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Powering Asia's Growth: Meeting Rising Electricity Needs

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EXECUTIVE SUMMARY

This paper provides an overview of Asia's electricity and energy challenges and outlines the fuel and power generation choices that the region faces as it seeks to meet rising demand and move toward a cleaner power future.

Main Argument

Asia faces enormous challenges in meeting rapidly rising power demand to fuel economic growth, while at the same time shifting to a cleaner energy mix and extending the benefits of electricity to rural and urban areas as a means to reduce poverty. Policymakers will need to mobilize and incentivize all potential sources of new power generation, including natural gas, nuclear, renewables, hydroelectric, and cleaner coal-burning technology. They will also need to enable major new investments in more flexible and efficient electricity grids by utilizing every potential source of financing, including private capital, multilateral financing, and government support. Mobilizing all available power resources and investments will require important but politically sensitive reforms and unbundling in the power industry across the region.

Policy Implications

- Governments in Asia need to provide a policy environment conducive to investment and technology development and the requisite deployment needed. This means stronger and more supportive domestic energy policy environments to promote investment in new supplies, more efficient generation technologies, and cleaner power sources, including renewables.
- Power industry reform, unbundling, and the introduction of greater competition are critical to increasing investment and production, improving efficiency and reliability, lowering costs, and introducing and deploying renewable and cleaner technology.
- Electricity price reform and reducing costly and inefficient subsidies are essential to accelerating investment and reducing chronic power shortages. Price reform is crucial to introducing renewables, which require effective "feed-in" tariffs and investment in more flexible grid systems.
- Efficiency gains are critical to slow demand growth and can be supported through price reform and regulatory programs that promote best practices and strong efficiency programs.
- Special efforts are needed to reduce growth in coal-fired generation and raise the thermal efficiency of new coal-fired units. Carbon capture and storage (CCS) technology needs to be promoted as the long-term solution to rising air pollution and carbon emissions coming from coal in power generation.

Asia's three decades of booming economic growth is driving extraordinarily rapid electricity demand growth. However, the combination of this rising demand with insufficient investment and expansions in generation, transmission, and distribution capacity has led to severe and increasingly chronic electricity shortages across the region in ways that threaten to undermine economic growth. This chronic supply-demand gap has reduced the ability of governments to extend electricity availability to poor and rural populations across the region, which has undermined opportunities for these areas to break out of poverty. Further complicating the issue, growing pressure to meet rising demand has also meant that countries in the region frequently have had to resort to using the most readily available, lowest-cost domestic generation fuels such as coal, a practice that has led to growing and increasingly unsustainable environmental problems that will impact the Asia-Pacific for decades to come.

Consequently, it is vital for Asia's continued and future economic growth, social stability, and environmental sustainability to find ways to meet rising electricity needs that sustain economic growth and job creation, extend the reach of electricity access to reduce poverty, and support the shift to a more diversified, clean power generation mix. This is a daunting challenge.

Asia's Electricity Challenges

Asia's electricity consumption has risen at truly breathtaking speed. Demand growth has been driven by Asia's rising population, a rapid pace of urbanization, enormous increases in industrial production, and the progressive extension of access to modern electricity to larger and larger segments of Asia's rural populations. In fact, as these economies modernize, the use of electricity has continued to rise at an even faster rate than that of primary energy demand—reflecting a natural shift in energy consumption patterns in modernizing economies. For example, from 2000 to 2010, while primary energy demand in Asia rose by 73%, electricity consumption doubled.¹ In China, while primary energy demand rose by a staggering 150% over that decade, electricity

¹ All historical data in this section is drawn from the *BP Statistical Review of World Energy 2011*, BP Global.

demand tripled. In Vietnam, while primary energy demand also rose 150%, electricity consumption increased fourfold. Painting a broader picture, although Asia accounted for only 27% of the world's electricity consumption in 2000, it went on to account for two-thirds of all global electricity demand growth over the decade of 2000–2010. Looking to the future, it is expected that Asia's electricity demand will rise by another 150% by 2035 and account for 60% of global electricity demand growth.² Within these projections, China's electricity use is expected to rise by 240% over the next 25 years, and India's use is projected to rise by 430%. And this will happen while countries are also working to extend the benefits of modern electricity to rural and poor populations in the region.

