

ENERGY INVESTMENT

- *To meet the rapid energy demand growth, APEC economies will require between US\$ 5.95 and 7.55 trillion.*
- *For the APEC region on average, the energy investment share of GDP is projected to be 0.7 percent. Only six APEC economies fall below this average: Japan, Hong Kong, China, New Zealand, United States, Chinese Taipei and Singapore. Five APEC economies – Indonesia, Malaysia, Russia, Papua New Guinea and Viet Nam – are projected to have energy investment burdens greater than two percent of GDP.*
- *Governments of host economies will need to provide conditions that can attract a mix of domestic and foreign investors to provide the investment capital needed for energy projects.*

INTRODUCTION

Energy is an integral part of economic activities, and thus, investment in energy infrastructure is essential to support activities and growth of APEC economies. It facilitates the mobility of people and goods, underlies the production of manufacturing and services, and sustains the comfort and convenience in living. All in all, quality of our living standards, performance of industries and business activities invariably depend upon stable and reliable energy supply.

Disruption of energy supply can create significant economic losses. For example, electricity blackout that took place on August 2003 in New York and neighbouring states has resulted in losses of some billions of US dollars. During the 1980s, about twenty percent of the industrial factories in China were kept idling due to the inadequate electricity supply. Costly incidents such as these are raising concerns over the reliability of future energy supply in the world and in APEC particular, as their future energy demand is expected to grow at the faster pace.

APERC projects that energy demand of APEC economies will grow 2.0 percent through 2030. The trend of energy demand growth for the APEC economies is somewhat faster than that of world average. In order for the fast energy demand growth to be realised, and hence to sustain economic growth, economies in APEC would require substantial investment from production, transportation and through to delivery. This would mean upstream investment in oil and gas, and midstream investment for oil and gas pipelines, transmission lines, and tankers, and downstream investment for oil refineries, and power plants.

Despite the importance in developing energy infrastructure, some APEC economies do not necessarily provide conditions attractive enough to invite investment. In the United States, for example, since deregulation of electricity industry had given a strong competitive pressure, efforts by companies to reduce capital investment have made transmission

capacity insufficient to meet demand growth. China has been experiencing a slow progress in building new refineries or expanding production capacities as their regulated prices of gasoline and diesel cannot provide enough rate of return for investors. Meanwhile, some of the developing economies in APEC could not attract capital for energy projects because of the opaque laws, rules, and regulations and even because of the high political risks.

Financing energy project would pose challenges to the energy sector of APEC. Given the tight budgetary conditions, APEC economies should rely on their increasing share of energy projects for private financial sources. However, private financiers would ultimately see no boundary both in terms of *economy* and *sector*, therefore, attracting financial sources from private sources would face increasing competition. In brief, it would have to be met with appropriate or favourable conditions that can minimise cost and maximise benefit.

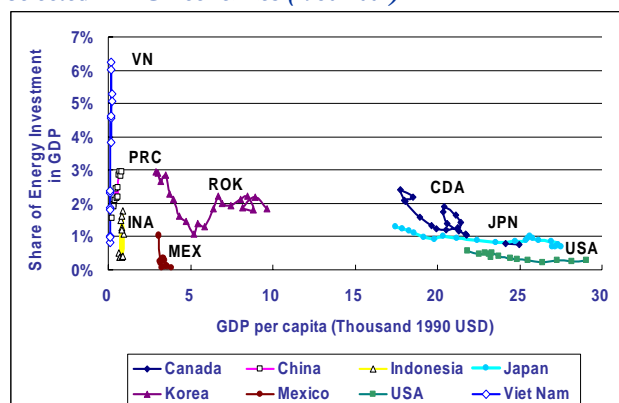
In this chapter, a brief introduction of the historical trend for energy investment from upstream, midstream to downstream are provided in consideration for the factors affecting the trends in energy investment. With the special focuses on upstream investment in oil and gas E&D, and midstream investment in power transmission, we will further investigate both drivers and constraints for energy investment. To evaluate the size of investment requirements to the energy sector, we will present an overview of a thirty-year investment requirement both by sector and by economy. An overview of historical trends in financing to the energy sector will be presented to highlight difficulties or enabling activities for attracting capital to the energy projects. Finally policy implications will be drawn to present how economies in APEC could give incentives to the private sector to participate in energy projects and to provide financial sources.

