CSCAP Study Group on Energy Security in the Asia-Pacific Region
Singapore, October 26-27 2015
Co-Chairs' Report

1. Study Group Mandate

The perpetuation of the Asia-Pacific's tremendous economic growth is contingent primarily on the price of economic inputs, most of all energy. Asian countries are consuming increasingly vast amounts of energy every year, which, due to the region's relative poverty in primary energy sources, is met with imported supplies. According to British Petroleum, in 2014 the Asia-Pacific region accounted for 41.3 percent of global primary energy consumption, but had only 2.5 percent of global oil reserves and 8.2 percent of global natural gas reserves. As a consequence, the region must diversify the sources of its energy supply.

This CSCAP Study Group was charged with focusing on the regulatory, political and economic risks and challenges associated with diversifying the energy mix and broadening the range of energy suppliers. Where is the region, in a word, heading in terms of the diversification of its energy mix? What promise does nuclear energy hold? How can renewable energy sources be developed given their cost relative to hydrocarbon alternatives? What will be the impact of new sources of supply amidst the changing energy landscape in North America, and the role of new sources of supply? The key goal, in this discussion, has been to consider the regulatory, safety and risk challenges associated with Asia's emerging energy mix.

The report proceeds with an overview of the first two meetings for background information, and then provides a detailed account of the third meeting and outcomes. This is not a consensus document and therefore does not necessarily reflect the opinions and inputs of all Member Committees.

2. Previous Meetings

Meeting One: 15-16 December 2014, Singapore

a) The State of Energy Security in the Asia-Pacific

Since the last CSCAP Study Group on Energy Security, the Asia-Pacific region has experienced four key developments: 1) political and economic changes; 2) short term changes in China's energy mix; 3) the US's energy independence and its impact on Asia; and 4) China's energy development strategy action plan. 70 percent of the increase in global energy demand is from developing countries. China and emerging economies need to transition and reform their export and investment driven growth models, which will also impact global energy demand. China is optimizing its energy structure by moving away from coal and oil and towards other sources such as natural

gas and renewables. However, its oil imports and energy demands will still increase due to growth. Climate change cooperation between China and the US is important as both combined contribute 45 percent of global emissions.

Growing recognition of the impact of pollution will drive regional energy policies. Concerted efforts and government policies are needed to continue pursuing renewable energy development. The negative impact of energy policies on poor and local communities will also need to be mitigated. A regional energy market needs mechanisms preventing corruption, maintaining standards and mitigating negative impacts on local communities. There is a need to share information and knowledge, with an emphasis on transparency, especially on energy efficiency and technology. National policies will also need to be harmonized. Domestic changes in energy policies reflect the significant shifts in regional dynamics away from old energy geopolitics to a more cooperative arrangement.

b) The Changing Energy Landscape

Two main challenges were identified: different economies having different priorities, energy mixes and trade-offs; and the requirement for both inter and intra-regional cooperation. The level of economic development confers different priorities and access to fuel sources. Energy security is a multi-faceted dilemma, too complex for one country to manage itself, and will not be addressed by pursuing energy independence. Natural gas is a bridge fossil fuel source for energy generation while oil is mainly used for transport and rural micro-grids. India is looking at liquefied natural gas, small to medium hydroelectric, solar and wind for energy generation, with a 40:60 distribution goal of hydroelectric and thermal energy mix. The current government is focusing mainly on developing renewable energy sources with a dedicated ministry. However, India's energy mix will remain import-dependent regardless of renewable sources, but it is moving towards more stable sources. India is also pursuing nuclear options. The US-China climate deal will create political pressure on India to also undertake similar action. A more transparent, equitable, multilateral structure along with commitment to financial regulation and financial and technical assistance is required for regional energy integration.

Energy policies face a trilemma consisting of security, affordability and sustainability. The public desires clean energy sources but is unwilling to pay for such options. Removing subsidies on fossil fuels can make renewable energy more attractive. While natural gas is being promoted as a cleaner bridge fuel, some studies have raised questions on emissions and environmental impact. Trade-offs need to be properly observed, as there is no other energy source except oil for transportation, while energy generation can have a diverse mix. Electricity and heating only consume a small fraction of energy usage whereas industry, transportation and petrochemical industries contribute a large component of emissions. The economy will be a guiding point for energy security. Technological exporters are using cleaner technologies at home but exporting polluting energy sources abroad. Coal being cheap and accessible makes it the first contingency energy source for Northeast Asia. The energy mix should also include energy saving technologies that reduce demand.

c) The Challenges of Renewable Energy

Renewable energy has a low energy density, which means its power production is lower and more diffused than that of convention sources such as oil, gas and coal. For

instance, to produce 5.5 hours of sunshine per day for a year from a solar-PV, it requires 1,800 sq km of panel area or 2.5 times of Singapore's area. A class 4 wind farm with wind speed of 5.5 miles per hour needs 180 sq km, equivalent to 25% of Singapore's area. Dr Choi recommended massive technological improvement to sustain a "net gain" for renewable energy.