Meeting rising demand will also require expanding into new types of generation and infrastructure that will present new technical, financial, and geographic challenges for integrating electricity sources into transmission grids. Developing renewable energy places new technical demands on grids for flexibility and load-management capacities that do not exist in most countries. Financing new generation and grid systems will require new investment models that rely less on the centralized, vertically integrated state-run industries of the past. And extending electricity supplies to new geographic areas will require new models of rural electrification and distributed energy solutions. As such, in a region where meeting overall energy demand is already an enormous challenge, meeting electricity demand in the Asia-Pacific presents even more daunting challenges.

As a result, policymakers in Asia have had to scramble over the past two decades to try to mobilize needed investments in generation, transmission infrastructure, and distribution fast enough to keep up with demand. Virtually every country in developing Asia has sought to reform or restructure its electricity industry, improve competitiveness and efficiency, stimulate new generation fuels and technologies, mobilize more private capital, and reform subsidized electricity pricing—ultimately, with the hope of advancing market capabilities fast enough to boost electricity supplies and improve reliability. However, countries across the region have inevitably struggled to keep up. As of 2012, electricity shortages are chronic during the summer and winter across much of China,

² The historical and forecast data in this section is from *Asia/World Energy Outlook 2011*, Institute of Energy Economics, Japan (IEEJ), October 2011.

while shortages in India are estimated at nearly 10% of national needs; electricity shortages are also a chronic feature across most South and Southeast Asian economies.

This extraordinary pressure to meet this surging electricity consumption has meant that Asia has had to rely heavily on low-cost fuel supplies that are regionally and domestically abundant, mainly coal, in an effort to prevent severe electricity shortages from becoming an even more significant bottleneck to economic growth. This electricity-coal nexus in Asia is strong and durable. While coal accounted for 40% of the power-generation fuel mix globally in 2010, in Asia, this share rises to 61%. Much of this is due to the fact that coal makes up a large percentage of the supply mix in China and India, but coal use is also strong more broadly in developing areas of Asia. This need for coal-fired power generation meant that the Asia-Pacific accounted for the entire net global increase in coal use over the 2000–2010 decade. Conversely, the relative use of other, less environmentally damaging fuels in power generation is much lower in Asia than elsewhere. Natural gas is only 13% of the region's supply mix for power generation, compared to 21% globally; hydroelectric is 13% compared to 16% globally; nuclear generation is 8% in Asia compared to 13% globally; and other modern renewables are only 1% compared to 3% globally.

Given this supply mix, not surprisingly, the CO₂ intensity of Asia's power generation sector actually rose strongly during 1990–2010 while the rest of the world's CO₂ intensity declined sharply. Asia's CO₂ intensity for power generation is nearly 25% higher than the world average, given this legacy fuel mix, and this figure makes it the largest and fastest growing emitter of CO₂ globally. Moreover, continuing heavy reliance on coal raises a host of other environmental, safety, and public health issues. Local and regional air pollution rooted mainly in the predominance of coal-fired power generation is a huge problem in Asia's rapidly urbanizing environment. Coal-fed pollution increasingly intersects with air pollution from Asia's rapidly growing transportation sector to create a toxic mix of local and regional air quality. Poorly regulated coal mining industries also often add to serious environmental degradation, which is a serious problem in China, India, Indonesia, and elsewhere. Mine safety is also a huge concern across the region.

The Way Forward

Meeting the dual challenges of Asia's rising electricity needs while addressing concurrent environmental impacts requires progress on increasing supplies, managing demand growth, supporting new technology development, and advancing environmentally sustainable sources of generation and demand management.