HISTORICAL TRENDS OF ENERGY INVESTMENT IN APEC

The fundamental driver for energy investment is economic activity and the resulting demand for energy services. Thus, requirements for investment in energy infrastructure may be particularly large in economies that are at an early stage of development and growing rapidly.

Figure 52 compares the share of gross domestic product that is taken up by investment for energy utilities with gross domestic product per capita in several APEC economies for the period from 1980 through 2001. The comparison clearly shows that the burden of investment, relative to GDP, often declines as GDP per capita increases, both between economies and over time within economies. The most developed economies, with the highest GDP per capita, have relatively low investment burdens, as shown by Canada, Japan and the United States. The least developed economies, with lowest GDP per capita, have relatively high investment burdens, as shown by China and Viet Nam.

Figure 52 *Investment by Energy Utilities as share of Gross Domestic Product, Compared with GDP per Capita, in Selected APEC Economies (1980-2001)*



Source: APERC Analysis (2003)

Less developed economies may tend to exhibit relatively high investment requirements for energy infrastructure because such economies are in the midst of a transition from reliance on non-commercial energy sources, which require little infrastructure, to commercial fuels like coal, oil, gas and hydropower, which require substantial infrastructure. In Viet Nam, for example, just 40 percent of total primary energy supply comes from commercial fuels, and a three-quarter of households do not have access to the national electricity grid. Development of commercial energy sources and expansion of the power grid will entail substantial new investment.

In middle-income economies, requirements for new energy infrastructure are likely to continue to exert a considerable burden. In Korea, for example, the share of energy utility investment in GDP declined roughly from 3 percent in 1980 to 1 percent in 1988 but grew again to around 2 percent during most of the 1990s. Increased investment for the last decade has been largely driven by natural gas infrastructure development. Since the introduction of LNG in 1986 to supply natural gas to power generation and a subsequent policy for the economy-wide introduction of natural gas, substantial investment has been needed to develop gas trunklines and distribution networks. Such downstream networks often have greater investment requirements than upstream gas development.

Higher-income economies like Canada, Japan and the United States have smaller energy utility investment requirement than other economies even though their absolute level of energy utility investment is higher since their GDPs are large. The main reason for their smaller energy utility burdens is that they have a substantial capital stock of energy infrastructure already in place. One of their main challenges is how best to replace obsolete facilities in a deregulated environment for gas and power production where utilities are faced with the competitive pressure to reduce costs.

ENERGY SECTOR REFORM AND INVESTMENT

Energy investment is also influenced by institutional factors such as government rules, regulations and industrial structure. Many APEC economies are considering or have already taken market reforms and restructuring of energy sector. Such reform efforts are designed to encourage competition from additional energy producers and lower energy costs to consumers and for consumers to have a fair choice of suppliers.

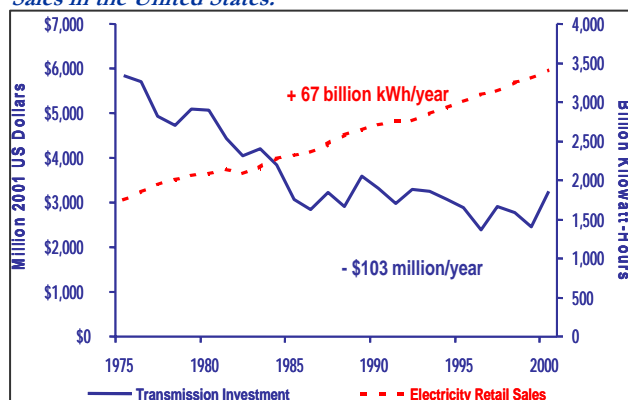
Fair access to consumers means non-discriminatory access to transmission and distribution networks, which typically remain regulated as natural monopolies. The construction of transmission and distribution lines for natural gas and electricity as well as terminal facilities for receipt and processing of liquefied natural gas (LNG) in some places usually subject to rate-of-return on investment, based on the weighted average cost of debt and equity capital.

