2016 SUMMIT REPORT

PACIFIC
ENERGY SUMMIT
2016 • SINGAPORE

Sustainable Futures: Energy and Environmental Security in Times of Transition





NBR THE NATIONAL BUREAU of ASIAN RESEARCH

REPORT FROM THE

Pacific Energy Summit

SUSTAINABLE FUTURES: ENERGY AND ENVIRONMENTAL SECURITY IN TIMES OF TRANSITION

2016 · SINGAPORE

PACIFIC ENERGY SUMMIT

About the Pacific Energy Summit

THE PACIFIC ENERGY SUMMIT is an annual, invitation-only meeting that convenes leaders from government, business, and research to explore innovative solutions to the dual challenges of rising energy demand and a changing climate. The urgency of meeting this energy demand to sustain the economic growth that has lifted millions out of poverty, while safeguarding the environment and climate, demands cooperation and collaboration across nations, sectors, and research areas. The Summit is a consultative effort, bringing together a wide array of stakeholders to develop an interactive and diverse program.

Bringing Depth to High-Level Discourse—The Pacific Energy Summit facilitates a frank exchange of information and perspectives by bringing together leading policymakers, industry representatives, and research specialists in a high-trust setting.

Focus on Market-Based Solutions—We are committed to practical and tenable approaches to energy and environmental challenges. The world needs realistic solutions based on an informed understanding of the economic and environmental needs of the region, and the Pacific Energy Summit strives to provide this essential foundation for a productive discussion.

Collaborative and Interactive Experience—We embrace the diverse expertise of all participants by encouraging dialogue before, during, and after the program itself. Participation is limited to ensure concrete discussions and a high-quality exchange of ideas and expertise.

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Printed in the United States of America
Written for The National Bureau of Asian Research by Clara Gillispie, Ashley Johnson, and Laura Schwartz
Summit photos by REVO Communications
Report design by Sandra Ward

Front cover photo (top, left to right): Meredith Miller (Albright Stonebridge Group), Irshad Vaziralli (Chevron Asia Pacific Exploration and Production), Thein Lwin (Pyidaungsu Hluttaw, Myanmar's Union Parliament), Minister Ben Micah (National Parliament of Papua New Guinea), and Luluk Sumiarso (Indonesia Institute for Clean Energy and Climate Change)

Front cover photos (bottom, left to right): Satya Widya Yudha (House of Representatives, Indonesia), Admiral Dennis C. Blair (Sasakawa Peace Foundation USA; NBR), Kavita Gandhi (Sustainable Energy Association of Singapore), Jeff Appleton (ExxonMobil Asia Pacific Pte Ltd), and Bambang Susantono (Asian Development Bank)

Back cover photos (bottom, left to right): Lian Yok Tan (K&L Gates LLP), Edwin Khew (Sustainable Energy Association of Singapore; Institution of Engineers, Singapore), Tan Eng Chye (National University of Singapore), Irshad Vaziralli (Chevron Asia Pacific Exploration and Production), and Munetaka Horiguchi (Japan Bank for International Cooperation)

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Introduction

THE ASIA-PACIFIC has reached a potential tipping point in its efforts to enhance its energy outlook. Breakthroughs in technologies, policies, and markets have enabled a wide range of stakeholders to accelerate efforts to ensure that energy can play a positive role in sustaining economic development while still protecting the environment. If well-managed, such trends could revolutionize international energy market expectations, given that the region is projected to be the primary driver of rising global energy demand and carbon dioxide (CO_2) emissions over the next 25 years. Within this context, the Asia-Pacific has a unique opportunity to forge a sustainable energy and environmental outlook and make significant progress in tackling the adverse effects of climate change.[1]

To address these important issues, senior leaders from government, industry, and the research community, representing over twenty countries, gathered in Singapore for the 2016 Pacific Energy Summit "Sustainable Futures: Energy and Environmental Security in Times of Transition." The 2016 Summit explored the following questions:

- What are the technologies, policies, and strategies that can help countries embrace an era of cheaper and seemingly abundant energy options to advance energy and environmental security? How might future market volatility, shifts in public opinion, and other developments affect these efforts?
- How can national planning and regional market reforms support more flexible, adaptable energy systems?
- Looking out to 2050, how can we address the emerging and anticipated challenges (including energy demand and transportation access) for Asia's growing urban centers while also reinvigorating commitments to rural communities?
- How can the public and private sectors work together to better meet critical investment needs?
- How can we strengthen ties between Asia and North America to achieve common energy and environmental security goals?

VOICES OF THE SUMMIT

This conference has affirmed country commitments articulated at COP21, but there's always a challenge in moving from policy to implementation. That's where the Pacific Energy Summit as a platform can be useful.

- **Tan Eng Chye**, National University of Singapore

VOICES OF THE SUMMIT

If we are going to achieve energy security, it is not going to be through purely bilateral means; it has to be as a global village working together.

- **John V. Rindlaub**, Wells Fargo; NBR Board of Directors

Summit leaders highlighted that much of the challenge will be to translate goals into action. As countries work to turn the lofty aspirations expressed in the Paris Agreement and their national energy plans into on-the-ground policymaking and implementation, partnerships across sectors and borders will be essential. This report presents key recommendations from the 2016 Summit for policymakers, industry leaders, and other major stakeholders.

Left to right: 2016 Summit co-chairs **Dennis C. Blair** (Sasakawa Peace Foundation USA; NBR Board of Directors) and **Tan Eng Chye** (National University of Singapore) laugh between sessions at the 2016 Summit.

Endnotes

1. The Pacific Energy Summit embraces a broad definition of the Asia-Pacific that includes East Asia, Southeast Asia, South Asia, the Pacific islands, Russia, and North America.

The Asia-Pacific: The Center of World Energy Demand

TODAY, THE COUNTRIES of the Asia-Pacific account for well over half of the world's energy demand, and looking out to 2035, the region will constitute 65% of the increase in global demand based on current projections for overall population growth and rising standards of living.[1] Natural gas and renewable energy are anticipated to see the highest rates of overall growth in demand from the region due to efforts to accelerate transitions to lower-carbon energy sources in the power sector. Meanwhile, the need for energy is so great that the demand for oil, coal, nuclear, and hydropower is expected to rise significantly as well. As noted by **Vandana Hari**, a Research Scholar at S&P Global Institute, the region's impact on global demand for oil is particularly striking: the International Energy Agency (IEA) estimated that world oil demand grew to about 1.5 million barrels per day by the end of 2016, and nearly 1 million barrels of this demand is from the Asia-Pacific alone.[2]

Asia as a whole is thus already having a profound impact on global energy markets. Meanwhile, consumption patterns and projections for the future vary widely across the region:

- Japan's overall energy demand growth is slowing due to an aging population, yet its energy mix is anything but stagnant. Uncertainties about nuclear power after the Fukushima Daiichi disaster have resulted in a relative increase in demand for coal and natural gas. Meanwhile, renewables are targeted to increase to approximately 14% of the energy mix, while gains in energy efficiency will also reduce overall demand by 13%.[3]
- South Korea's growth in demand for natural gas is anticipated to decline from 2.3% annually to 1.7% by 2040 due to decreased consumption in the industrial, residential, and commercial sectors.[4] Seoul is also banking heavily on nuclear energy, in contrast to other countries in the region, and plans to maintain nuclear power generation at 29% of national energy capacity.[5]
- China has been one of the strongest drivers of global energy demand growth over the past several decades, but recently domestic growth rates have begun to ebb. From 2014 to 2015, electricity consumption rose by just 0.5% due to slowing economic growth and emerging efforts to improve the efficiency of energy systems.[6] This slowing of demand growth does not necessarily result in a shift away from cleaner fuel sources. During the same period, natural gas increased by over 3% and renewables by 1.7% in China's energy mix.[7] Given these trends, **Li Junfeng**, Director General of the National Center for Climate Change Strategy and International Cooperation and President of the Chinese Renewable Energy Industries Association, discussed the possibility of China soon reaching its peak coal demand.
- In Southeast Asia, the Asia Pacific Energy Research Centre (APERC) estimates that overall energy demand will increase 110% by 2035.[8] **James Kendell**, Vice President at APERC, additionally observed that despite Southeast Asian countries' ambitious clean energy goals, coal demand will still increase fourfold over the next several decades.

VOICES OF THE SUMMIT

The gravity of world energy markets is clearly shifting to Asia. In particular, the appetite for energy by China, India, and ASEAN countries is transforming the global energy system.

- **Ken Koyama**, Institute of Energy Economics, Japan

- The IEA projects that India will contribute more to the growth in global energy demand than any other nation, accounting for approximately 25% of the total.[9] Demand for coal and oil will increase more than in any other country, but India is making significant strides to expand the use of natural gas and solar energy.

Delegates were quick to observe that projections about any one country's future energy mix are subject to change; major shifts in markets or world events can alter expectations about the viability of particular supplies or strategies. Yet Summit participants were optimistic about the progress toward bolstering energy and environmental security, as the Asia-Pacific has made progress in advancing cleaner energy options. One way forward is the opportunity provided by technology and innovation. As noted by **Bambang Susantono**, Vice President for Knowledge Management and Sustainable Development at the Asian Development Bank (ADB), "disruptive innovation" in energy technology can have dramatic impacts, as illustrated by the shale gas revolution, the promotion and use of distributed generation in rural areas, and industrial shifts to incorporate solar photovoltaic systems. Moreover, **Jeff Appleton**, ExxonMobil Senior Vice President of LNG Marketing, observed that "energy efficiency is the largest new source of energy." He estimated that current projected growth in energy demand would actually be a 100% increase in demand if developments in energy efficiency are not taken into account. As such, most of the participants agreed that high expectations can lead to systemic breakthroughs that enhance both socioeconomic well-being and energy security. But for this to occur, governments need adaptable energy mixes, a commitment to creative development, and open communication efficiency are not taken into account. As such, participants collectively agreed that high expectations can lead to systemic breakthroughs that enhance both socioeconomic well-being and energy security. But for this to occur, governments need adaptable energy mixes, a commitment to creative development, and open communication.

Jeff Appleton (ExxonMobil Asia Pacific Pte Ltd) speaks during the session "The Future of Energy Demand."

RECOMMENDATIONS FROM THE SUMMIT

1. **Encourage flexible energy policies.** Although the abundance of a resource may suggest security of energy supply, policymakers should be wary of potential overreliance on one supply source, stated **Peter Hughes** of Peter Hughes Advisory Limited and global gas partners gmbh. Summit delegates from South Korea and Japan, who have been reassessing expectations for the role of nuclear power in their countries' energy mixes, placed special emphasis on this point. Flexible policies are needed to better adapt to changing outlooks and address the challenges involved with upgrading the region's energy system to rely more on cleaner sources of energy. Diversification, while not a blanket solution to the challenges faced by policymakers, is an important part of creating a flexible system, which reduces the likelihood of overreliance on a particular resource in the event of a future supply shock. (See the section on "Sustainable Development That Promotes Both Sustainability and Development" on page 29.)
2. **Foster collaborative approaches.** Much of the discussion from Summit participants about energy security in the Asia-Pacific centered on domestic supply needs and competition for this supply, but finding collaborative solutions will allow the region to think about energy security in terms of broader prosperity. The current period of low energy prices and relative regional stability provides a prime opportunity for countries to look beyond their own energy security and focus on strengthening the region as a whole.
3. **Encourage decision-makers to place a premium on innovation.** Innovation and technological development are key areas of opportunity and have the potential to reshape the conversation on energy. Mr. Appleton noted that "through technology advancements, shale gas developers were successful and…changed our industry completely, turning import terminals into export terminals." Additionally, **John V. Rindlaub**, a member of the National Bureau of Asian Research (NBR) Board of Directors and Executive Vice President and Asia Pacific Regional President of the International Group of Wells Fargo, stated that ongoing innovations have decreased the costs of solar power and will eventually increase its efficiency to 35%–40%, making solar power a more viable alternative.

Endnotes

1. BP plc, "BP Energy Outlook: Country and Regional Insights—Asia Pacific," 2016, http://www.bp.com/content/dam/bp/pdf/energy-economics/energy-outlook-2016/bp-energy-outlook-2016-regional-insights-asia-pacific.pdf.
2. International Energy Agency (IEA), *Oil Market Report*, January 19, 2017, https://www.iea.org/media/omrreports/fullissues/2017-01-19.pdf.
3. Sara Itagaki and Ashley Johnson, "The Paris Climate Agreement: Implications for Energy and Environmental Outlooks in the Asia-Pacific," National Bureau of Asian Research (NBR), Fact Sheet, January 22, 2016, http://nbr.org/downloads/pdfs/eta/PES_factsheet_COP21_012216.pdf.
4. U.S. Energy Information Administration (EIA), *International Energy Outlook 2016* (Washington, D.C.: EIA, 2016), chap. 3, https://www.eia.gov/forecasts/ieo/nat_gas.cfm.
5. Asia Pacific Energy Research Centre (APERC), *APEC Energy Demand and Supply Outlook*, vol. 1, 6th ed. (Singapore: Asia-Pacific Economic Cooperation, 2016), 16, http://aperc.ieej.or.jp/file/2016/5/10/APEC_Outlook6th_VolumeI.pdf.
6. Enerdata, "Total Energy Consumption," Global Energy Statistical Yearbook 2016, https://yearbook.enerdata.net.
7. Ibid.
8. Cecilia Tam, "APEC Energy Demand and Supply Outlook 6th Edition" (presentation, Washington, D.C., June 2016), slide 6, http://pacificenergysummit.org/wp-content/uploads/2016/06/APEC-Outlook-Cecilia-Tam.pdf.
9. IEA, *India Energy Outlook 2015* (Paris: OECD/IEA, 2015), https://www.iea.org/publications/freepublications/publication/IndiaEnergyOutlook_WEO2015.pdf.