To meet rising demand, Asia will need to mobilize investment in every available generation source. This means that a huge increase in investment is necessary, mainly in relatively cleaner generation fuels and cleaner, more efficient generation technologies. The Institute of Energy Economics of Japan (IEEJ) estimates that a \$20 trillion investment in electricity will be required to meet growth in global demand during 2009–35. Of this, \$9 trillion will be needed in Asia alone.

Mobilizing this investment will require using every form of available financing. Private capital, both domestic and foreign, can become a much larger source of investment where governments develop electricity pricing arrangements that can support new generation and transmission investment. Investors are looking for those opportunities. In areas such as renewables and distributed energy systems, various forms of public-private partnerships are possible where public agencies help support the high initial capital costs of new equipment, which are then financed over the longer term with mixed public and private investment as costs are gradually reduced. Additionally, although many rural electrification programs can be financed through normal market arrangements, individual governments and multilateral agency partnerships are often required to initiate new rural electrification projects where the costs of infrastructure and generation equipment are not suited to market solutions.

Many electricity-generation fuel options need to be pursued vigorously. The potential for natural gas as a power-generation fuel is enormous. The International Energy Agency (IEA) has extolled the global potential for natural gas in its recent report entitled “Are We Entering a Golden Age of Gas?”³ On average, natural gas is 25%–30% less CO₂-intensive than oil and 40%–45% less CO₂-intensive than coal. Yet gas is

³ “Are We Entering a Golden Age of Gas?” Special Report, World Energy Outlook 2011, International Energy Agency, Paris, 2011.

relatively underutilized in Asia, while the availability of regional and global supplies is increasing rapidly at affordable prices.⁴ Gas accounts for only 11% of Asia's energy mix while it accounts for 24% of the global energy mix. There is enormous scope for increases in gas use in Asia, most importantly as a substitute for coal in power generation. This is underscored by the added benefit that natural gas generation has lower upfront capital costs than coal-fired power, nuclear generation, or renewables.

Fortunately, Asia's energy policymakers are moving rapidly to boost natural gas use while encouraging natural gas exploration and development in the region, as policymakers begin to see its potential as a power generation fuel. Asia is expected to triple its natural gas use and account for one-half of global gas demand growth between now and 2035. Asia is also set to benefit from a booming global and regional liquefied natural gas (LNG) supply picture. Asia already accounts for 62% of global LNG demand, and it is expected to triple its LNG consumption and account for two-thirds of global LNG demand growth. The share of gas in Asian power generation is expected to rise from 13% to 17%, almost mirroring the expected decline in coal's share of power generation from 61% down to 55%. Gas use is expected to triple in China and India, the two most coal-intensive power sectors.

Nuclear power generation must be a part of the solution to meeting rising demand, but in the wake of the Fukushima disaster in Japan, the region clearly needs to address legitimate concerns related to the safety and reliability of nuclear technology and practices. Asia is expected to account for three-quarters of global nuclear development. Although plans for nuclear development in Japan have been deeply undermined, China and India have responded by revisiting their safety, training, and reliability programs while remaining committed to large expansions in nuclear capacity. Even withstanding questions about the future of nuclear energy in the region, post-Fukushima estimates suggest that Asia will still account for nearly three-fourths of global nuclear capacity additions, with another 130–140 gigawatts (GW) of nuclear capacity between now and

⁴ For an excellent view of Asia's promising natural gas prospects and challenges, see "Unlocking the Potential for Natural Gas in the Asia-Pacific" (report of Pacific Energy Summit, hosted by The National Bureau of Asian Research, Jakarta, Indonesia, 2011).

2035; this figure includes 80 GW in expansions in China, 30 GW in India, and another 15 GW in Southeast Asia.

Finally, modern renewables are growing rapidly from a small base and are expected to add substantially to the cleaner direction of the generation mix in Asia. Asia is expected to triple its use of solar and wind power and account for one-third of global growth in renewables. Renewables' share of Asia's power generation mix is likely to rise dramatically, from 1% in 2009 to 6% by 2035. Public policies to support renewable development are critically important. With the right mix of supportive policies, most importantly feed-in tariffs and appropriate subsidization, renewables' share could rise to nearly 14% of Asia's power mix. Hydroelectric power is also clean and renewable, and Asia possesses extensive hydro resources. However, maximizing the region's hydroelectric potential will require greater regional cooperation to expand output while addressing important environmental and social externalities. It will also require stronger efforts to build regional cooperation in Southeast Asia's river systems between China and the regional states. While hydroelectric power in Asia is expected to double over the next 25 years, it will maintain its overall share in energy use at about 2%.