Another major challenge is the high capital cost. Renewable energy involves massive upfront capital costs in terms of money, materials and energy. To address this, government policies should support renewable energy development with explicit subsidies such as feed-in tariffs, quota obligations, energy tax exemptions, and tax holidays. Increasing carbon taxes on fossil fuels may be one strategy to make renewables relatively cheaper than fossil fuels. Also, R&D is crucial to find ways in lowering the capital costs of deploying renewables.

Renewable energy also has low energy return on investment (EROI), i.e., the ratio of the amount of energy put into energy production and the amount of energy being produced. For all energy sources, consuming energy to produce energy is unavoidable. But in the case of most renewables, the amount of energy needed is much higher than the power generated. Nonetheless, the solar PV industry has been a net electricity provider since 2012 and will "pay back" the electrical energy required for its early growth before 2020 through technological improvement.

Other challenges to massive deployment of renewables in ASEAN include lack of appropriate technology to deal with disasters, limited technical capacity to manage complex grid integration problems, non-existent or weak regulatory and policy frameworks, difficulties with land acquisition, and lack of private sector investments. Nonetheless, renewable energy is projected to have a bigger share in the global energy mix primarily due to global commitment to reduce carbon emissions. Renewables and nuclear are the only two energy sources which do not emit (or have very little) GHG. It is essential to develop synergetic mechanisms between the two to ensure a low/zero carbon energy world.

d) The Future of Nuclear Energy After Fukushima

Prof Tadahiro Katsuta first presented an overview of the aftermath of the Fukushima accident including its impact on nuclear security, safety and safeguards (3S). Four major problems are yet to be resolved by both the Japanese government and Tokyo Electric Power Corporation (TEPCO). Firstly, both the seawater near the affected reactors and the underground freshwater are still contaminated and proposed solutions did not yield positive outcomes. For instance, the radioactivity removal system for the use of contaminated water has constantly experienced problems. The impervious wall, which was built using public funds worth US$3.2 billion, is deemed to be a failure. Secondly, the decommissioning of crippled reactors will take 30-40 years. Thirdly, the evacuation of affected residents has to be prolonged as radiation levels in Fukushima's "difficult-to-remain-zone" remain high. As of 2014, the number of "nuclear plant accident-related deaths" (deaths associated with evacuation) in Fukushima has reached 1,700. Already more than 50 people have committed suicide. Lastly, the interim storage and final disposal of radioactive waste have yet to be determined.

Japan has adopted various safety measures in response to the accident. The Atomic Energy Law was revised in 2012 to enhance safety measures. An independent Nuclear Regulatory Authority was established to ensure effective implementation of a new

safety standard for nuclear power plants, including strengthened NPP design standards and operators' emergency protocols. As of now, 17 NPPs have already applied for safety evaluation to determine their compliance to the new safety regulations. However, there are other safety issues that have not been fully addressed. No plant design evaluation was conducted. There is no established method for assessing the possible consequences of disaster-induced nuclear accidents. And more importantly, a joint evacuation plan between local and national governments in Japan is yet to be established.

Northeast Asian states have already begun addressing the need to jointly deal with future nuclear crises through regional mechanisms. Japan, China and South Korea regularly conduct nuclear regulators meetings to discuss information exchange, emergency drills, and implementation of regional cooperation programmes. This kind of regional cooperation may be emulated elsewhere, including ASEAN, to facilitate effective regional coordination in addressing trans-boundary effects of nuclear accidents.

e) Strengthening Regional and Global Energy Cooperation

The Fukushima disaster led to a greater commitment to nuclear safety, security and safeguards in Southeast Asian states. Gaps in the nuclear cycle undermine growth of the nuclear industry. These include trade-offs and the credibility of the Environmental Impact Assessment during construction, health implications, transparency of ensuring standards, and a lack of investment in facilities to handle waste. ASEANTOM is the primary regional platform for regional nuclear security and energy cooperation. Asia is rich in both renewable and non-renewable energy sources which are unevenly distributed. This creates opportunities for trade and regional cooperation but such efforts are facing barriers. ASEAN's policy of non-interference poses difficulties to implement regional policies at the national level. Energy, economic and environmental analyses of energy policies also need to include social implications. Data and information required for regional cooperation needs to be identified. The quality and timeliness of the data is also crucial. Transparency is important to assure neighbours if a state pursues nuclear power generation.