The Geopolitics of Energy Security

GIVEN THE REGION'S immense need for energy supply and the uneven distribution of domestic resources, the Asia-Pacific is often seen as ground zero for energy security discussions. Summit participants noted that while concerns about the availability, accessibility, affordability, and acceptability of potential energy choices often dominate these discussions, sustainability has also become an increasingly important consideration. Within this context, key energy security trends across the region include:

- The Asia-Pacific accounts for over one-third of the world's oil consumption, and its demand for oil is set to climb even as domestic production remains generally stagnant.[1] By 2035, 75% of oil consumed in the region will be imported.[2]
- South Korea and Japan rely on the Middle East for 85%–90% of their oil imports. Similarly high dependence on oil imports from the Middle East is seen in China and India (50% and 80%, respectively).[3]
- Several countries in the Asia-Pacific are poised to become exporters of fuels as domestic industries develop. As pointed out by **Ben Micah**, Minister for Petroleum and Energy of Papua New Guinea, Papua New Guinea has a sizeable store of liquefied natural gas (LNG) that is being developed for export to serve the regional market.
- Japan is looking to increase its import supply of natural gas from the United States and Russia, as such diversification will help reduce the country's vulnerability to supply disruptions at chokepoints in the South China Sea. Similarly, South Korea has been working to alleviate the country's domestic energy shortage and diversify its imports by establishing a natural gas pipeline and enhancing LNG trade with Russia.
- Energy import and export dynamics in North America have changed drastically over the past several years, as the shale gas revolution has made the United States a natural gas exporter. Shifts in U.S. policy on energy exports will have a significant impact on global natural gas markets, while new outlooks may also give the United States an opportunity to play an even greater role in shaping global energy diplomacy.

VOICES OF THE SUMMIT

In Asia, oil and energy security are national security, and energy security has been among the top items on the strategic agendas of every big oil importing country across the region.

- **Mikkal E. Herberg,** NBR

VOICES OF THE SUMMIT

Ages of scarcity are difficult, as are ages of abundance. Neither one of them solves the basic problem. What's required is really smart leadership both in the public and in the private sector, aided by the efforts of [representatives from the research community] to reinforce efforts like the Pacific Energy Summit, like the sort of collaboration that takes place in many other different venues and in the many international groupings that we have.

- **Admiral Dennis C. Blair**, Sasakawa Peace Foundation USA; NBR Board of Directors

When viewing these country-level and sub-national trends as part of a larger whole—where rising challenges can be served by increasing global opportunities—significant opportunities exist to work toward broader cooperation. In particular, most energy and environmental planning still occurs in a domestic context, even though many of the issues involved, including energy trade, air pollution, transboundary water management, and climate change, are transnational in nature, as observed by **Ambassador Tariq Karim**, the former High Commissioner of Bangladesh to India, who works with the Vivekananda International Foundation and the World Bank.

One of the first steps to enhance collaboration is to move away from a zero-sum mindset and emphasize achieving multilateral improvements. With no existing template for navigating geopolitical disputes on energy security, policymakers should look to other domains for examples of the successful handling of geopolitical competition over resources. Regional collaboration on transboundary water issues provides one useful model, given that water is a sensitive resource that is crucial for economic development, social well-being, and, to an extent, energy security. As aptly stated by Ambassador Karim, stakeholders moved from a view focused on "water sharing," which refers to dividing up resources, to "water management," thereby reframing the discussion in terms of shared responsibilities.

Highlighting the importance of shared responsibilities and collaborative efforts helps put nations on a path toward enhanced energy and environmental security. Ambassador Karim noted that when countries are unable to cooperate on an issue like water security, it becomes difficult to cooperate on broader goals. Conversely, progress on transboundary water collaboration leads to more opportunities for cooperation in other areas. Ambassador Karim explained that when India, Bangladesh, and Bhutan were able to agree to mutually manage, and not just share, water from the Brahmaputra River and its tributaries, they were able to formulate plans to harvest hydroelectricity. Well over 150,000 megawatts of hydroelectric power is estimated to be available in the Brahmaputra River Basin, which could vastly improve energy access in the respective countries.

RECOMMENDATIONS FROM THE SUMMIT

1. **View energy security as an avenue for collaboration rather than competition.** There are many promising opportunities for collaboration, including financing from development banks, international initiatives like Mission Innovation, and bilateral exchanges, all of which can help countries navigate energy and environmental challenges.
2. **Foster collaboration for greater regional fora.** The Asia-Pacific, and the world as a whole, would benefit from enhanced dialogue on international energy collaboration. The appetite exists for a high-level forum to forge international cooperation on energy issues, particularly given the evolution of energy markets. However, the current institutional structure for this type of dialogue is weak.[4] Asia is home to some of the world's largest consumers of energy, and increasing their role in institutions such as the IEA, which sets requirements for petroleum reserves and mechanisms for sharing information and resources, would have great benefits. Providing further opportunities for participation in these types of sharing agreements would strengthen national and international policies and help prevent energy shortages.

Left to right: **Minister Ben Micah** (National Parliament of Papua New Guinea), **Thein Lwin** (Pyidaungsu Hluttaw, Myanmar's Union Parliament), **Irshad Vaziralli** (Chevron Asia Pacific Exploration and Production), **Meredith Miller** (Albright Stonebridge Group), and **Luluk Sumiarso** (Indonesia Institute for Clean Energy and Climate Change) before the session "South and Southeast Asia: Emerging Giants in Global Energy Markets."

Endnotes

1. IEA, *Oil Market Report*, June 14, 2016, 4, https://www.iea.org/media/omrreports/fullissues/2016-06-14.pdf.
2. Tom Cutler, "The Architecture of Asian Energy Security," in "Adapting to a New Energy Era: Maximizing Potential Benefits for the Asia-Pacific," NBR, NBR Special Report, no. 46, September 2014, 42, http://nbr.org/publications/issue.aspx?id=305.
3. Mikkal E. Herberg, "Forging a New Strategy for U.S., Japanese, and Asian Energy Security," in "Adapting to a New Energy Era," 6.
4. Cutler, "The Architecture of Asian Energy Security," 41.

The Complex Threat of Climate Change

CLIMATE CHANGE MANIFESTS itself in several ways, including warming or cooling temperatures, rising sea levels, changing weather patterns, and water insecurity, among other considerations. Such large-scale global geophysical shifts lead to mass migration, increased poverty, public health issues, and declining regional stability.[1] In particular, it strains agricultural production as changes in temperature, CO_2 levels, and soil and water quality affect crop yields.[2] Lower harvests contribute to higher food prices, and for every 10% increase in prices, ADB estimates that more than 64 million people are pushed into poverty.[3]

"The effects of climate change are already being felt in developing Asia and the Pacific," said Mr. Susantono of ADB. He and others observed that this includes greater frequency of catastrophic weather events, damage to the agriculture and fisheries sectors, and mass migration of people escaping rising sea levels. Meanwhile, as noted by the IEA and the Institute of Energy Economics, Japan, among others, we are also in an unprecedented period of accelerated climate change due to the man-made release of greenhouse gases (GHG) such as CO_2, methane, sulfur, nitrous oxide, and chlorofluorocarbons, two-thirds of which can be attributed to the world's energy sector.[4] Participants acknowledged that climate change can be difficult to conceptualize, but many people in the region are already experiencing the following impacts:

- *Air pollution*. The IEA has estimated that indoor and outdoor air pollution is linked to 6.5 million deaths each year.[5] As noted by several Summit participants, the largest portion of air pollution worldwide comes from electricity generation, followed closely by agriculture and land use, transportation, and industrial GHG emissions.

Mely Caballero-Anthony (S. Rajaratnam School of International Studies, Nanyang Technological University) moderates the roundtable session "Tackling Water Insecurity for Sustainable Development."

Ambassador Tariq Karim (Vivekananda International Foundation; World Bank) comments on the catastrophes posed by rising sea levels.

- *Water insecurity.* Climate change will only exacerbate water insecurity for individuals, communities, industries, and governments, given that water is central to stakeholders at every level. **Mely Cabellero-Anthony**, Head of the Centre for Non-Traditional Security at the S. Rajaratnam School of International Studies, pointed out that a reliable supply of clean water is essential for food security, health, and development in general. When looking at energy security, water is a key factor as well—energy production is water-intensive, which requires that water be transported to areas that are less water secure.
- *Land loss.* Ambassador Karim warned that a 2° Celsius increase in ocean temperature will cause a rise in sea levels that will displace millions of people. Land loss will cause mass internal and transnational migration, and it will be challenging for other cities to absorb these new residents. Many countries across the Asia-Pacific are extremely threatened by rising sea levels, predominantly the Pacific Islands and South Asian states (particularly Bangladesh and Maldives). Bangladeshi scientists predict that by 2050, 17% of the delta region of Bangladesh may be submerged, displacing eighteen million people.[6]

Delegates claimed that, despite these formidable challenges, market developments and technological innovations—ranging from renewable energy options and breakthroughs in gas expansion to scrubbers on coal-fired power plants—provide hope for mitigating GHG emissions and alleviating the impacts of climate change. Although there remain economic and social barriers to progress, Summit participants viewed recent trends in international environmental and economic cooperation as a sign of change. **Admiral Dennis C. Blair**, Chairman and CEO of Sasakawa Peace Foundation USA and a member of the NBR Board of Directors, observed that for the first time both developing and developed economies have rallied on a global scale to address popular discontent with polluted air, contaminated water, and violent weather patterns.

RECOMMENDATIONS FROM THE SUMMIT

1. **Tackle specific, near-term problems in order to spur action on alleviating long-term challenges.** Several Summit participants commented on the necessity of enhancing clean-energy technology and enforcing the use of cleaner fuels in the industrial, power, and transportation sectors. Such developments will be crucial for reducing air pollution, which could in turn reduce the rate at which sea levels rise and land is lost in many Asia-Pacific countries.
2. **Adopt policies to promote technology development.** "Technologies change things for the better when they are supported by effective policies," stated one Singaporean academic. Governments need to diversify their national energy mix to ensure long-term energy security and make the development of new technology practical. Additionally, addressing issues pertaining to social license, such as building community engagement and garnering public support, must be considered when adopting new energy technologies.
3. **Avoid complacency in the face of optimism.** Admiral Blair commented that the voluntary approach that the world has now taken in the Paris Agreement reached at the UN Framework Convention on Climate Change's 21st Annual Conference of Parties (COP21) was encouraging. In particular, he was struck by the ambitious goals set by many Asia-Pacific governments to address climate change. However, it is imperative that governments across the region turn these energy and environmental targets into actions to actually generate change.

Endnotes

1. Caitlin E. Werrell and Francesco Femia, ed., "The U.S. Asia-Pacific Rebalance: National Security and Climate Change," Center for Climate and Security, November 2015, 14, https://climateandsecurity.files.wordpress.com/2015/11/ccs_us_asia_pacific-rebalance_national-security-and-climate-change.pdf. See the meeting minutes from the 6,587th meeting of the UN Security Council, July 20, 2011, 2, http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/CC%20SPV%206587%20RES1.pdf.
2. "Climate Impacts on Agriculture and Food Supply," U.S. Environmental Protection Agency (EPA), https://www.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply.
3. Asian Development Bank (ADB), "Soaring Food Prices Again Threaten to Push Millions of Asians into Poverty," April 26, 2011, https://www.adb.org/news/soaring-food-prices-again-threaten-push-millions-asians-poverty-adb.
4. IEA, "Energy and Climate Change," World Energy Outlook Special Report, 2015, 17, https://www.iea.org/publications/freepublications/publication/WEO2015SpecialReportonEnergyandClimateChange.pdf.
5. IEA, "Energy and Air Pollution" (press presentation, London, June 27, 2015), slide 2, https://www.iea.org/newsroomandevents/speeches/London_Launch_Master_4x3.pdf.
6. Gardiner Harris, "Borrowed Time on Disappearing Land," *New York Times*, March 28, 2014, https://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-the-consequences-of-climate-change.html.

Tackling Carbon Emissions Post–Paris Agreement and Beyond

IN LATE 2015, over 190 countries came together in Paris for COP21 with the broad goal of establishing a framework to enact policies that collectively prevent a global temperature increase of greater than 2° Celsius by 2100. By December 2016, 163 countries had submitted intended nationally determined contributions (INDC)—high-level plans for how they intend to achieve their energy and environmental security goals—indicating a strong commitment to reducing carbon emissions in the medium term (by 2025–30).[1]

The INDCs submitted by countries in the Asia-Pacific were watched with particular anticipation, given that GHG emissions have increased by 330% over the past 40 years in the region.[2] Indeed, many regional countries had already been working toward reducing carbon emissions, and COP21 provided a venue to build momentum on a global scale. The generally ambitious INDCs of major actors in the Asia-Pacific contributed to the feeling of optimism emanating from the conference. Key examples of the INDC goals include:[3]

- China will cut the intensity of CO_2 emissions by 60%–65% from 2005 levels. It will also reduce its dependence on coal by expanding the use of natural gas and increasing the share of non-fossil fuel sources (including nuclear, wind, solar, and hydroelectric) to 20% of its energy mix.
- India will reduce emissions to 33%–35% below the level of 2005 emissions and will increase the share of non-fossil fuels in electricity generation from 27% to 40% by 2030. Solar energy is anticipated to be a key factor in achieving this goal, as India plans on constructing one hundred gigawatts of new capacity.
- Indonesia will double its use of natural gas and increase the share of renewables in its energy mix to 23%, with the goal of reducing emissions by 29%–40%.
- Singapore will reduce emissions intensity by 36% from 2005 levels and expand investment for smart-grid technology.
- South Korea will reduce emissions by 37% of business-as-usual levels by 2030 across all economic sectors through a combination of increased nuclear capacity, enhanced use of renewables, and the implementation of a domestic cap-and-trade system.