If regulators fail to sanction a market-based rate of return on investment in transmission and distribution facilities, such facilities will not be constructed. Regulatory failure of this sort is by no means confined to markets in which regulatory reforms have allowed competition among gas

producers and electricity generators over the regulated transmission and distribution lines.

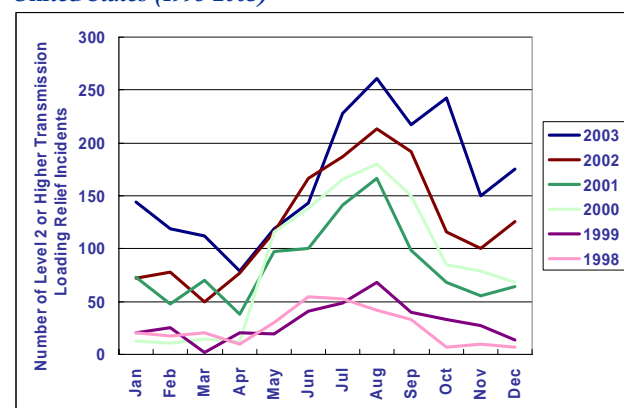
An interesting illustration concerning investment under deregulated environment is provided by the United States. As shown in Figure 53, US transmission investments have been falling by an average of US\$103 million per year for the last 25 years. By the late 1990s, annual investment outlays for transmission facilities were around half of what they were in 1975. One could argue that the use of transmission is getting more efficient, moving more electricity per unit of transmission capacity. This could be due in part to the growing use of combined-cycle gas-fired power plants, which are often located close to demand centres.

Figure 53 Transmission Investment and Electricity Retail Sales in the United States.



Source: Edison Electric Institute (2001)

Figure 54 Growing Transmission Line Congestion in the United States (1998-2003)



Source: North American Electric Reliability Council (2003)

On the other hand, as shown in Figure 54 the transmission grid is becoming more congested, with incidents requiring transmission loading relief becoming much more frequent since 1998. This can be attributed to increased electricity generation to meet growing demand, combined with vigorous trading in the wholesale market for generation. The blackouts experienced in the Northeast in 2003,

which affected 80 million people and were thus the most extensive in history, also suggest that the grid may be strained beyond its capacity. Together, the growing congestion and recent blackouts strongly indicate the need for additional transmission capacity to be built if market competition is to keep growing and the supply of electricity is to remain reliable.

The question then is: What are the barriers to additional investment in transmission lines? One of the most intractable obstacles relates to difficulties in siting. Transmission networks increase the options for customers to buy less expensive electricity from more distant sources. But siting new transmission facilities is difficult due to the complexity of environmental and land use regulations, as well as the NIMBY or “not in my backyard” syndrome. Regulations may require that before a construction permit is granted, environmental impact assessments must be performed and transmission investments must be shown to be the least-cost alternatives. NIMBY may be particularly pronounced where new lines are proposed in what might be called “transit” areas that contain neither major power plants (whose owners would profit from increased sales) nor major load centres (whose consumers would benefit from competition among more generators).

Another critical obstacle for transmission investment in the United States is that owners of transmission facilities often have little incentive to invest in new facilities. Current regulatory frameworks do not provide a mechanism for transmission owners to share the benefits that accrue to power plant owners and electricity customers from competition, even though transmission lines are what make the competition possible. Hence, returns on investment in transmission facilities may often be inadequate to attract such investment. According to a study by Hyman, transmission owners can earn an after-tax return on investment of 9 percent per annum over a 40-year period, which is less attractive than returns on other investments in the energy sector and elsewhere.