Japan, South Korea and the US face difficulties in spent fuel management. Studies on multilateral cooperation for spent-fuel management have been failures with disagreements on specific concepts. Reprocessing and recycling may be a future option but states will get access to sensitive technology for creating nuclear weapons. The three fields to enhance regional energy cooperation are supply and demand, accommodating local communities, and energy governance. ASEAN energy market integration, such as the ASEAN power grid, will promote energy security cooperation. Energy security contains two different components – security of supply and security of the system. The European Coal and Steel Community can serve as a model of energy cooperation in Asia. Northeast Asia's approach to managing spent fuel can serve as good learning examples for Southeast Asia. The Bataan Nuclear Power Plant serves as a good example of issues concerning nuclear power plant site selection. Other issues include construction and operating costs and training. The existing regional rice database can serve as an example of a data-sharing mechanism for energy.

Meeting Two: 14-17 June 2015, Beijing, China

Hosted by CSCAP China and the China Institute for International Studies, the second meeting focused on five critical issues of regional energy security: nuclear energy in East Asia, including some countries in ASEAN; introduction of more renewable energy sources; challenges to information-sharing; challenges to building greater interconnectivity; and the modalities for building a regional energy security architecture including the issue of leadership.

a) Capacity Building on Infrastructure Construction

Regional actors must address the challenge of increasing inter-connectivity at both the sub-regional and regional levels in order to meet future energy needs. This entails mapping out the series of financial, policy, and political challenges to enable long-term policy planning by states in the region.

There have been new oil pipeline projects between Russia and Northeast Asia and growing cross-border power trade in the Mekong region. But little has been done to build greater interconnectivity in the Asia-Pacific, first at the sub regional level, then moving to the full region. Interconnectivity also encompasses collaboration in physical infrastructure, policy coordination, financial integration, and market and trade cooperation. The role of the Asian Infrastructure Investment Bank in contributing to interconnectivity was also highlighted as a way forward.

Key barriers to investments in energy infrastructure include: long permit granting procedures; different national regulations; budget constraints; lack of finance; consumer unwillingness to pay increased prices in low-price zones; and public acceptance to certain infrastructure projects (e.g. NIMBY). Transmission capacity is a key foundation for integrated market development. Different regulatory regimes, transmission rules and tariff systems as well as different stages in national energy market liberalisation processes will influence energy cooperation.

b) Information Sharing

The group emphasised that energy security in the region is no longer just about the affordability of energy sources and security of supply routes/sea lanes. Any discussion on energy security should now consider emerging trends such as the advent of new technology in tapping unconventional oil and gas such as shale gas, environmental concerns, climate change and the decline of geopolitical considerations. A conceptual framework could address the multidimensional issues on energy security that encompass global issues such as climate change; transnational issues that relate to interconnectivity and transboundary effects, for instance, of nuclear accidents; and the impact on local communities. Energy security should not just be state-centric but should now address human security issues. A new working definition of energy security needs to go beyond the traditional notions of availability, affordability and reliability.

A country's energy security will improve if it is dealt with in a more inter-linked, holistic and interdisciplinary manner. Improved accessibility and transparency of information can lead to increased awareness and participation of stakeholders. There are governance gaps in the Asia-Pacific when it comes to a regional approach to energy security. The ASEAN Regional Forum and other institutions must develop the

institutional platforms necessary to increase regional cooperation on matters of energy security.

Regional centres of excellence on energy security should be established. Such institutions now exist at the national level, where developments related to the changing energy landscape in the Asia-Pacific region are studied. There should be more cooperation between existing centres, which in turn should lead to the creation of sub-regional and regional centres. The issue of information and knowledge sharing should be part of the discussion in creating these centres, and the development of regional crisis response centres could also be included.

c) Energy Management

While the group reiterated that it does not endorse the use of any particular energy source, it also recognised that the region is increasingly considering nuclear energy sources in addition to renewables as states try to address growing domestic demand for energy while reducing carbon emissions. Both the suppliers and the market for nuclear technology are now dominated by Asian states. China is set to open more nuclear reactors while some ASEAN countries such as Vietnam and Malaysia are keen to add nuclear energy into the energy mix in order to diversify their energy sources.