Should all the INDCs outlined at COP21 be achieved, the emission of 3.3 gigatons of CO_2 equivalent would be prevented by 2030.[4] For reference, a reduction of CO_2 emissions by around 4 gigatons is the equivalent of preventing approximately 2.4 million premature deaths caused by air pollution.[5] Under this scenario, the benefits from increased labor alone would inject more than $98 billion into the global economy.[6]

How these commitments translate into policy action is an ongoing question. Many Summit delegates noted that their respective governments are struggling to execute their INDCs, given

VOICES OF THE SUMMIT

A successful response to energy and environmental challenges will require dedicated leadership and innovative ideas. It will require policy and industry leaders who can think collaboratively to balance both short-term and long-term needs.

- **David K.Y. Tang** K&L Gates LLP; NBR Board of Directors

challenges related to securing investment, figuring out how to enforce rules and evaluate their impact, and identifying how to better engage both industry and the public in these processes. Meanwhile, over the course of the past year political transitions occurring in numerous countries across the Asia-Pacific—including in the United States, South Korea, and the Philippines—have also introduced further uncertainty as new governments look to be responsive to evolving domestic policy considerations and priorities.[7]

Yet as many Summit participants argued, current market conditions could be a windfall for policymakers who are trying to determine the right energy mix for their countries. For example, low energy prices present an opportunity for governments to roll back subsidies and invest in cleaner technologies while minimizing the impact on consumers. Still, more changes will be necessary, as the current favorable market conditions and the global sense of optimism can aid, but not enforce or expand on, proposed commitments. Even if governments are able to successfully enact their existing INDCs, the current commitments will not achieve the goal of preventing a global temperature rise of 2° Celsius (or even the goal of 1.5° Celsius described in the Paris Agreement).

Left to right: Summit speakers **Bambang Susantono** (Asian Development Bank), **Admiral Dennis C. Blair** (Sasakawa Peace Foundation USA; NBR Board of Directors), **James Slutz** (National Petroleum Council), **James Kendell** (Asia-Pacific Energy Research Centre), **Jeff Appleton** (ExxonMobil Asia Pacific Pte Ltd), and **Vandana Hari** (S&P Global Research Institute) before the panel "The Future of Energy Demand."

RECOMMENDATIONS FROM THE SUMMIT

1. **At minimum, ensure that INDCs as outlined are accomplished.** With so much at stake, all INDCs must be met as they were presented at COP21. This will involve significant effort to improve infrastructure and financial access, increase the share of cleaner-energy sources in the energy mix, and improve energy efficiency across the region. Despite the current period of optimism, governments cannot become complacent and slow the current momentum toward fulfilling each INDC.
2. **Recognize climate change as a transnational challenge requiring global solutions to avoid lose-lose outcomes.** Summit participants noted that many issues surrounding carbon emissions are transnational in nature. As in the case of the 2016 Summit host country, Singapore, even with laudable efforts to reduce domestic emissions through heightened efficiency and greater use of cleaner fuels, no country is immune to the challenges of balancing environmental sustainability and economic growth. All countries can attest that air pollution knows no boundaries, and governments cannot insulate themselves from the transient nature of winds. Participants recognized an ongoing disconnect between the aspirations set out at COP21 and the specific policies required to achieve global climate goals. Many transnational industries, such as energy trade, shipping, and aviation, were not adequately addressed by individual country commitments or the final agreement. Countries must come together to work toward comprehensive action in these important sectors.
3. **Enhance international cooperation to move past this bare minimum.** Countries must more broadly embrace international collaboration to achieve reductions in carbon emissions. Whether in the form of technology transfers or financing for infrastructure development and maintenance, support from developed countries and financial institutions is needed. As **Yongping Zhai**, Senior Advisor for the Sustainable Development and Climate Change Department at ADB, remarked, development banks alone cannot tackle this problem due to the scale of the funding needed and the important long-term goal of establishing a domestic desire to support such financing. The deployment of clean energy should be pursued by governments, private commercial banks, and development organizations alike. Regional and transregional collaboration through initiatives such as Mission Innovation, the Asia-Pacific Economic Cooperation (APEC), and the UN Office for South-South Cooperation is also necessary. However, the ability of these forums to provide the needed levels of financing, technology transfer, or R&D is yet to be seen.
4. **Respond to the opportunities presented by market conditions.** The current period of low energy prices supports efforts by policymakers to achieve sustainable energy goals, many of which were outlined in the INDCs presented at COP21. Various market conditions—abundant supplies of oil and gas, lower costs of energy-associated technologies, and shifting consumer demand—have converged, providing governments with an opportune moment to integrate lower-carbon sources of energy and reduce harmful emissions.

Endnotes

1. For a full record of the 163 countries to submit INDCs, see the UN Framework Convention on Climate Change website, http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx.
2. R.K. Pachauri, "Trends and Drivers in Global Energy Investment" (presentation at the Intergovernmental Panel on Climate Change, Columbia University, September 24, 2014), slide 5, http://energypolicy.columbia.edu/sites/default/files/energy/Sept%2024_Pachauri_Energy%20Investment_CGEP.pdf.
3. Itagaki and Johnson, "The Paris Climate Agreement."
4. UN Framework Convention on Climate Change, "Aggregate Effect of the Intended Nationally Determined Contributions: An Update," May2, 2016, 10, http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf.
5. IEA, "Energy and Air Pollution," World Energy Outlook Special Report, 2016, https://www.iea.org/publications/freepublications/publication/WorldEnergyOutlookSpecialReport2016EnergyandAirPollution.pdf.
6. "Air Pollution Deaths Cost Global Economy US$225 Billion," World Bank, Press Release, September 8, 2016, http://www.worldbank.org/en/news/press-release/2016/09/08/air-pollution-deaths-cost-global-economy-225-billion.
7. Eva Busza and Heather Kincaide, "Prices and Politics Dim Canada's Hopes for Diversifying Its Energy Export Markets," NBR, Brief for the Pacific Energy Summit, May 2016, http://www.nbr.org/downloads/pdfs/eta/pes_2016_brief_canada.pdf.

Near-Term Plenty, Long-Term Risk

MUCH OF THE Summit discussion was framed by considerations of lowering costs for energy across the board. In these past few years, consumers have benefited from lower costs for wind and solar projects, natural gas, and most noticeably oil. The price of oil bottomed out from a high of approximately $145 per barrel in 2008 to a low of $26 per barrel in February 2016, a price point unseen since the early 2000s.[1] Increased supply from unconventional oil and gas production played a major role in driving prices down, in conjunction with rising OPEC production as well as Iran's return to global markets. Over the past year, oil prices have seen some growth but remain far below prices a decade ago. Perceptions that this could be the "new normal" have changed the game in Asia and worldwide.

Given these trends, some analysts have heralded this as "an era of plenty," a dramatic change from the last ten years. During that period, high oil prices "accentuated the anxiety about energy security, oil supplies, and diversification of supplies from different places," as highlighted by **Mikkal E. Herberg**, Research Director of NBR's Energy Security Program. Concerns about energy security have eased significantly, and energy-importing countries in the Asia-Pacific such as Japan and South Korea have seen sharp improvements in their balance of payments as a result of lower energy prices.

However, low oil prices have negatively affected energy exporters in the region and have reduced investment in energy production and infrastructure worldwide.[2] Summit participants expressed concern about this trend, emphasizing the negative impacts on the maintenance and development of production fields, which will affect future supply:

- The oil industry is starting to see its current surplus capacity diminishing, and as a result, the oil market will rebalance to reflect the changing conditions of supply and demand, noted **Ken Koyama** of the Institute of Energy Economics, Japan.
- This rebalancing could result in a future supply shock, which would lead to higher prices and ultimately a resurgence in investment, argued by **Tony Nash**, Chief Economist and CEO of Complete Intelligence. However, governments must prepare for this shock now by increasing their domestic petroleum reserves, as there will be a lag between new investment in production and exploration capabilities and the initial supply disruption.[3]
- Energy investment is a long-term game. As several delegates remarked, today's low prices are the result of investment decisions from five to ten years ago, and if current investment remains at low levels, there will be a long delay in addressing a future supply crunch.

We thus cannot assume that prices will stay low forever, given that long-term investment has declined sharply. Summit participants noted that the breakeven price for the oil industry appears to have declined to $60 per barrel, but national governments also need to plan for future variability

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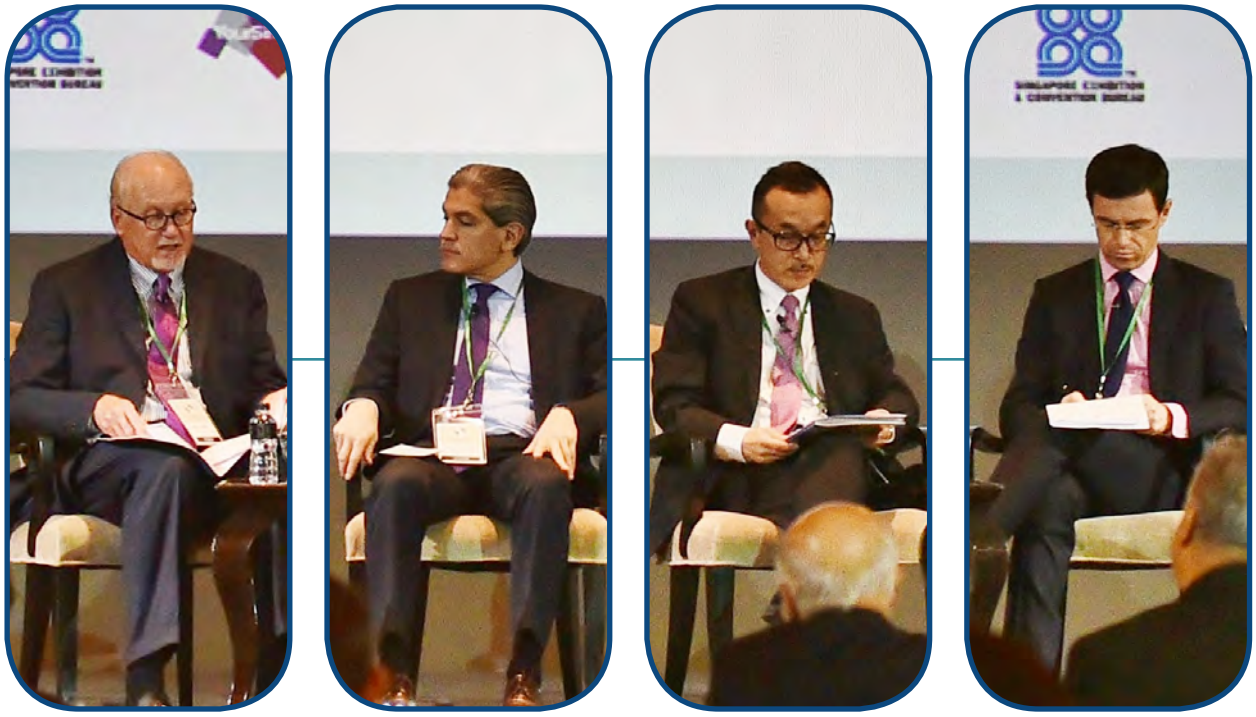
One of the risks that we are confronting right now is complacency.... All of these choices are easier in a lower-price environment. And so we really need to seize this opportunity, particularly if oversupply is a near-term instead of a long-term phenomenon.

- **Clara Gillispie**, NBR

in prices.[4] At the same time, delegates also expressed concern that a lengthy period of lower prices can encourage complacency and discourage efforts to improve energy efficiency, decrease energy intensity, and promote cleaner energy options. Consequently, policymakers and industry leaders must view the current lower-price environment in a wider context, keeping in mind ongoing desires to address worsening air quality and rising import dependence, and prepare for a range of possibilities in an era of market volatility.



Left to right: Moderator **Mikkal E. Herberg** (NBR) and panelists **Aldo Flores-Quiroga** (International Energy Forum), **Ken Koyama** (Institute of Energy Economics, Japan), and **Pierre Noël** (International Institute for Strategic Studies) open Summit discussions in the panel "Near-Term Plenty, Long-Term Risk: Market Outlooks in an Era of Abundance."