Reforming Domestic Electricity Markets

Many forecasts suggest that Asia will seek to mobilize enormous new-generation sources to meet rising demand. However, this potential can only be reached if countries in the region provide a policy environment more conducive to the investment and technology development and the requisite deployment needed meet the challenge. Asia will need much stronger and more supportive domestic energy policy environments to promote the development of new supplies, new technology in more efficient generation technologies, and use of cleaner sources and renewables.

Five areas for reform stand out as critical to future success. First, the electricity sector across Asia tends to be dominated by national or regional monopolies that are highly bureaucratic, slow-moving, and increasingly ill-equipped to handle rapidly growing demand for electricity. There tends to be poor accountability and strong politicization of decision-making and investments, as well as little room for private or foreign capital to participate in electricity markets and production. Such issues are being

increasingly recognized, and many countries are somewhere along the process of opening up markets to investment and beginning the process of unbundling the industry to promote greater investment and improved efficiency. Although its electricity industry is still highly regulated, Vietnam provides an excellent example of a country that is beginning to recognize the importance of deregulating the industry in order to meet rising demand and is pursuing an active unbundling program to reform the industry. Moving to a more competitive market structure in the electricity industry remains challenging everywhere because it forces energy policymakers to recognize the true cost of providing power through the various parts of the system, generation, transmission, and distribution while reinforcing accountability. But industry reform and the introduction of greater competition are critical to increasing production, improving efficiency, improving reliability, lowering costs, and introducing and deploying renewable and cleaner technology.

A second critical area for reform is addressing the inappropriate pricing of electricity and the use of subsidies, both of which are prevalent across the Asia-Pacific. It is axiomatic that governments should seek to provide electricity at the lowest cost possible for both social and economic reasons. However, severe underpricing of electricity is endemic in the region and is a key reason for Asia's chronic electricity shortages. Low prices undermine the industry's ability to invest in new production. Prices commonly below the cost of electricity production typically have two results: chronic shortages in investment in electricity generation and infrastructure and debilitating drains on public budgets from efforts to shore up the weak finances of state electricity industries. Often, electricity subsidies paid out of government budgets exceed all spending on education, healthcare, and rural support. In other cases, electricity pricing is differentiated across classes of customers, which results in debilitating cross-subsidies. In order to subsidize very low residential customer prices, governments impose high prices on commercial and industrial customers, which both discourages new investment and encourages overconsumption among those receiving subsidies. In addition, such subsidies aggravate problems of corruption and mismanagement. Underpricing of electricity also discourages new investment in higher cost renewables by making the introduction of renewables very difficult. Similarly, this practice makes it much more

difficult to bring in new-generation sources, such as natural gas, which at the margin will be more expensive than cheap, locally available coal supplies. It also weakens the justification for investments in more efficient generation technology, such as super high-efficiency turbines and combined cycle generation, as well as undermines investment in more efficient transmission and distribution lines that can reduce transmission losses and improve reliability. Often, prices are so low that the industry is unable to even cover the cost of maintaining its existing plant and equipment.

Addressing this need for pricing reform is crucial to supporting a third area of reform: the need to enable the introduction of new renewable electricity supplies. Despite rapid advances in renewable technologies, sources such as solar remain relatively high-cost options that require innovative pricing or, in the case of more cost-competitive wind power, special access and dispatch policies to succeed. A key measure to support wind and solar penetration is the use of “feed-in tariffs.” Such tariffs pay renewable generators a higher price that is then blended into the broader electricity price in order to stimulate the rapid integration of new renewables and other generation sources into existing transmission and distribution grids. Also, reducing fossil fuel subsidies can improve the cost-competitiveness of renewables, and attaching a carbon or environmental charge to fossil fuels also can help support renewable penetration. Dispatch policies that enable renewables, which are by definition “intermittent” supplies, to access the grid in priority when available are also essential to the introduction of these new sources. This will also require large new investments in infrastructure and more efficient grids and transmission lines. The state electricity sector is stretched across the region and largely lacks the capacity to invest sufficiently to meet demand. Private sector investment on a large scale needs to be encouraged.