Investment in new transmission facilities may also be discouraged by regulatory uncertainty over transmission pricing, for which there are many different methodologies. For example, PJM is using license-place rates, charging an access price based on the location of the load. The New England Power Pool applies region-wide postage-stamp rates for transmission access which are the same regardless of where the load is located. Under these circumstances, transmission owners have little incentive to invest in the transmission facilities unless they are absolutely necessary. In the process of deregulating electricity markets in the US, discussion seems to have focused

on the importance of non-discriminatory access to the transmission infrastructure. Recognising the benefits obtainable from competition between the generators, the complementary role played by transmission facilities to enable access to less expensive sources of generation, deregulated electricity markets need careful designing to facilitate investment in transmission lines in a manner that keeps pace with rising demand.

To this end, there are at least two important requirements for enhancing transmission network investment. One is to ensure the long-term regulatory framework and the second is to provide incentives for transmission owners in a manner so that they can recover costs and earn a competitive return on transmission investments. Transmission pricing should include economically efficient signals to transmission users.

THE OIL PRICE AND INVESTMENT FOR OIL AND GAS EXPLORATION AND DEVELOPMENT

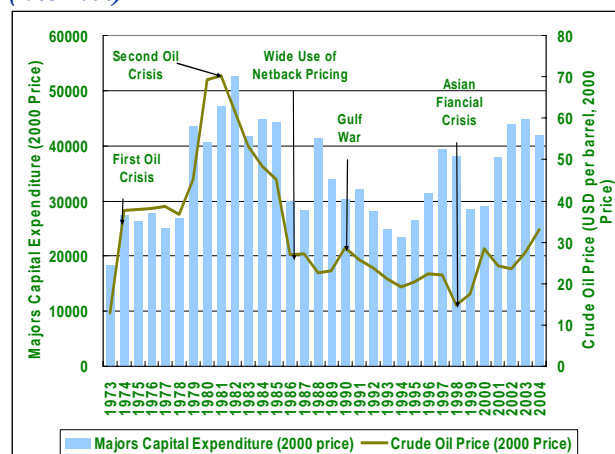
Oil and gas production is sustained by continued investment in order to add proved reserves to replace production. However, the investment environment for oil and gas upstream exploration and development has not always been favourable to investors. For one thing, investors have to deal with the risks arising from the geological conditions in finding profitable wells because exploration wells are mostly dry holes. Thus a small number of successful wells are required to cover the costs of unsuccessful field exploration.

In addition, investors, in particular foreign investors, must cope with further difficulties caused by the interaction with host governments. One of the difficulties lies in the fiscal policies of the host governments. Generally, underground mineral resources like oil and gas belong to sovereign. Therefore, investors are subject to payment of taxes, royalties and surcharges to the host government. Sometimes the fiscal framework is either unattractive or inadequate in view of the potential risks involved. The fiscal regime may also be subject to frequent revision, which may deter investors out of fear that the terms of deals will be altered once they are in place or out of hope that better deals can be secured at a later date. Legal issues and political stability are additional hurdles as far as foreign investment in oil and gas field development is concerned.

Then the question posed is: What is the main driver of investment for oil and gas exploration and development (E&D)?

Figure 55 shows the historical trend of capital expenditure for exploration and development of oil and gas reserves by four major oil companies (BP Amoco, ExxonMobil, Royal Dutch Shell and ChevronTexaco), along with the world crude oil prices.