RECOMMENDATIONS FROM THE SUMMIT

1. **Treat energy security as "energy + security."** Lower oil prices and gluts in energy supplies across sources could lead to complacency with regard to energy security. To maintain both a steady supply of energy and long-term security, it is crucial for governments to prepare for market changes. Diversification of energy sources, as well as their origin countries, is essential for future supply security and sustainable markets for investment.
2. **Reform and eliminate wasteful fuel subsidies.** Given the importance of economic growth in driving energy demand, the low price environment provides opportunities for easing energy subsidies while the burden on the consumer is low. Along with breaking up utility monopolies in some cases, Summit participants such as Mr. Herberg and Ms. Hari agreed that targeting subsidies toward low-income families will enable energy markets to function more effectively. (See the section "Addressing Energy Poverty" on page 39 for greater detail.)
3. **Develop strategic petroleum reserves.** Low prices provide an opportunity for governments to stock up on oil supplies, as argued by Admiral Blair, Dr. Koyama, and numerous other delegates representing both producer and consumer countries. Summit participants noted that governments must be proactive and plan for a future decline in availability and rise in prices.

Bambang Susantono (Asian Development Bank) delivers a keynote address on responding to the challenges of Asia's changing energy landscape.

Endnotes

1. Bernhard Hartmann and Saji Sam, "What Low Oil Prices Really Mean," *Harvard Business Review*, March 28, 2016, https://hbr.org/2016/03/what-low-oil-prices-really-mean.
2. Antoine Halff, "The Outlook for Asia's Oil Market in a Lower-Price Environment," in "Asia's Energy Security amid Global Market Change," NBR, NBR Special Report, no. 63, December 2016, 6.
3. Ibid., 14.
4. Ibid., 8.

Are We in a "Golden Age of Gas"?

IN A 2011 special report, the IEA highlighted the possibility of a coming "golden age of gas" for Asia, suggesting the region might turn toward increasingly large shares of natural gas in its overall energy mix.[1] Summit participants assessed the progress toward this goal and provided recommendations for how to enable this transition.

A number of participants noted that many governments' national plans have recently indicated a strong desire to increase the share of gas. In China, where the goal is to increase gas's share of primary energy from the current level of 5% to 10% and beyond by 2020,[2] one part of the answer will be to encourage gas-on-gas competition, although this could create problems for state-owned energy enterprises that have contracted for large volumes of LNG. If the demand for gas in China continues at its current rate, this trend will certainly increase confidence in gas's viability for Asia. As stated by Summit speakers **Mark Thurber**, Associate Director for Research for the Program on Energy and Sustainable Development at Stanford University, and **Satya Widya Yudha**, Deputy Chairman of the Energy Commission in the Indonesian House of Representatives, natural gas produces significantly lower CO_2 and local pollutant emissions than coal, making it a more environmentally sustainable option.

However, gas has not yet proliferated as widely in Asia as it has in the United States because of unconventional production challenges, market uncertainty, and a lack of cost-competitiveness, among other hurdles:

- *The importance of perception.* Gas is less carbon-intensive and lower-polluting than alternatives like coal or diesel, and improvements in extraction technology in North America and Australia have increased global supplies. However, Dr. Thurber noted that a scarcity mentality still exists for gas, with policymakers in Asia seemingly skeptical that gas prices will remain competitive into the future. For many policymakers, gas is perceived as a high-cost fuel, observed **Chen Weidong**, Chairman at DFS Energy Consultant (Beijing) Limited. Given the uncertainties inherent in energy planning, it is difficult for governments to increase the share of gas when other energy sources are perceived as cheaper, more accessible, or more secure. However, Mr. Chen also commented

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If gas is going to compete and realize its potential in the Asia-Pacific… then it's going to be about a transition to different market mechanisms—to a market dynamic, and a price that allows supply and demand to be balanced.

- **Peter Hughes,** Peter Hughes Energy Advisory Limited; global gas partners gmbh

that in China a general consensus has been reached—reducing coal's share in the national energy mix is not only a requirement for energy security but also necessary to advance goals to protect the environment and prevent climate change. Both the Chinese government and the general population view increasing the share of natural gas to be the most realistic option for achieving these targets.

- *The availability of infrastructure.* The penetration of gas demand into Asia's energy market is dependent on infrastructure, stated Ms. Hari. Switching infrastructure to accommodate gas for power generation is complex and requires significant investment of time and money. Not only do plants need to be constructed (if they do not already exist), but port terminals and shipping lanes need to be taken into consideration as well. Investments in the infrastructure for distribution and consumption must also be made to avoid the negative environmental effects of methane leakage during transmission.
- *Uncertain demand.* Uncertain demand in the Asian natural gas industry has created uncertainty in the market. It is challenging to convince companies to invest in natural gas infrastructure when the price of construction is relatively high, the cost of fuel is subject to fluctuations, and other options can easily meet demand.
- *Defining the end goal.* Debate exists on whether natural gas is a bridge fuel or a destination fuel, which can complicate five-to-ten-year energy planning strategies. For those who champion a larger shift to renewables, natural gas is a relatively low-emitting and efficient fuel that serves as a stepping stone to a cleaner energy mix. Others argued that natural gas should not be considered only as a means to an end but as the end itself. Natural gas may be more accessible for many countries than large-scale renewable energy.

Although these factors have hindered natural gas deployment across the Asia-Pacific thus far, Summit participants did not view these barriers as permanent. As a result of commitments made by countries at COP21, several participants anticipate that natural gas will compose a larger percentage of national energy mixes in the coming years.

Left to right: **Chen Weidong** (DFS Energy Consultant (Beijing) Limited) speaks in the panel "Realities and Aspirations for Balancing Coal, Gas, and Nuclear Energy Options in the Asia-Pacific"; **Satya Widya Yudha** (House of Representatives, Indonesia) comments on the benefits of transitioning to lower carbon fuels, such as natural gas.

RECOMMENDATIONS FROM THE SUMMIT

1. **Delink oil and gas pricing and remove destination clauses from contracts to allow for better gas-on-gas competition.** Delinking gas and oil prices is a goal of a broad range of actors who advocate for market-driven pricing. In particular, 2017–20 will be a critical period for LNG prices, given the new supply that will enter the open market as a result of expiring contracts and rising exports from Australia and the United States. Still, delegates acknowledged that some uncertainty remains around what the benchmark for gas pricing will be once it is delinked from oil, as well as how this will affect energy markets more broadly going forward.
2. **Plan for a price band rather than a price point.** Given market uncertainty, governments should prepare for a range of energy prices in their national planning rather than a particular price point, as Mr. Yudha remarked that Indonesia is doing.
3. **Enhance transparency in gas markets.** To build a successful gas hub in Asia, transparency is necessary to create confidence in the market and trust between buyers and sellers. The transparency and liquidity offered by an efficient hub could help stabilize markets and make gas a more competitive option in Asia. Furthermore, as noted by **Nathan Flaman**, Head of Global Energy Research at BHP Billiton, transparency allows market signals of supply and demand to better inform investment decisions by producers.
4. **Account for environmental externalities.** Putting a price on carbon and on emissions of local pollutants would do a lot to make natural gas more competitive relative to coal, Dr. Thurber noted. (See the section "Sustainable Development That Promotes Both Sustainability and Development" on page 29 for greater detail). He further argued that a price of $20–$30 per ton of CO_2 would likely be high enough to make gas a more attractive option than the use of inefficient, low-quality coal.

Endnotes

1. IEA, "Are We Entering a Golden Age of Gas?" World Energy Outlook Special Report, 2011, http://www.worldenergyoutlook.org/media/weowebsite/2011/WEO2011_GoldenAgeofGasReport.pdf.
2. EIA, "China," April 2016, 3, http://energy.gov/sites/prod/files/2016/04/f30/China_International_Analysis_US.pdf.

Harnessing the Power of Renewable Energy

THE ASIA-PACIFIC shows great potential for embracing renewable energy sources, including wind, solar, hydropower, bioenergy, geothermal, and ocean energy. This is due to both the ready availability of these sources across many countries in the region and stated policy goals to expand their use. Countries like India, Indonesia, and China have diverse but ambitious national plans to harness renewable energy for their respective national energy mixes. Of the available options, wind and solar were most frequently discussed at the Summit. These two sources have proliferated most significantly due to policy incentives, technology advancements, and falling installation and technology costs.

Some participants expressed concern that countries may turn away from emphasizing lower-carbon alternatives given the availability of relatively cheaper, more abundant energy supplies across a range of options. However, the policy push for expanding the use of renewable energy has been so strong that investment in renewable energy sources increased to a record $329.3 billion in 2015,[1] just as fossil fuel prices and investment in fossil fuel production declined, which was highlighted by **Pierre Noël**, Sultan Hassanal Bolkiah Senior Fellow for Economic and Energy Security at the International Institute for Strategic Studies in Singapore. With dramatic improvements in production and deployment margins, the overall costs of producing wind and solar energy are falling at a steady pace. In some parts of Texas and Iowa, for example, delegates noted that wind energy has become cost-competitive with traditional sources.[2]

Left to right: **Ken Koyama** (Institute of Energy Economics, Japan) and **Pierre Noël** (International Institute for Strategic Studies) speak during the panel "Near-Term Plenty, Long-Term Risk: Market Outlooks in an Era of Abundance."

Mark Thurber (Stanford University) emphasizes the importance of public approval in integrating renewable energy sources into the grid.

Stakeholders across the Asia-Pacific have exhibited a strong appetite for integrating renewable energy sources into their national energy mixes. Summit participants noted the following recent developments and perspectives:

- Mr. Rindlaub emphasized the viability of solar energy. "The sun is shining somewhere," he stated, elaborating that the cost and availability of the resource itself are not prohibitive; what needs to be developed is the grid transmission technology.
- Robust efforts by government and industry in China, a world leader in installed solar capacity and technology, have helped reduce the cost of solar photovoltaic by 90% in the last decade.[3]
- China is also a leader in wind energy. As Ms. Hari noted during her panel, approximately half of the world's added wind capacity in 2015 was in China.
- Summit participants commented that green growth creates jobs, which has been especially significant for countries in the Asia-Pacific. In China, the United States, India, and Japan, renewable energy (excluding large hydropower) accounted directly or indirectly for over five million jobs in 2015, and globally renewable energy employment increased by 5%.[4]

Combined with much-hoped-for gains in storage technology, lower costs are leading renewables toward becoming a viable baseline fuel source. Dr. Thurber commented that renewables have become the default "green" source of energy due to their broad public appeal, even though alternatives might sometimes be able to yield lower-cost emissions reductions. Challenges remain in better integrating renewable energy sources into the grid, but some Summit participants expressed optimism that the new frontier is in distributive generation, grid storage, and batteries.

RECOMMENDATIONS FROM THE SUMMIT

1. **Act now in order to achieve long-term sustainable energy targets.** Countries across the Asia-Pacific are striving to develop a more sustainable energy mix, an effort that was reflected by the INDCs submitted in advance of COP21. However, achieving the desired scenario will require significant commitment, political will, and infrastructure development, in addition to an increase in the amount of renewable energy generation. In fact, it is estimated that APEC member countries must double their renewable deployment in order to reduce carbon emissions by approximately two gigatons of CO_2.[6] Several Summit participants echoed the need to continue expanding efforts. Admiral Blair stated that governments were probably being fairly conservative in the INDC pledges presented in Paris, and several other experts mentioned that governments were potentially capable of doing more to reduce carbon emissions.
2. **Increase innovation in renewables and storage technology.** Further innovation in areas such as distributed generation and storage could transform the global energy system and make these sources more and more accessible. Dr. Noël agreed that the transformative power of renewable energy for the Asia-Pacific should not be underestimated. One example highlighted by Mr. Rindlaub was Advanced Rail Energy Storage. In this system, excess energy produced from renewable sources is used to bring a heavy train up a hill, and when the energy is needed, it can be regained as the train comes down the hill. As Mr. Rindlaub stated, this system has an efficiency of 80%, and bringing such technologies online at scale could have a transformative impact for energy systems worldwide.

Left to right: **Philip Andrews-Speed** (National University of Singapore) and **Munetaka Horiguchi** (Japan Bank for International Cooperation) during the session "Closing the Investment Gap: Financing Energy and Environmental Targets."

Endnotes

1. Jess Shankleman, "As Oil Crashed, Renewables Attract Record $329 Billion," Bloomberg, January 14, 2016, http://www.bloomberg.com/news/articles/2016-01-14/renewables-drew-record-329-billion-in-year-oil-prices-crashed.
2. Ryan Wiser and Mark Bolinger, "2015 Wind Technologies Market Report," U.S. Department of Energy, August, 2016, https://energy.gov/sites/prod/files/2016/08/f33/2015-Wind-Technologies-Market-Report-08162016.pdf.
3. Tom Randall, "Wind and Solar Are Crushing Fossil Fuels," Bloomberg, April 6, 2016, http://www.bloomberg.com/news/articles/2016-04-06/wind-and-solar-are-crushing-fossil-fuels.
4. International Renewable Energy Agency, "Renewable Energy and Jobs: Annual Review 2016," 2016, 11, http://www.se4all.org/sites/default/files/IRENA_RE_Jobs_Annual_Review_2016.pdf.
5. Brian Kennedy, "Two-Thirds of Americans Give Priority to Developing Alternative Energy over Fossil Fuels," Pew Research Center, January 23, 2017, http://www.pewresearch.org/fact-tank/2017/01/23/two-thirds-of-americans-give-priority-to-developing-alternative-energy-over-fossil-fuels.
6. Tam, "APEC Energy Demand and Supply Outlook 6th Edition," slide 25.

