises or falls in price, and by hedge funds, that are often hedging currency risks or hedging exposure in other commodities. For the serious users of the futures market, futures contracts are a form of insurance against disastrous movements in price, and by taking complex countervailing options they can keep their actual revenues within an acceptable band no matter what the market does. In this system the speculators are merely injecting capital and information into the system: their bets are actually a form of data on where people expect prices to move. Some of these are experts take 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.

Many will be unconvinced by this analysis. People tend to believe that the futures market is a valid tool when it gives them answers they like, and that it is rigged or damaging when it gives them answers they don't like. Today, oil exporters generally like the answers they are getting from the futures market, but these same people spent the last twenty years complaining that speculators in the futures and spot markets were driving the prices down.

To repeat our position: we accept that futures markets increase short-term volatility. We think 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.

Because so many people, including average citizens, are suspicious of the role of the futures market in price-setting, the subject deserves careful evaluation and study. And this could be an excellent area for APEC cooperative research, as any study done by a single country or entity is unlikely to set anyone's suspicions to rest. And if it turns out that our opinion is wrong, and that speculators in the futures market can be shown to have a major adverse long-term effect on average prices, this would be an important and vital research discovery.

Key questions to be addressed:

- ***What is the best mechanism for establishing and monitoring the barriers to energy-technology and energy-services trade in the APEC economies?***
- ***What are best approaches for expediting trade in energy technologies? Should existing procedures be simplified or fast-tracked—or is it better for all trade to be treated uniformly?***
- ***How would an APEC study of speculation and the futures market be structured so as to satisfy possible critics?***

D. 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 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.*

Expanding the Use of Clean Coal

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.

As in gas, the transport infrastructure can be a major barrier to expanded trade and use. Although a coal supply chain is neither as complex nor as specialized as an LNG chain, both port and rail transport facilities can prove to be significant hurdles to expanding coal use in areas where it is not already established. Clean coal technology (CCT) is by its nature limited in scale and scope, competing with oil and gas almost exclusively in power generation (although there are important co-generation options in the industrial sector). Although this cuts off many substitution possibilities, it also means that clean coal use need not develop a complex distribution system like that seen in oil products or a well-reticulated gas system. Assisting the expansion of fuel-import infrastructure for CCT projects is thus usually a relatively localized task.

Although new coal technologies are often far more efficient and are always far less polluting than traditional uses of coal, 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 is estimated to cut the thermal efficiency of the power generation process by 8-10 points, 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. No one is sure what future policies will be, what sort of taxes might be levied, or what control technologies will be best—or even allowed. (For example, some experts feel that ground injection of carbon dioxide poses significant hazards.) The combination of a long horizon to recoup investment coupled with uncertainty about future climate policies is a major barrier to the construction of clean coal plants.

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 economic. (Some in Europe are also worried that the EU emissions-trading scheme will be abandoned after 2012.) In any case, an emissions-trading market will be needed to encourage investment: 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.

Finally, almost any specialized, capital-intensive technology like CCT will face various kinds of import barriers in at least some possible importing countries. 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.

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 take a simple example, no one counts the energy provided by solar water heaters. At best, the number of solar water heaters might be tracked, and the reduction in electricity or gas demand might be estimated. 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 Korea, have the fewest opportunities for accessing renewable energy, if nothing else because of lack of space. But partnerships between countries 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 economics 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.

Limiting the "testbeds" for technologies to the economies conducting the research means that in many cases, renewables are evaluated against suboptimum conditions: for example, the performance and economic feasibility of new solar technologies may be judged in a climate where sunshine is a scarce resource. The conclusions of such studies may be valid where they are conducted, but taking a regional perspective might lead to very different results.

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. It is possible to imagine binational or multinational projects, based on, for example, technology licensed from Japan, equipment manufactured in Singapore, and applied to resources in Mexico. Conventional energy systems are already manufactured on this basis, but renewable energy is still more parochial 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.

There are also developing techniques in renewable-energy technology that should be closely monitored by policymakers. An example is found in polymer solar cells designed to harness longer-wavelength radiation; these cells have the potential of gathering energy from heat waves as well as direct sunlight, and hybrids of these with more standard cells could produce systems capable of gathering more energy across a broader range of lighting conditions. (They also might create a means for turning waste heat into electric power.)

Another 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 saltwater. The first algal biodiesel plant (which is based on saltwater species) began production in April 2008.

This is an example of why it is vital for decisionmakers 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 crops. If policies are adopted strictly on the basis of current commercial technologies, the policies may discourage the development of unforeseen possibilities that could be of immense benefit.

Key questions to be addressed:

- ***Can government assist in expanding coal-import facilities where they are needed? Can coal exporters take a stake in import ports and terminals? Can industrial facilities be co-located to make use of waste heat? Does coal deserve special treatment?***
- ***How can APEC economies cooperate to establish a sustainable carbon-trading system? Does a workable system require widespread coordination, or can a successful system be launched based initially on only a few pioneer countries?***
- ***How can APEC economies lower the uncertainty associated with future government climate policies? Should permanent carbon exemptions or offsets be offered for pathfinder or demonstration CCT projects, or does this send the wrong signals to the industry?***
- ***What untapped renewable resources exist in APEC economies? What technologies are under development which might be applicable to those resources?***
- ***Where are the possibilities for joint-venture companies in renewable energy? Can high-tech solutions under development in one country be manufactured more cheaply in another? Can high-tech solutions be modified to be more applicable to developing nations?***

Conclusions

As the array of policy issues outlined above shows, energy security today requires a dual approach to the problem 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 hold prices down and to avoid disruption.

Although it may seem schizophrenic to try and undercut oil's role while simultaneously trying to expand and expedite increased oil trade, these positions are complementary. Much political rhetoric today is focused either on the need to find new oil, or instead on the need to cut our dependency on oil. Any framework to enhance energy security in APEC will have to recognize the necessity for doing both at once without giving priority to one over the other.

In short, the four themes discussed in this paper are critical for APEC Leaders, Energy Ministers, and individual economies to address if the 2007 Darwin and Sidney Declarations are to be implemented. Singapore (efficient energy market), Japan (efficient use of energy), United States (energy demand management), and Russia (expansion of energy supply) as the hosts of the APEC Leaders' meetings through 2012 offer unique opportunities to address the policy issues underpinning these four themes. It is believed that 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 next five years.

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