Figure 55 Oil Price and Investment in Oil and Gas E&D (1973-2004)



Source: APERC Analysis (2006)

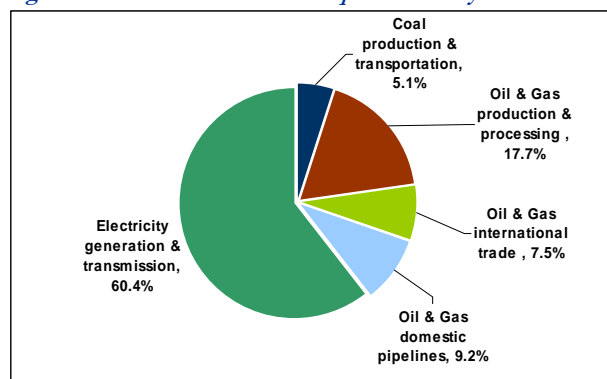
As the above figure shows, oil investment for oil and gas upstream E&D has high correlation with the oil price movements. In particular, the major oil companies' investment activities share a common trend with oil price movements over the period between 1977 and 2004, while they do not share any common trend between 1973 and 2004. These coincide with the timing when investment of oil major companies changed. In the early 1970s, investment activities were led by political considerations to enhance security of oil supply, while since the end of 1970s, investment activities have been more driven by the commercial viability of investment in E&D, for which crude oil prices have played the key role as a determinant.

ENERGY INVESTMENT REQUIREMENTS IN APEC

To meet the rapid energy demand growth, APEC economies will require between US\$ 5.95 and 7.55 trillion. As Figure 57 shows, electricity generation and transmission are projected to account for about 60.4 percent of the projected total investment requirements through 2030. Oil and gas production and processing are projected to account for about 18 percent of the total projected during the same period. Domestic oil and gas pipelines represent about 9.2 percent of the total. Investment for the international trade of oil and gas, which include the costs of tankers, LNG facilities, and pipelines used for international trade, represent about 7.5 percent of the total. Coal production and transportation has the

smallest share at 5.1 percent of the total investment requirements.

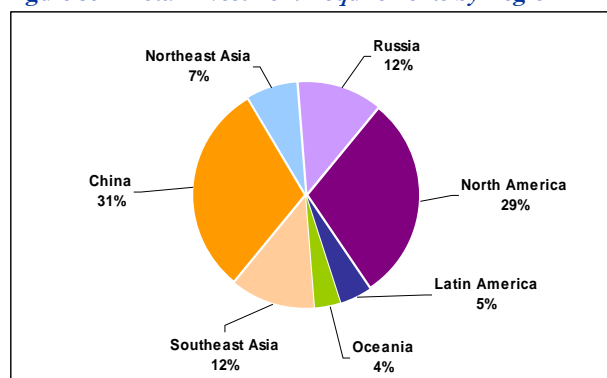
Figure 56 Total Investment Requirements by Sector



Source: APERC Analysis (2006)

Figure 57 shows the total investment requirements by region. China accounts for the largest share in total APEC energy investment requirements at 31 percent, followed by North America at 29 percent and Russia and Southeast Asia at 12 percent respectively.

Figure 57 Total Investment Requirements by Region



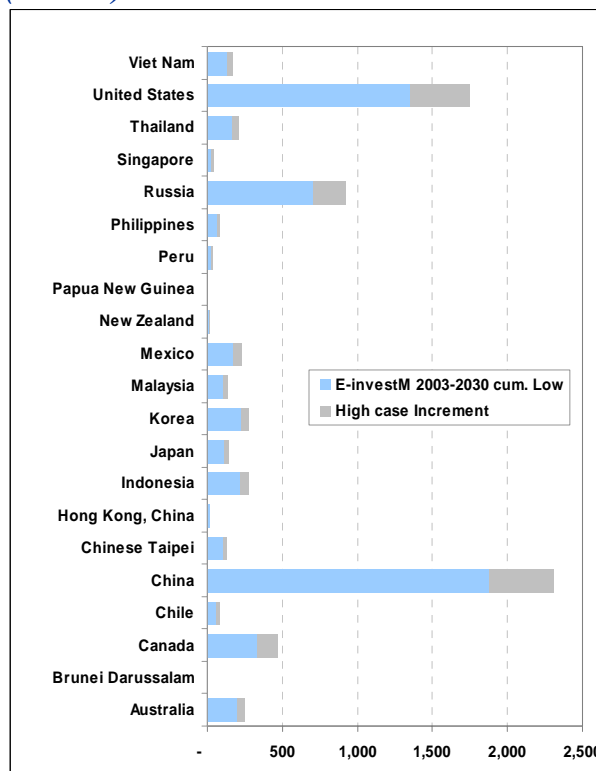
Source: APERC Analysis (2006)