Fourth, domestic electricity policy also needs to focus on addressing the demand side of the electricity equation in order to offset the current heavy pressure to find new generation supplies. This is the most important task now facing energy policymakers. Efficiency is effectively the lowest cost source of electricity because it helps curb demand and reduces pressure to invest in new supplies. The IEEJ estimates that nearly one-half of the potential reductions in energy consumption that would occur under its “Advanced Technology” scenario would come from “energy savings”—a much larger

impact than either fuel switching or carbon capture and storage (CCS). Electricity prices are central to managing demand, but governments have many other potential regulatory tools to improve efficiency and reduce the need for new supply investments. China's "Top 1,000 Energy Consuming Enterprises" program, which sets efficiency and electricity consumption standards for its major industrial electricity consumers, has been very successful. The development and enforcement of building efficiency standards and appliance standards can also be very effective. A focus on generation efficiency and the promotion of new, high-efficiency turbines and generation technology can be an important part of the efficiency policy mix.

Finally, the Asia-Pacific will inevitably continue to rely heavily on coal for power generation. Given the scale of demand growth, there is no reasonable scenario for coal use not to continue to rise in Asia, particularly in China and India. But growth in the region's dependence on coal for generation needs to be slowed dramatically while new, more efficient and environmentally sustainable technologies to burn coal are developed and deployed broadly. High-efficiency turbines and combined cycle technology are key parts of the effort. Policies to explicitly encourage fuel-switching toward natural gas, nuclear energy, hydroelectricity, and renewables are needed. Some countries in the region, such as Australia, have also begun using a carbon tax or carbon trading scheme, which will encourage investment in non-coal generation. The region also must move rapidly on cooperation to develop CCS technology to address coal's problematic environmental impact. In its "Advanced Technology" scenario, the IEEJ estimates that by 2035 CCS could account for nearly 20% of the potential reduction in CO₂ emissions. However, this development will require huge investments to develop CCS technology, which can best be mobilized on a regional cooperative basis.

Conclusion

Asia faces enormous challenges in meeting rapidly rising power demand while at the same time shifting to a cleaner energy mix and extending electricity to rural and poorer areas. Meeting electricity needs will be crucial to supporting continuing rapid economic growth, social stability, and poverty reduction. The region's policymakers will need to mobilize and incentivize all potential sources of new power generation, including

natural gas, nuclear, renewables, hydroelectric, and cleaner coal-burning technology. They will also need to enable major new investments in more flexible and efficient electricity grids by utilizing every potential source of financing, including private capital, multilateral financing, and government support. Mobilizing all available power resources and investments will require important but politically sensitive reforms and unbundling in the power industry across the region.

To achieve these goals, governments will need to create a policy environment that drives new investment and encourages technology development and deployment. This means supporting stronger policies to promote investment in new supplies, more efficient generation technologies, and cleaner power sources. Power industry reform, unbundling, and the introduction of greater competition are critical to increasing investment, improving efficiency and reliability, and lowering costs. Electricity price reform and reducing subsidies are also essential to accelerating investment and reducing chronic power shortages. Efficiency gains are absolutely critical to slowing demand growth and can be supported through pricing reforms and regulatory programs. Finally, special efforts to reduce growth in coal and raise the thermal efficiency of new coal-fired units are vital to addressing deepening fears over rising air pollution and carbon emissions coming from coal in power generation. Addressing these challenges will require not only innovative and collaborative solutions, but committed, forward-looking leadership. Decisions made today will define how we will meet burgeoning energy demand, and have far-reaching impacts worldwide for decades to come.