Sustainable Development That Promotes Both Sustainability and Development

AS COUNTRIES ACROSS the Asia-Pacific look to expand access to energy, Summit delegates reflected on the range of options that can play a role in strengthening supply security. They noted, however, that when selecting a baseload energy source to supply energy at scale and on demand, the choice often comes down to coal, gas, or nuclear. "Despite its severe environmental drawbacks, policymakers in emerging economies have tended to view coal as the most economic and reliable choice for power,"[1] commented Dr. Thurber. As noted by **U Thein Lwin**, a member of the Myanmar Commission for the Assessment for Legal Affairs and Special Issues of the Pyidaungsu Hluttaw, emerging economies face the challenge of addressing investment, technology, and environmental issues, while also needing to expand power generation for further development. Ambassador Karim highlighted that Bangladesh must continue investing in coal-fired power plants to expand energy access to the level needed to support job creation, even with the country's ambitious goals to have renewables compose 10% of energy generation by 2020 (up from less than 5% in 2015) and to reduce energy intensity by 20% by 2030.[2]

Other Summit delegates emphasized that coal and lower-carbon sources of energy are often not mutually exclusive—governments can utilize coal while also working to increase energy generation from lower-carbon sources.

- Although APEC economies are expected to increase renewable capacity to 34% of electricity generation by 2040, fossil fuels will still dominate in the region.[3]
- According to the IEA, global coal use is expected to increase 11% from 2013 to 2040, and Asia is projected to be responsible for 80% of total coal consumption by 2040.[4]
- Asian countries purchased 72% of globally traded LNG in 2015, with 56.5% of the global total going to the top three LNG importers—Japan, South Korea, and China.[5]
- The top eight coal-consuming countries all have nuclear power capability, yet nuclear energy only generates 364 million tonnes of oil equivalent (Mtoe) of power, whereas coal generates 1,979 Mtoe.[6]

Younkyoo Kim (Hanyang University) comments on the benefits of creating a natural gas hub in Northeast Asia and the challenges that interested parties face.

As a first step for countries to integrate these options into their energy mixes, balancing coal, gas, and nuclear, among other options, will help governments achieve social license, diversify their energy supply, and align their aspirations for a healthier environment with their overall economic goals. Yet numerous political and economic challenges are involved in bringing other energy sources to scale. Some countries hope to increase the share of nuclear in their energy mixes given that it is a zero-emission fuel that is cost-competitive once a plant is online. However, nuclear energy infrastructure is expensive to construct from scratch, and public opposition remains relatively high owing to safety concerns following events such as the Fukushima Daiichi nuclear disaster. Calls for greater safety measures, despite nuclear energy's very good safety record over the long term, have reduced its cost-competitiveness, as highlighted by **Younwon Park**, CEO of BEES, Inc., and ACT, Inc. Given these constraints, nuclear energy can play a role where existing nuclear infrastructure is in place but is unlikely to be successfully introduced elsewhere.

Governments face challenges when considering the expansion of natural gas as well. Based on the current abundance of supply in the natural gas market as a result of the shale gas revolution, it would appear that there would be plenty of opportunities for countries to increase the percentage of natural gas in their energy mixes. However, the fluctuation of gas prices and the high costs associated with constructing the necessary infrastructure limit this fuel's implementation. For example, there is a large push for the development of an LNG trading hub in Northeast Asia to more directly cater to China, Japan, and South Korea. As **Younkyoo Kim**, Professor in the Division of International Studies at Hanyang University, noted, the desire to create such a hub exists but has been held up by issues like the cost of building import terminals, hub indexation, and destination flexibility, among others.

Left to right: Moderator **Peter Hughes** (Peter Hughes Advisory Limited; global gas partners gmbh) and panelists **Chen Weidong** (DFS Energy Consultant [Beijing] Limited), **Younwon Park** (Best Engineering in Energy Solutions, Inc.; Atomic Creative Technology, Inc.), **Nathan Flaman** (BHP Billiton), and **Mark Thurber** (Stanford University) after the session "Realities and Aspirations for Balancing Coal, Gas, and Nuclear."

Left to right: **Ambassador Tariq Karim** (Vivekananda International Foundation; World Bank), **Irshad Vaziralli** (Chevron Asia Pacific Exploration and Production), **Admiral Dennis C. Blair** (Sasakawa Peace Foundation USA; NBR Board of Directors), and **Jeff Appleton** (ExxonMobil Asia Pacific Pte Ltd) smile for a photo after the gala dinner.

(For more on natural gas in Asia, see "Are We in a Golden Age of Gas?" on page 23.) Coal too can be included in sustainable development targets, as clean-coal technologies, such as carbon capture and storage (CCS) and integrated gasification combined cycles (IGCC), can help achieve goals for reducing CO_2 emissions. However, policymakers are faced with barriers related to upfront costs, technology maintenance, and long-term infrastructure and investment planning.

Social license issues stemming from carbon-related pollution and concerns about nuclear safety will have an effect on the political will required for the transition to a more diversified energy mix. A carbon-related example is the potential peak of coal demand in China, where coal's share of primary energy is now steadily falling as a result of government policy, driven primarily by air-quality issues. Nuclear energy, on the other hand, has been largely held back by public concerns about its safety. However, one must look at the overall costs, benefits, and risks of fuels to make well-informed decisions regarding the best option for countries moving forward. As an example, Mr. Rindlaub remarked that even though coal may seem cheaper and more accessible than nuclear, the environmental cost from emissions, as well as the human costs of mining accidents, tip the scale in a different direction.

Several Summit participants argued that governments should plan for unexpected supply disruption, continue improving clean-coal technologies, and integrate lower-carbon sources of energy into their national energy mixes. However, they also emphasized that one blanket policy will not achieve energy and environmental security in the Asia-Pacific. Instead, countries must incorporate their unique domestic resources, financial means, and supply demands into national energy policymaking.

RECOMMENDATIONS FROM THE SUMMIT

1. **Plan for the unexpected.** The diversification of an energy mix is necessary for a country to prepare for unanticipated disasters that disrupt energy supply. Policymakers have struggled to tilt the balance of national energy mixes away from the reliance on coal, and it remains a priority for many governments across the region to diversify their energy systems and further integrate gas, nuclear, and renewables.
2. **Enact market-driven policy tools to curb emissions.** Mechanisms like carbon taxation could create a stronger economic argument for decreasing overall emissions or switching to lower-emitting sources of energy generation. Carbon markets have already seen limited success in some countries, like China and Canada. China has implemented trial carbon markets, which it plans to expand nationwide in 2017. Although it is always difficult to establish causality, China's energy intensity fell in 2015 compared with the previous year.[7] These trends could be amplified through broader implementation of carbon trading.
3. **Incentivize the use of existing cleaner technologies.** Through the implementation of the above-mentioned market-driven policies, governments can incentivize the use of existing clean technology, such as IGCC or CCS. Although these technologies are not without their own challenges, they present policymakers with an option to reduce carbon emissions.

Minister Ben Micah (National Parliament of Papua New Guinea) comments on the potential for Papua New Guinea to become an LNG exporter in the panel "South and Southeast Asia: Emerging Giants in Global Energy Markets."

Endnotes

1. Mark C. Thurber, "Coal, Gas, or Nuclear: Asia's Inconvenient Energy Choice," NBR, Pacific Energy Summit, Working Paper, 2016, 2, http://nbr.org/downloads/pdfs/eta/pes_2016_working_paper_thurber.pdf.
2. Ministry of Environment and Forests (Bangladesh), "Intended Nationally Determined Contributions (INDC)," 2015, 5, http://www4.unfccc.int/dcregistry/PublishedDocuments/Bangladesh%20First/INDC_2015_of_Bangladesh.pdf.
3. Tam, "APEC Energy Demand and Supply Outlook 6th Edition," slide 12.
4. IEA, *World Energy Outlook* 2015 (Paris: OECD/IEA, 2015), 278.
5. Shi Xunpeng, "The Impact of Low Oil Prices on Natural Gas and the Implications for the Asia-Pacific," NBR, Pacific Energy Summit, Working Paper, 2016, 3, http://nbr.org/downloads/pdfs/eta/pes_2016_working_paper_shi.pdf.
6. Thurber, "Coal, Gas, or Nuclear," 5.
7. Anthony Kuhn, "China Plans to Create a Nationwide Carbon Market by 2017," National Public Radio, November 24, 2015, http://www.npr.org/sections/parallels/2015/11/24/457203851/china-plans-to-create-a-nationwide-carbon-market-by-2017.

Addressing Urbanization in Asia

URBANIZATION IS A large-scale phenomenon in which populations migrate from rural to urban areas even as villages gradually become cities through growth and densification.[1] In 2014 the United Nations noted that well over half of the world's population lived in urban areas, a marked transition in global demographics.[2] Asia, in particular, is being transformed by urbanization, with 120,000 people moving to cities every day.[3] The United Nations projects that by 2030 the region will contain approximately twenty megacities (urban areas with a population greater than ten million), while the majority of growth will actually be seen in cities with populations below one million.[4]

Clara Gillispie, Senior Director of Trade, Economic, and Energy Affairs at NBR, commented during her panel that the main question of urbanization is how to build smarter, stronger systems in areas already straining to keep up with energy demand, even as the challenge of developing new infrastructure for transportation, power, and buildings intensifies. In their 2016 Summit working paper, **Srikanth Shastry** and **Madhav Pai** of the World Resources Institute note that the world's fastest rates of urbanization are in China, India, and Nigeria. Considerable attention has been paid to meeting the energy demand of megacities, which are typically the economic hubs of a country. However, Mr. Shastry and Mr. Pai argue that it is increasingly important for governments to develop and strictly enforce tailored policies for a variety of cities, as most challenges will be faced in small- to medium-sized cities.[5] Smaller cities may benefit more from improved social systems, which could help reduce both migration rates to larger metropolitan areas and demand on energy systems.

Kavita Gandhi (Sustainable Energy Association of Singapore) discusses the importance of including government, industry, and citizens in developing smart cities.

Specifically addressing the effects of urbanization on a city's transportation system, **Fengshi Wu**, Associate Professor at the S. Rajaratnam School of International Studies at Nanyang Technological University, highlighted an example of a collaborative approach from three major Chinese cities. The city governments of Beijing, Shanghai, and Hangzhou have brought together businesses and the public to develop advanced mobile applications that target each city's extreme congestion. These programs help urban residents track buses, subway trains, and bicycles in the local bike-share programs, thereby increasing the convenience and thus the ridership of public transportation. Although this type of approach does not eliminate the need for other potential methods to incentivize the use of public transportation or improved fuel standards, it does provide an inclusive solution that addresses some of the effects of urbanization. (For more on transportation issues, see "Transportation in Asia" on page 36.)

The effects of urbanization on climate change are more common and significant than people often realize. Many urban cities in Asia experience high levels of air pollution, a visible public health and economic issue, and 70%–80% of urban air pollution is caused by transportation. Air pollution itself also contributes to climate change through GHG emissions increasing global temperatures. Given its visibility and negative effects, air pollution should spur action, with local populations calling for policy changes to improve air quality and public health, which would then decrease the negative impacts of urbanization on the climate. As emphasized by several Summit panelists, there is not one right path for policymakers, industry, and the public to address the various challenges presented by urbanization. However, a critical design element of any comprehensive effort should be to encourage tools for creating and sustaining social license to operate—the process of ensuring multilevel stakeholder approval of a project, which is often developed informally and requires attention to factors that go beyond simple regulatory requirements.[5]

Ambassador Michael Michalak (US-ASEAN Business Council, Inc.) addresses a question to the panelists on the roundtable "The Road to Urbanization: Smart Cities, Efficient Transportation, and Cleaner Air."

RECOMMENDATIONS FROM THE SUMMIT

1. **Focus on "smart" urban planning.** As Mr. Shastry and Mr. Pai note, because infrastructure typically locks in a city's development trajectory for up to one hundred years, it is essential that early planning explore how to develop systems that can promote rising levels of prosperity while also protecting the environment. Policymakers must assess the demographics and variations of energy usage in cities and not implement a one-size-fits-all policy. This requires investment in both research and infrastructure development itself.
2. **Bring together public and private partners.** When developing a sustainable urban area, contributions from both the public and private sectors to policymaking and financial decisions are instrumental. (See the section "Energy Financing and Investment" on page 42). Both Professor Wu and **Kavita Gandhi**, Executive Director of the Sustainable Energy Association of Singapore, encouraged expanded involvement to develop strategic urban planning policies. Ms. Gandhi emphasized Singapore's success as a "smart city" due to the inclusion of government, industry, and public representatives throughout the process of crafting recommendations for urban infrastructure development. Professor Wu similarly encouraged the inclusion of citizens, as they often understand the issues the best.
3. **Apply existing efficiency standards.** Enforcing existing appliance standards and building codes, as well as adapting these standards to changing needs and technologies, is essential. Smart systems provide the opportunity for using technology to better manage energy demand and send market signals to consumers, which has implications for infrastructure. Transitioning to smarter systems requires investments to both upgrade and modify the existing infrastructure and ensure adequate planning and construction of new projects.