Figure 58 shows total energy investment requirements for each APEC economy through 2030. The lower estimate of investment needs is shown by the blue portion of each bar. The higher estimate of investment needs is indicated by the sum of blue and grey portions of each bar. The economies are shown in order from the largest to smallest projected investment requirements over the outlook period. China will need about US\$ 2.3 trillion through 2030 to supply energy needed to support robust economic growth. United States will require about US\$ 1.7 trillion through 2030.

The magnitude of the energy investment requirements over the next three decades has raised concerns over whether sufficient financial resources can be obtained to meet them. Later portions of this study appraise the availability of financial resources for energy sector investment in APEC economies

and examine policies and mechanisms to attract the resources required. But to put the issue in perspective, it is important to evaluate the burden of anticipated energy investment needs in relation to overall economic output. For economies where energy investment needs represent a small share of gross domestic product, the burden should be relatively light. For economies where energy investment needs are a larger share of GDP, they may be more difficult to satisfy.

Figure 58 Total Investment Requirements by Economy (2003-2030)



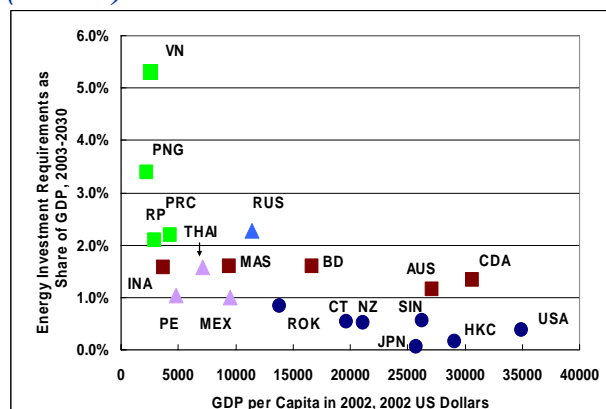
Source: APERC Analysis (2006)

Figure 59 shows the share of GDP that the projected energy investment requirements will represent in each APEC economy over the period from 2003 through 2030 compared with GDP per capita. For the APEC region on average, the energy investment share of GDP is projected to be 0.7 percent. It can be seen in the figure that only six APEC economies fall below this average: Japan, Hong Kong, China, New Zealand, United States, Chinese Taipei and Singapore, in ascending order of energy investment burden. All of these economies are highly developed, with high incomes per capita.

According to the World Energy Council and International Institute for Applied Systems Analysis, global capital spending on energy projects amounted to 1.5 percent of Gross World Product in the early 1990s and should not exceed 2 percent of GWP in

the future.³⁴ But five APEC economies are projected to have energy investment burdens that exceed this 2 percent threshold: China, Philippines, PNG, Russia and Viet Nam.

Figure 59 Total Investment Requirements by Economy (2003-2030)



(Source) APERC Analysis (2006)

HURDLES FOR MOBILISING NEEDED CAPITAL: FINANCING ISSUES

Financing energy projects will pose challenges to energy industries throughout the region. However, the challenges are greatest for developing and transitional economies, not only because their energy investment burdens are often greater as a share of economic output, but also because their capital markets are less well developed and offer fewer options for obtaining funds.

In developing and transitional APEC economies, governments are less and less willing to finance energy projects from public budgets. Budgets are tight, and if energy projects can be financed from private sources, public moneys are better spent on social programmes for which private financing cannot be obtained. Yet capital markets in these economies are at an early stage of development, so private financing may be costly or unavailable. Opaque laws, inconsistent regulations, political risks and new firms without a proven track record can all raise the cost of financing to unsustainable levels.³⁵

DEVELOPMENT OF DOMESTIC CAPITAL MARKETS

Many developing APEC economies are have high savings rates, representing 20 to 30 percent of GDP. However, their domestic capital markets are generally under-developed so that the necessary financial resources for energy sector investment may not be readily available from internal sources. Their

equity markets have not been very liquid, and their bond markets usually lack the stabilizing presence of large institutional investors such as pension funds and insurance companies.

In the developing APEC economies of China, Indonesia, Papua New Guinea, Philippines, Thailand, Russia and Viet Nam (Peru is left out), financing energy projects rely mostly on bank lending for well over half of all project financing. This is mainly because their bond and equity markets are at an early stage of development. While stock market capitalisation amounts to more than three-fifths of GDP in the Philippines and nearly half of GDP in Indonesia, it is much smaller in the other economies listed. Bond financing represents about a fifth of overall funding for investment projects in Papua New Guinea and Thailand and Viet Nam but much less in the other economies shown.

In light of the way that most developing economies have industrialised and built up their energy sectors, their heavy reliance on bank lending is not surprising. Historically, the state has often intervenes in financing long-term investments, so a combination of self-financing and lending through state-owned banks and development banks has played a major role in financing long-term investments.³⁶ Later, as state intervention in the financial system was scaled back, commercial bank lending and self-financing have become the major financial sources for the energy companies. In the transitional economies of China and Russia, state banks are still a major source of financing.

Generally speaking, commercial bank loans have short maturities that are not appropriate for long-term energy projects. The reason that a large numbers of energy projects have been financed through bank lending is borrowers' typical expectation that simply the loans of short maturities will be periodically renewed (rolled over) by banks over an extended portion of each project's life.

Bond financing is often preferable for large-scale investments for two reasons. Firstly, bonds provide long-term capital for investment in energy projects at lower interest rates than commercial loans. Secondly, bonds issue in domestic capital markets can replace some portions of borrowings denominated in foreign currency. This reduces the currency mismatch between domestic currency assets and foreign currency liabilities, which is a source of vulnerability in many financial systems.

³⁴ IASA/WEC (1998).

³⁵ Petroleum Economist (2003).

³⁶ Sharma (2000).

IMPLICATIONS

While future energy sector investment requirements for APEC economies will be large in absolute terms, they should not be large relative to projected economic output. For the APEC region as a whole, energy investment over the next two decades should take up less than one percent of total GDP. With respect to electric power generation, which accounts for nearly a third of energy investment needs, there is a clear trend for the economic burden of investment to decline over time as economies grow, and this trend is projected to continue in most of the region.

Yet energy sector investment will generally absorb a greater share of output in less developed economies than in more developed ones. Five APEC economies are projected to have energy investment burdens greater than two percent of GDP. Several of these have substantial underdeveloped energy resources that might be of value for financing energy investment. These include Indonesia, Malaysia, Russia, Papua New Guinea and Viet Nam.

In the less developed economies, direct government financial supports to energy projects are declining because of growing public budgetary deficits. Thus, the role of governments is shifting from direct intervention to establishment of regulatory regimes that will be favourable to capital formation. Governments of host economies will need to provide conditions that can attract a mix of domestic and foreign investors to provide the investment capital needed for energy projects.

Cooperation among APEC economies should be strengthened to promote energy investment. Many economies are building or planning natural gas pipelines and power grid interconnections that extend beyond their borders. Such projects can reduce investment requirements by taking advantage of differences in the timing of peak demand and efficiently mobilising diverse energy endowments. To help ensure that trans-boundary projects can be put in place, APEC economies should work together to harmonise differences in laws, regulations, environmental standards, and technical standards and to establish dispute settlement mechanisms that investors can rely upon.

Demand for energy in APEC is growing, so there are many opportunities for investment in energy projects. But building and operating energy projects entails a broad range of risks. And the needs of host economies, the interests of investors, and requirements of financial institutions do not always coincide. By building channels for dialogue, APEC governments can help to better evaluate investment

risks and bridge diverse interests so that needed energy projects can get built.

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