Endnotes

1. Carl Haub, "What Is a City? What Is Urbanization?" Population Reference Bureau, October 2009, http://www.prb.org/Publications/Articles/2009/urbanization.aspx.
2. United Nations, "World's Population Increasingly Urban with More Than Half Living in Urban Areas," July 10, 2014, http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html.
3. ADB, "Green Cities," https://www.adb.org/green-cities.
4. UN Department of Economic and Social Affairs, *World Urbanization Prospects: The 2014 Revision, Highlights* (New York: United Nations, 2014), 2, https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf.
5. Srikanth Shastry and Madhav Pai, "The Role of Transportation in the Future of Urban Developing Asia: A Case Study of India," NBR, Pacific Energy Summit Working Paper, 2016, 2, http://www.nbr.org/downloads/pdfs/eta/pes_2016_working_paper_Shastry_Pai.pdf.
6. Brian Yates, "Building Social License: Harnessing the Environmental Impact Assessment for Social Capital," Interview with NBR, April 30, 2014, http://nbr.org/downloads/pdfs/eta/Yates_interview_043014.pdf.

Transportation in Asia

TRANSPORTATION IS THE second-largest source of energy demand, accounting for 28% of final consumption.[1] Over the past decade, vehicle ownership per one thousand people grew more than 200% in China and approximately 130% in both India and Indonesia.[2] ADB estimates that motor vehicle fleets in Asia as a whole are doubling every five to seven years.[3] These dramatic increases in vehicle ownership have a tangible impact on public health, as 70%–80% of air pollution in urban areas comes from transportation emissions.[4] Economically, ADB estimates that congestion from the rapidly growing number of motor vehicles causes a loss of 2%–5% of GDP each year in Asian economies.[5] As **Tao Wang**, Assistant Director at CBN Research Institute and a Nonresident Scholar at the Carnegie-Tsinghua Center for Global Policy, argued, congestion can increase the amount of pollutants emitted to three to five times the level in non-congestion scenarios.

Summit participants focused on the role of urban transportation not only due to the above-mentioned projections for fleet growth and resulting pollution but also because of the potential to tame this growth

Left to right: Moderator **Clara Gillispie** (NBR) and panelists **Fengshi Wu** (Nanyang Technological University), **Tao Wang** (CBN Research Institute; Carnegie-Tsinghua Center for Global Policy), **Kavita Gandhi** (Sustainable Energy Association of Singapore), and **Haksik Yoo** (Korea Energy Economics Institute) at the roundtable session "The Road to Urbanization: Smart Cities, Efficient Transportation, and Cleaner Air."

Vandana Hari (S&P Global Institute) highlights the importance of establishing and enforcing fuel efficiency standards.

through efficiency measures. Goals include managing demand, enhancing fuel emissions standards, and harnessing technology to improve urban planning and public transportation:

- An average passenger vehicle emits 4.7 metric tons of CO_2 annually.[6] With an estimated 1.7 billion registered vehicles on the road, that equates to nearly 8 billion metric tons of CO_2 emitted annually worldwide. This is equivalent to the annual energy use of 834 million homes.[7]
- Public transportation modes, such as bus-rapid-transit systems and urban rail, can carry 10 to 50 times the number of people per hour than passenger cars.[8]

In a move to reduce transportation emissions, many countries are implementing fuel-efficiency standards; however, many of the standards in the Asia-Pacific lag behind those in other parts of the world. Vehicles utilizing Tier 2 fuel-efficiency standards in the United States and Euro 6 standards in the European Union and elsewhere have been on the road for several years now. To put the importance of these policies into perspective, when shifting from Euro 5 to Euro 6 standards, nitrogen oxide (NO_x) emissions decrease from 0.18 grams per kilometer (g/km) to 0.08 g/km. If only considering the annual km traveled by personal vehicles in China, utilizing Euro 6 standards would reduce NO_x emissions by 344 million kg. This is the equivalent of removing GHG emissions from almost 22 million passenger vehicles annually.

Ms. Hari noted that two of the largest vehicle markets, China and India, are still producing vehicles with Euro 4 and Euro 5 standards. Although both countries are transitioning their transportation industries to the highest standard, an even greater challenge will be ensuring that fuel-efficiency regulations are properly enforced. The current period of low oil prices has caused an increase in the number of people choosing to drive personal vehicles and created some uncertainty in the outlook for technological improvements in efficiency. On the other hand, lower prices allow governments across the region to reform their fuel subsidy schemes, freeing up that expenditure to be put toward R&D on efficiency and clean technology.

RECOMMENDATIONS FROM THE SUMMIT

1. **Avoid one-size-fits-all measures.** Particularly in a region as diverse as the Asia-Pacific, one size does not fit all when addressing public transportation–related issues. Each city has distinct challenges and characteristics that must be addressed independently. Public transportation plans that work for a town smaller than 50 km^2 will not necessarily work in a city with an area greater than 150 km^2.[9] In their Summit working paper, Mr. Shastry and Mr. Pai suggest three alternative plans, depending on the size and population density of an urban area—active mode cities, transit cities, and balanced cities.[10]
2. **Enforce standards to reduce both costs and emissions.** Summit participants stressed the importance of enforcing fuel standards, something they noted that China has done rather successfully. Participants also mentioned that India has made noticeable strides in establishing policies, yet there are concerns with the phased implementation and stringency of the standards. It is essential to emphasize practical implementation and enforcement of fuel standards, as ambiguity in enforcement adversely affects the impact of good policies.
3. **Strengthen transportation technology and infrastructure.** There are ample opportunities for technological innovation in transportation, including electric vehicles, engine improvements, and higher fuel efficiency, and these could have a strong impact on efforts to reduce overall emissions from Asia's transportation sector. As Mr. Appleton noted, natural gas is a promising emerging fuel for certain types of transportation, as compressed natural gas vehicles have the potential to reduce air pollution in major urban areas. Additionally, as argued by Mr. Shastry and Mr. Pai, policymakers should include transit-oriented planning when developing infrastructure for cities. Well-designed cities that account for public transportation, walking, and biking will be effective in reducing pollution and the impact of climate change.[11]

Endnotes

1. IEA, "Key World Energy Trends, Excerpt from: World Energy Balances," 2016, https://www.iea.org/publications/freepublications/publication/KeyWorldEnergyTrends.pdf.
2. Stacy C. Davis, Susan W. Diegel, and Robert G. Boundy, *Transportation Energy Data Book*, 34th ed. (Oak Ridge: Oak Ridge National Laboratory for the U.S. Department of Energy, 2015), 86, http://cta.ornl.gov/data/tedb34/Edition34_Full_Doc.pdf.
3. ADB, "Addressing Climate Change in Transport," http://www.adb.org/sectors/transport/key-priorities/climate-change.
4. ADB, "Urban Transport," http://www.adb.org/sectors/transport/key-priorities/urban-transport.
5. Ibid.
6. EPA, "Greenhouse Gas Emissions from a Typical Passenger Vehicle," May 2014, https://www.epa.gov/sites/production/files/2016-02/documents/420f14040a.pdf.
7. EPA, "Greenhouse Gas Equivalencies Calculator," https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
8. ADB, "Solutions for Urban Transport," June 19, 2012, https://www.adb.org/news/infographics/solutions-urban-transport.
9. Shastry and Pai, "The Role of Transportation," 5.
10. Ibid.
11. Ibid., 2.

Addressing Energy Poverty

IN 2015, APPROXIMATELY 700 million people in Asia lacked access to electricity and over 2 billion relied on biomass for cooking and heating.[1] Indoor air pollution caused by biomass-fueled cook stoves and appliances causes the majority of air pollution–related deaths, making the expansion of access to cleaner sources of energy necessary to improve standards of living in Asia. Delivering these crucial services will require a concerted effort from governments, industry, and financial institutions to guarantee that policies will not falter in the long term.

Summit delegates urged that to ensure sustainable development, accurate pricing signals are critical for enabling investment in energy production, distribution, and other infrastructure building. This allows governments and industry to better allocate funds to areas where they are needed, which can improve the viability of a country's domestic energy market. Indeed, Summit participants emphasized that, without reform, fuel subsidies often do not benefit those who most need economic relief. Thus, targeted subsidies toward the poor, or direct income support, might be more effective.

A discussion of improving access to energy in the Asia-Pacific cannot exclude an analysis of oil market transparency. Asia consumed one-third of the world's oil in 2015, most of which was used for transportation. Given that this ratio is expected to increase as more people gain access to energy, Summit participants noted that managing the immense future demand for fueling Asia's transportation sector will be essential for a number of reasons. Asia's climbing demand for oil, and in particular imported oil, may raise concerns about government balance of payments and supply certainty, as well as environmental considerations. Summit participants advised governments to take advantage of lower oil prices and seize the opportunity to implement policies that better manage demand and target needed subsidies for lower-income populations.

Subsidies and price ceilings result in delayed and skewed responses to market trends, which can cause supply crunches, massive government spending, and overreliance on fossil fuels such as gasoline, diesel, and coal. For example, in 2014 the Indonesian government spent nearly

VOICES OF THE SUMMIT

Already China, India, and Indonesia have taken advantage of low oil prices to end fossil fuel subsidies. The continual presence of subsidies creates an unfair playing field for clean energy, making it seem far less financially viable than it truly is.

- **Bambang Susantono**, Asian Development Bank

20% of its total expenditure on subsidies that kept prices for oil and gas consumers lower than global market value.[2] President Joko Widodo has since eliminated subsidies for gasoline and capped subsidies for diesel. It is important to enable a price for electricity that targets subsidies and aims to minimize market distortion, in order to discourage overconsumption. Indeed, over the past two years, the Indonesian government has taken a number of steps to remove the country's fossil fuel subsidies, and other countries should look closely at their own subsidy systems for similar opportunities for reform.[3]

Ms. Hari aptly noted that, despite reforms in countries such as Indonesia and Malaysia, much of Southeast Asia still has some of the lowest pump prices in the Asia-Pacific. Although fuel subsidies have contributed to the current low pump prices, the influence of the global phenomenon of low oil prices cannot be discounted. Unless further action is taken to mitigate demand through market forces, oil demand in Southeast Asia will continue to grow at rates that undermine efforts to increase access to energy and create markets favorable for investment.

Left to right: **James Slutz,** (National Petroleum Council) moderates a session on "The Future of Energy Demand" with panelists **Jeff Appleton** (ExxonMobil Asia Pacific Pte Ltd), **Vandana Hari** (S&P Global Institute), and **James Kendall** (Asia Pacific Energy).

RECOMMENDATIONS FROM THE SUMMIT

1. **Don't pass up the opportunities afforded by low energy prices to advance reform.** As the current oil price environment provides an opportunity to strip away subsidies at a lower economic cost to the consumer, governments face lower political costs from enacting such market reforms. Thus, it is important to seize the moment and work to reform subsidy programs to transition smoothly into a more liberalized, transparent market.
2. **Assist poor populations through targeted, rather than blanket, subsidies.** Subsidies should be focused on areas where they can achieve the greatest impact. In many countries across the Asia-Pacific, subsidies targeted toward impoverished populations have the greatest potential to reduce energy poverty and improve the standard of living for a large portion of the population while minimizing market distortions.
3. **Allow market forces to work.** By reducing government subsidies and permitting national oil prices to reflect global market prices, many countries in the Asia-Pacific will receive positive market feedback. As Mr. Flaman stated, transparent markets allow for an accurate reflection of supply and demand.

Left to right: **Younwon Park** (Best Engineering in Energy Solutions, Inc.; Atomic Creative Technology, Inc.), **Nathan Flaman** (BHP Billiton), and **Mark Thurber** (Stanford University) speak in the panel, "Realities and Aspirations for Balancing Coal, Gas, and Nuclear Energy Options in the Asia-Pacific."

Endnotes

1. ADB, "Access to Energy," 2016, https://www.adb.org/sectors/energy/issues/access-energy.
2. Alexandra Stuart, "Indonesia's Energy Policy: Challenges and Opportunities," in "Indonesia: A Regional Energy Leader in Transition," NBR, NBR Special Report, no. 53, December 2015, 15, http://www.nbr.org/publications/specialreport/pdf/Free/013115/SR53_Indonesia_Dec2015.pdf.
3. Andy Nguyen, "President Jokowi's Economic and Energy Reforms: A Year in Review," NBR, October 23, 2015, http://nbr.org/research/activity.aspx?id=621.

Energy Financing and Investment

ADB FINDS THAT the Asia-Pacific will require $22.6 trillion of investment in power, transportation, telecommunications, and water sanitation infrastructure from 2016 to 2030 to accommodate growth and upgrade aging systems, as well as another $3.6 trillion to cover costs adjusted for the impacts of climate change.[1] In addition, the participating countries at COP21 highlighted that developing countries will need at least $100 billion per year in assistance to make progress toward reaching their climate targets. Dr. Zhai noted that the Asia-Pacific will only receive approximately half of this proposed total of $100 billion to mitigate and adapt to climate change. Asia's gaping deficit in energy investment could have a devastating impact on the region's ability to address energy security and environmental challenges.

Numerous sources of energy financing exist and can help bolster project viability in different ways. Summit participants highlighted several current sources of funding for energy projects:

- Governments are the primary source of funding for energy projects in Asia, as mentioned by **Lian Yok Tan**, Partner at K&L Gates. National governments across the region are investing hundreds of millions of dollars in energy generation and storage projects, such as the $400 million commitment made by the Indian government to improve grid connectivity and renewable deployment. China has also promised to provide approximately $3 billion to the South-South Cooperation initiative, which helps developing countries invest in capabilities to lower carbon emissions.[2]

Lian Yok Tan (K&L Gates LLC) discusses the important role of national governments to provide funding for energy investment projects in Asia.

VOICES OF THE SUMMIT

Just as strong policy can incentivize investment, weak or absent policy can jeopardize future plans.

- **Bambang Susantono**, Asian Development Bank

- Development banks play a crucial role. ADB is contributing $5 billion toward the overall goal of $100 billion. Yet governments and development banks cannot handle energy investment financing on their own. Dr. Zhai maintained that in order to make upward of 90% of projects viable, development banks should use their financial contributions to leverage private firms and commercial banks to help close investment gaps. **Munetaka Horiguchi**, Executive Officer for Asia and Pacific of the Japan Bank for International Cooperation (JBIC), reiterated the importance of supporting a project's fiscal soundness and explained that JBIC's primary approach is to co-finance loans with private financial institutions to encourage greater participation.

Participants at the Summit argued that the money exists, but the impact of financing depends on how it is applied—inefficient projects waste money without solving problems. Several participants maintained that project financing should be directed toward efficient electricity generation and distribution. For many developing economies in the Asia-Pacific, the governments are pressed to expand access to energy, which takes priority over clean energy development. The best investments will be those that increase access to energy through low-carbon methods.

Tony Nash (Complete Intelligence) presents remarks during the session "Closing the Investment Gap: Financing Energy and Environmental Targets."

Summit participants also noted the urgent need for a better environment and greater transparency for doing business, as these would bring more private investment to the table. Mr. Nash contended that Southeast Asia particularly struggles with fostering a transparent environment for capital. Indeed, as Minister Micah noted, key goals for Papua New Guinea are improving the stability of the country's fiscal regime and enhancing the ease of doing business. He identified several ways in which the government is working toward these goals, including streamlining national energy industries, granting the Department of Petroleum and Energy more authority so as to be more proactive, and encouraging credible developers to invest in Papua New Guinea's resources.

RECOMMENDATIONS FROM THE SUMMIT

1. **Promote Public-Private Partnerships.** By engaging public and private entities, transparent environments for financing are likely to emerge. Cooperation between large-scale banks and governments can provide assessments on reducing risk and use the power of public-private partnerships to create momentum. As Mr. Susantono commented, "just as strong policy can incentivize investment, weak or absent policy can jeopardize future plans." Policies that increase transparency and the ease of doing business heighten investor confidence. Cooperation and transparency are instrumental for all parties to succeed. Finally, reducing dependence on subsidies and allowing markets to set prices will help manage demand and stabilize markets.
2. **Increase cooperation to assess risk.** Assessing risk in the Asia-Pacific is a crucial way to work toward closing the gap in energy financing. Banks, governments, and private-public partnerships need to cooperate to develop sound investment plans. Collaborations like Mission Innovation may be useful in meeting emissions targets and attracting industry investment, but it is too early to know definitively. New organizations like the Asian Infrastructure Investment Bank should be viewed as partners rather than adversaries in working toward shared goals.

Yongping Zhai (Asian Development Bank) speaks on the need for diverse sources of financing to tackle the large-scale problem of mitigating and adapting to climate change.

Left to right: **John V. Rindlaub** (Wells Fargo; NBR Board of Directors) and **Roy D. Kamphausen** (NBR) talk before Mr. Rindlaub gives his lunchtime address.

Endnotes

1. ADB, *Meeting Asia's Infrastructure Needs* (Mandaluyong City: ADB, 2017), xi, https://www.adb.org/sites/default/files/publication/227496/special-report-infrastructure.pdf.
2. John McGarrity and Catherine Roberts, "China Pledges US$3.1bn of Climate Finance," chinadialogue, September 25, 2015, https://www.chinadialogue.net/blog/8208-China-pledges-US-3-1bn-of-climate-finance-/en.

Summit Snapshots

Left to right: **Tan Eng Chye** (National University of Singapore), **Roy D. Kamphausen** (NBR), **Ambassador Tariq Karim** (Vivekananda International Foundation; World Bank), **Li Junfeng** (National Center for Climate Change Strategy and International Cooperation; Chinese Renewable Energy Industries Association), **David K.Y. Tang** (K&L Gates LLP; NBR Board of Directors), **Peter Hughes** (Peter Hughes Advisory Limited; global gas partners gmbh), **Mikkal E. Herberg** (NBR), and **Than Min** (Ministry of Electricity and Energy, Myanmar) enjoy the gala dinner.

Left to right: **Ian Storey** (Institute of Southeast Asian Studies), **Meredith Miller** (Albright Stonebridge Group), **Satya Widya Yudha** (House of Representatives, Indonesia), and **Satya Hangga Yudha Widya Putra** (New York University) pause for a photo.

James Slutz (National Petroleum Council) reacts to comments made during the panel "The Future of Energy Demand."

Conclusion

ALTHOUGH ADDRESSING THE numerous energy and environmental security challenges facing the Asia-Pacific will not be easy to accomplish, progress can be seen in the more widespread recognition of the way forward. Significant unknowns remain, but uncertainty cannot be an excuse for avoiding action. In the face of these daunting challenges, what should governments do?

RECOMMENDATIONS FROM THE SUMMIT

1. **Look toward collaborative international policy solutions**
   - Foster collaborative approaches by viewing energy security in terms of broader prosperity
   - View climate change as a transnational challenge that requires communication among regional and global partners
   - Utilize transnational technology transfers and infrastructure development financing to reduce carbon emissions
   - View energy security as an avenue for collaboration rather than competition
   - Improve collaboration by enhancing regional forums through more inclusive high-level dialogue
2. **Avoid complacency**
   - Take advantage of the opportunities afforded by low energy prices to transition into a more liberalized, transparent market
   - Recognize that even though the COP21 agreement was encouraging, current goals alone will not prevent a temperature increase of 2° Celsius
   - Meet all INDCs as presented at COP21 in order to bring about meaningful change
   - Do not abandon previous commitments to renewables because of current low energy prices
   - Apply existing efficiency standards to ensure that all old and new investment projects are using the best available technologies
   - Recognize that one size does not fit all when determining how problems in individual countries and cities should be addressed
   - Enforce existing standards in order to reduce both costs and emissions
3. **Work now to promote market-driven policies**
   - Target fuel subsidies to more directly help poor populations and avoid the inefficient allocation of public funds
   - Delink oil and gas pricing and remove destination clauses from contracts to allow for better gas-on-gas competition
   - Introduce carbon pricing to allow low-carbon sources of energy to become more competitive
   - Enact market-driven policy tools, such as carbon taxation and trading to curb emissions
   - Allow market forces to work by increasing transparency

Looking beyond these individual recommendations, Summit participants found widespread general agreement on the goal of achieving a cleaner energy future, and this progress is worth recognizing. The more difficult task is implementing policy recommendations like those listed here. Much more effort will be needed to actually bring about positive change, as the expressed commitments will be insufficient to meet the stated goal of preventing an increase in temperature of 2° Celsius or more.

Mr. Susantono noted that both achieving the goals outlined at COP21 and pushing beyond those commitments will require dedicated collaboration across nations, sectors, and projects. Now is the time to begin implementing these policy prescriptions because low energy prices generally reduce the political and economic costs of action. Moreover, many of the policy prescriptions presented in this report are relevant for any energy price environment. Thus, the time to act is now.

4. **Diversify energy supply sources to ensure future supply security**
    - Encourage flexible policies that reduce overreliance on a particular energy source
    - Develop strategic petroleum reserves while oil prices are low to prevent future supply shortages
    - Treat "energy security" as "energy + security" by preparing for future market changes through the diversification of energy sources
    - Plan for a price band rather than a price point to ensure that national energy policies can be adapted to future changes in gas prices
    - Plan for the unexpected
5. **Promote investment and innovation**
    - Embrace innovation in order to lower long-term costs and heighten efficiency
    - Increase investment in renewables and storage technology to change the dynamics of energy markets
    - Utilize cleaner technologies, such as IGCC and CCS, to complement market-driven policies
    - Focus on smart and flexible urban planning by emphasizing sustainability at the early stages of development
    - Enhance transparency in gas markets to attract investment
    - Strengthen transportation technology and infrastructure via innovations in engines and electric vehicles as well as improvements to public transportation
6. **Promote public-private partnerships**
    - Bring together government, industry, and civil society representatives to ensure that all perspectives are heard
    - Increase cooperation among multiple groups to assess risk when making investment decisions
    - Strengthen cooperation between public and private entities to heighten transparency and reduce risk

Appendix

Agenda Overview

GALA DINNER AND DISCUSSION

Welcome and Introductions	**Roy D. KAMPHAUSEN**, *The National Bureau of Asian Research*
Remarks	**David K.Y. TANG**, *K&L Gates LLC; The National Bureau of Asian Research Board of Directors*
Discussion Facilitator	**Clara GILLISPIE**, *The National Bureau of Asian Research*

SESSION ONE

Near-Term Plenty, Long-Term Risk: Market Outlooks in an Era of Abundance

Welcome and Introductions	**Dennis C. BLAIR**, *Sasakawa Peace Foundation USA; The National Bureau of Asian Research Board of Directors*
	TAN Eng Chye, *National University of Singapore*
Moderator	**Mikkal E. HERBERG**, *The National Bureau of Asian Research University of California, San Diego*
Panelists	**Aldo FLORES-QUIROGA**, *International Energy Forum*
	Ken KOYAMA, *Institute of Energy Economics, Japan*
	Pierre NOËL, *International Institute for Strategic Studies*

Left to right: **Irshad Vaziralli** (Chevron Asia Pacific Exploration and Production), **Admiral Dennis C. Blair** (Sasakawa Peace Foundation USA; NBR Board of Directors), and **Ambassador Tariq Karim** (Vivekananda International Foundation; World Bank).

SESSION TWO

South and Southeast Asia: Emerging Giants in Global Energy Markets

Moderator	**Meredith MILLER**, *Albright Stonebridge Group; The National Bureau of Asian Research*
Panelists	**Thein LWIN,** *Commission for Assessment of Legal Affairs and Special Issues, Pyidaungsu Hluttaw (Union Parliament), Myanmar*
	Ben MICAH, *Department of Petroleum and Energy National Parliament of Papua New Guinea*
	Luluk SUMIARSO, *Indonesia Institute for Clean Energy and Climate Change*
	Irshad VAZIRALLI, *Chevron Asia Pacific Exploration and Production*

Left to right: **Thein Lwin** (Pyidaungsu Hluttaw, Myanmar's Union Parliament) and **Edwin Khew** (Sustainable Energy Association of Singapore/Institution of Engineers, Singapore) take advantage of one of the Summit's many opportunities to engage with colleagues from across the Asia-Pacific.

LUNCH

Introduction	**Roy D. KAMPHAUSEN**, *The National Bureau of Asian Research*
Remarks:	**John V. RINDLAUB**, *Wells Fargo;* *The National Bureau of Asian Research Board of Directors*

SESSION THREE

Implications of Low Oil Prices on Post Paris Climate Ambitions

Moderator	**Edwin KHEW**, *Sustainable Energy Association of Singapore;* *The Institution of Engineers, Singapore*
Panelists	**Arthur HANNA**, *Accenture*
	Younkyoo KIM, *Center for Energy Governance and Security, Hanyang University*
	LI Junfeng, *National Center for Climate Change Strategy and International Cooperation;* *Chinese Renewable Energy Industries Association*
	Satya Widya YUDHA, *Energy Commission, House of Representatives, Indonesia*

Left to right: **Ambassador Michael Michalak** (US-ASEAN Business Council Inc.) and **Roy D. Kamphausen** (NBR) enjoy lunch between panels.

ROUNDTABLE ONE

Tackling Water Insecurity for Sustainable Development

Moderator	**Mely CABALLERO-ANTHONY**, *S. Rajaratnam School of International Studies, Nanyang Technological University*
Panelists	**Tariq KARIM**, *Vivekananda International Foundation; World Bank*
	Cecilia TORTAJADA, *Institute of Water Policy, Lee Kuan Yew School of Public Policy, National University of Singapore*

Left to right: Panelists **Satya Widya Yudha** (House of Representatives, Indonesia), **Li Junfeng** (National Center for Climate Change Strategy and International Cooperation; Chinese Renewable Energy Industries Association), **Edwin Khew** (Sustainable Energy Association of Singapore; Institution of Engineers, Singapore), and **Arthur Hanna** (Accenture) are escorted by **Laura Schwartz** (NBR) to the session "Implications of Low Oil Prices on Post-Paris Climate Ambitions."

ROUNDTABLE TWO

The Road to Urbanization: Smart Cities, Efficient Transportation, and Cleaner Air

Moderator	**Clara GILLISPIE**, *The National Bureau of Asian Research*
Panelists	**Kavita GANDHI**, *Sustainable Energy Association of Singapore*
	Tao WANG, *China Business New Research Institute; Carnegie-Tsinghua Center for Global Policy*
	Fengshi WU, *S. Rajaratnam School of International Studies, Nanyang Technological University*
	Haksik YOO, *Korea Energy Economics Institute*

SESSION FOUR

The Future of Energy Demand

Introduction	**Dennis C. BLAIR**, *Sasakawa Peace Foundation USA; The National Bureau of Asian Research Board of Directors*
Featured Address	**Bambang SUSANTONO**, *Asian Development Bank*
Moderator	**James SLUTZ**, *National Petroleum Council, United States*
Panelists	**Jeff APPLETON**, *ExxonMobil Asia Pacific Pte Ltd*
	Vandana HARI, *S&P Global Institute*
	James KENDELL, *Asia Pacific Energy Research Centre*

Left to right: **Edwin Khew** (Sustainable Energy Association of Singapore/ Institution of Engineers, Singapore) and **Kavita Gandhi** (Sustainable Energy Association of Singapore).

SESSION FIVE

Realities and Aspirations for Balancing Coal, Gas, and Nuclear Energy Options in the Asia-Pacific

Moderator	**Peter HUGHES**, *Peter Hughes Energy Advisory Limited;* global gas partners gmbh
Panelists	**CHEN Weidong**, *DFS Energy Consultant (Beijing) Limited*
	Nathan FLAMAN, *BHP Billiton*
	Younwon PARK, *Best Engineering in Energy Solutions, Inc.; Atomic Creative Technology, Inc.*
	Mark THURBER, *Stanford University*

SESSION SIX

Closing the Investment Gap: Financing Energy and Environmental Targets

Moderator	**Michael MICHALAK**, *US-ASEAN Business Council, Inc.*
Panelists	**Philip ANDREWS-SPEED**, *Energy Studies Institute, National University of Singapore*
	Munetaka HORIGUCHI, *Japan Bank for International Cooperation*
	Tony NASH, *Complete Intelligence*
	Lian Tok TAN, *K&L Gates LLC*
	Yongping ZHAI, *Asian Development Bank*

Left to right: **Mely Caballero-Anthony** (Nanyang Technological University) and **Meredith Miller** (Albright Stonebridge Group) converse at the Summit's welcome reception.

CONCLUSION

Dennis C. BLAIR, *Sasakawa Peace Foundation USA; The National Bureau of Asian Research, Board of Directors*

TAN Eng Chye, *National University of Singapore*

Left to right: **Xunpeng Shi** (National University of Singapore), **Chen Weidong** (DFS Energy Consultant [Beijing] Limited), **Yongping Zhai** (Asian Development Bank), **Admiral Dennis C. Blair** (Sasakawa Peace Foundation USA; NBR Board of Directors), **Li Junfeng** (National Center for Climate Change Strategy and International Cooperation; Chinese Renewable Energy Industries Association), **Tao Wang** (CBN Research Institute; Carnegie-Tsinghua Center for Global Policy), **Yang Yifang** (CBN Research Institute), and **Siyuan Ma** (Columbia University).

Essential Readings

To inform plenary sessions and promote thought-provoking discussion during and after the event, the National Bureau of Asian Research commissioned original research engaging top experts on energy and environment policy questions.

Working Papers

Coal, Gas, or Nuclear: Asia's Inconvenient Energy Choice

Mark Thurber, *Stanford University*

This working paper considers the potential for natural gas and nuclear power to displace coal in key Asian and Pacific Rim countries and explores the policy levers that could enhance fuel switching.

The Impact of Low Oil Prices on Natural Gas and Implications for the Asia-Pacific

Shi Xunpeng, *Energy Studies Institute, National University of Singapore*

This paper examines the current prolonged period of low oil prices and assesses its effect on the natural gas sector in the Asia-Pacific.

The Role of Transportation in the Future of Urban Developing Asia: A Case Study of India

Madhav Pai, *World Resources Institute*

Srikanth Shastry, *World Resources Institute*

This paper examines the role of dominant transportation technologies in managing the mobility needs of differently sized cities in India and draws implications that are similar for other countries in developing Asia.

Left to right: **Clara Gillispie** (NBR), **Wu Fengshi** (Nanyang Technological University), and **Irshad Vaziralli** (Chevron Asia Pacific Exploration and Production) gather at the Summit's welcome reception.

Briefs

Japan's Energy Security in the Age of Low Oil Prices
Shoichi Itoh, *Institute of Energy Economics, Japan*

Prices and Politics Dim Canada's Hopes for Diversifying Its Energy Export Markets
Eva Busza and Heather Kincaide, *Asia Pacific Foundation of Canada*

China's Oil Industry Enters a New Era with the Trend of Energy Transitions
Chen Weidong, *DFS Energy Consultant (Beijing) Limited*

Indonesia's Gas Challenge: Can the Former LNG Champion Regain Its Leadership?
Donald Hertzmark, *DMP Resources*

Rethinking Energy Security in Asia under Low Oil Prices: A South Korean Perspective
Younkyoo Kim, *Hanyang University*

Additional Material

Air Pollution in Indonesia: Challenges and Imperatives for Change
Satya Widya Yudha, *Energy Commission, House of Representatives, Indonesia*

The Paris Climate Agreement: Implications for the Asia-Pacific
Sara Itagaki and Ashley Johnson, *The National Bureau of Asian Research*

Five Years since Fukushima: Revisiting the Prospects of Nuclear Energy in Japan
An Interview with Kei Shimogori, *Institute of Energy Economics, Japan*

Trade in Clean Energy: Bridging the Governance Gap
Christopher Dent and Clare Richardson-Barlow, *University of Leeds*

Rising to the Challenge of Energy Security: How the United States, India, and China Can Lead the Way
Tom Cutler, *Cutler International, LLC*
Clara Gillispie, *The National Bureau of Asian Research*

Access these publications as well as additional material on Asia's energy and environmental challenges at www.nbr.org.

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Summit Leadership

The National Bureau of Asian Research (NBR) launched the Pacific Energy Summit in 2009 with the vision to find innovative solutions to energy and environmental challenges in the Asia-Pacific. As host of the Summit, we would like to express our gratitude for the insights, contributions, and support of our core Summit leadership—our advisors, lead sponsor, partner, sponsor, supporter, collaborating institutions, and affiliates—as well as the Summit staff. We are also deeply appreciative of the moderators, panelists, and authors, who have played an integral role in developing and strengthening this year's program.

Secretariat

The National Bureau of Asian Research is a nonprofit, nonpartisan research institution dedicated to informing and strengthening policy in the Asia-Pacific. NBR conducts advanced independent research on strategic, political, economic, health, and energy issues affecting U.S. relations with Asia. Drawing upon an extensive network of the world's leading specialists and leveraging the latest technology, NBR bridges the academic, business, and policy arenas. The institution disseminates its research through briefings, publications, conferences, congressional testimony, and email forums, and by collaborating with leading institutions worldwide.

Lead Sponsor

Chevron is one of the world's leading integrated energy companies. Headquartered in San Ramon, California, the company is involved in virtually every facet of the energy industry. Chevron explores for, produces, and transports crude oil and natural gas; refines, markets, and distributes transportation fuels and lubricants; manufactures and sells petrochemicals and additives; generates power and produces geothermal energy; and develops and deploys technologies that enhance business value in every aspect of the company's operations.

Partner

Asian Development Bank (ADB) is dedicated to reducing poverty in Asia and the Pacific through inclusive economic growth, environmentally sustainable growth, and regional integration. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Its main instruments for helping developing member countries are policy dialogues, loans, equity investments, guarantees, grants, and technical assistance. Established in 1966, ADB in December 2016 will mark 50 years of development partnership in the region. It is owned by 67 members, with the United States and Japan serving as its largest shareholders. In 2015, ADB assistance totaled $27.2 billion, including $10.7 billion in co-financing. It is based in Manila.

Sponsor

ExxonMobil is the world's largest publicly traded international oil and gas company, holding an industry-leading inventory of global oil and gas resources. It is the world's largest refiner and marketer of petroleum products, and its chemical company ranks among the world's largest. ExxonMobil applies science and innovation to find better, safer, and cleaner ways to deliver the energy the world needs.

Supporter

The Sustainable Energy Association of Singapore (SEAS) represents the interests of and provides a common platform for companies focused on renewable energy, energy efficiency, carbon management, e-mobility, and smart grids to meet with financial institutions to discuss, collaborate, and undertake viable projects together. SEAS is a nonprofit, nongovernmental business association, and its mission is to assist its members in achieving sustainable growth locally and regionally through business and market development. It plays a strategic role in supporting and promoting Singapore's vision to be a global center for sustainable energy, where products and solutions are developed and exported.

Collaborating Institutions

The Center for Energy Governance and Security (EGS) of Hanyang University conducts dynamic research on today's global energy issues while bringing together groups of energy experts from the United States and major countries in the Asia-Pacific (including South Korea, China, Japan, Singapore, and Australia). Building upon its comprehensive network base from all three sectors (government, business, and academia), EGS looks to actively explore and discuss global energy governance, energy security, and other issues of significance to the Asia-Pacific region.

The Energy Studies Institute (ESI) at the National University of Singapore was established in 2007 with the aim of conducting policy-related research regarding energy issues of regional and global significance, particularly in relation to Singapore and the ASEAN region. Its quarterly publication, the ESI Bulletin on Energy Trends and Development, serves to inform its readers about current energy-related issues. In the 2015 Global Go To Think Tank Index Report, ESI was ranked 8th in the Energy and Resource Policy Think Tanks category.

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For more information about the Pacific Energy Summit, please contact the Summit Secretariat at pacificenergy@nbr.org or visit www.pacificenergysummit.org.

NBR's Trade, Economic, and Energy Affairs Group

Fostering collaborative solutions to shared challenges in the Asia-Pacific

NBR's Trade, Economic, and Energy Affairs Group collaborates with a broad range of U.S. and Asian specialists from industry, research, and policy to conduct innovative research and convene high-level dialogues. Guided by an in-house research team and a select group of senior advisors, the group's research focuses on three broad areas: (1) energy security and policy, (2) energy and the environment, and (3) trade, investment, and economic engagement. Highlighted initiatives include:

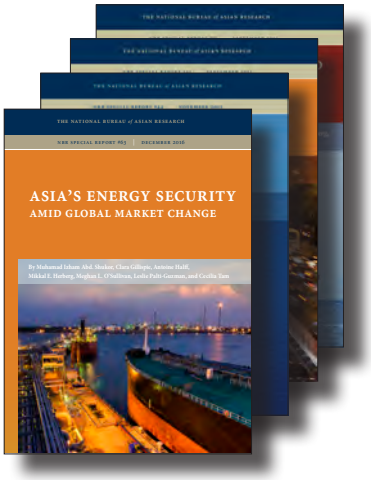
Pacific Energy Summit

As economies in the Asia-Pacific region continue to grow at astonishing rates, the Pacific Energy Summit aims to foster economic and energy security in the Asia-Pacific by developing practical solutions to the dual challenges of rising energy demand and global climate change. The annual, invitation-only Summit convenes 200 global leaders to articulate practical and tenable policy solutions to energy and environmental challenges.

PACIFIC
ENERGY SUMMIT

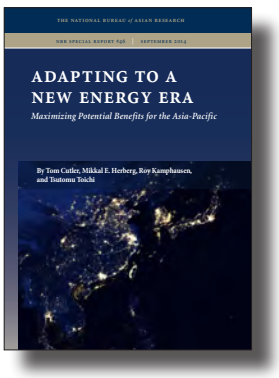
Energy Security Program

Dramatic developments are taking place in Asian energy markets, and these changes will affect the geopolitical situation in the Asia-Pacific region. Rising demand has led to increasing dependence on energy imports and a growing sense of energy insecurity among the major Asian powers. To address these issues, this initiative convenes senior policy and industry leaders and Asia energy specialists from across the region for high-level discussions on Asia's energy policies and their geopolitical implications. Experts share insights and recommendations through an invitation-only spring workshop; NBR's annual Energy Security Report, which compiles expert essays on each year's specific topic; and a public fall launch event.



Adapting to a New Energy Era

An unexpected boom in U.S. and Canadian production of shale gas and tight oil has accelerated an already steady decline in U.S. imports of Middle East oil and gas. At the same time, China, Japan, and the rest of Asia have emerged as major importers of oil and natural gas from the Persian Gulf. This initiative aims to provide in-depth and academically rigorous research into how the United States, Japan, and other countries can craft stronger diplomatic, strategic, and economic tools to support common energy security interests.



NBR does a terrific job at getting great people, with great ideas, and making it into a process of dialogue and interaction that leads to recommendations that are very useful in the policymaking process.

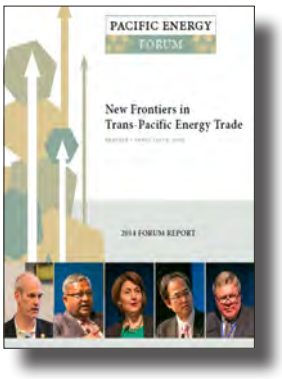
- **Robert Hormats**, Former Under Secretary of State for Economic Growth, Energy, and the Environment, Department of State, United States

Innovation and IP Policy

Economies in the Asia-Pacific have shown unprecedented growth rates in recent years, and the United States aims to engage with the many burgeoning economies in the region. As India, China, and others work to further develop their economies, intellectual property and innovation policies have increasingly appeared in national and international discussions. To assess these key issues, NBR has developed projects looking at intellectual property protection and innovation policy development in the Asia-Pacific and how emerging players in the region continue to shape global discourse on the future of these policies.

Pacific Energy Forum

Broad and fundamental global energy shifts, along with rapidly evolving technologies and capabilities, suggest that Asia and North America need to fundamentally reconsider their current energy relationship. The Pacific Energy Forum gathers experts and leaders from Asia, the United States, and Canada to assess the key policy questions that will shape the future trans-Pacific energy relationship and enhance energy and environmental cooperation among key actors in the region.



For more information on these programs, please contact Clara Gillispie, Senior Director, Trade, Economic, and Energy Affairs, at pacificenergy@nbr.org.

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