However, there are numerous drawbacks to nuclear energy. It is often associated with problems such as nuclear weapons proliferation, reactor accidents and waste disposal. One major issue for nuclear energy is the management of spent fuel due to the absence of final disposal sites. Temporary solutions have been adopted, posing challenges to global nuclear security and safeguards. Nuclear reactors are characterised by strong local opposition, long lead times, substantial security requirements and perceptions of high risk, all of which affect the deployment of nuclear energy to some regions.

In the context of Southeast Asia, where some countries have strong interest in nuclear power, the development of nuclear power plants will introduce a range of new opportunities and problems. A comprehensive policy for each country entering the radioactive material produce life cycle must include the ability to create and maintain safe harbours, overland transportation, and storage and disposal facilities. The by-products of NPP generate potential hazards. In addition to the potential environmental risks associated with NPPs, there is a risk of non-state actors or terrorist organisations gaining access to NPP by-products such as highly enriched uranium and plutonium which could be used to create weapons of mass destruction.

Several critical infrastructure issues need to be adequately addressed by any country interested in developing nuclear power. In Southeast Asia, Vietnam, which has the most advanced NPP plan in the region, is yet to implement a framework on regulatory independence and its regulatory body is only ‘partly independent’ as it remains under the Ministry of Science and Technology. Despite not having control over NPP construction and operation licenses, the ministry is the chief promoter of nuclear energy. Additionally, Vietnam, Malaysia and Indonesia still need to pass domestic laws to effectively implement and comply with IAEA conventions on nuclear safety and emergency preparedness for nuclear accidents. For some anti-nuclear experts, the interminable radioactive nuclear waste is cited as a primary reason why ASEAN states should reject nuclear power.

Another issue that arises is the need for an experienced nuclear workforce. There is a significant need for educating young people and enhancing the skills of older professionals in the nuclear field, particularly in nuclear safety and security. It was emphasized that as some ASEAN countries plan to pursue nuclear power, they need to create and maintain a pool of local nuclear professionals with relevant experience in the nuclear industry. Furthermore, well-trained and experienced nuclear professionals are crucial to institutionalising competent and independent regulatory bodies. However, the region still does not have sufficient human resources to safely operate its future NPPs.

Like nuclear energy, renewables can help minimise carbon emissions and are now making inroads into the Asia-Pacific. Renewable energy is ubiquitous, available nearly everywhere in vast quantities and is sustainable. It entails commonly available sources such as solar, wind and hydropower; has minimal security and military risks; and has tolerable environmental impact over unlimited time scales. The highly dispersed location of renewable energy sources entails a robust and resilient energy system with limited utility for warfare and terrorist activity. Compared to fossil-fuel-based electricity generation, renewable energy technologies offer a major advantage in lower emissions of carbon dioxide and other greenhouse gases. In addition, all forms of renewable electricity production are expected to have significantly lower life cycle greenhouse gas emissions than electricity production from conventional coal and natural gas plants. Unlike with nuclear energy, public acceptance for renewables is generally high. Both the risk and consequences of transboundary accidents are very low compared with fossil fuels and nuclear power generation. Nevertheless, in the context of environmental protection, there is still a need to discuss the cross border effects of some renewables such as large hydropower projects. It remains uncertain as to how the region can proceed towards tapping more renewable energy sources. Major issues include challenges for renewables to be reliable sources of base-load power, the lack of subsidies for investments in renewables, and untapped renewable energy potentials in the region.

d) Moving Towards Efficient Mechanisms

Market forces are the best guarantee for shared energy security. There is a need for multiple energy sources and suppliers, competition, and free market prices. Elements for energy security also include infrastructure security, regulatory cooperation, and information sharing. China's gas pricing has the potential to help reduce the "Asia premium" and lead to greater energy security in the Asia Pacific.

Asia's energy security is undermined by fractured energy markets. The Asian energy market lacks inter-connectivity, competitive supply sources, compatible standards, coordination, and the ability to safeguard key shipping lanes and pipeline routes.

3. Meeting Three

The third and final meeting of the CSCAP Study Group on Energy Security in the Asia-Pacific Region met in Singapore on 26-27 October 2015, co-chaired by Mr Kwa Chong Guan (CSCAP Singapore) and Madam Wang Haihan (CSCAP China).[1] The meeting included 21 participants from eight CSCAP member committees as well as local experts, and was opened with a keynote address delivered by Dr Olli Heinonen, Senior

[1] CSCAP Canada co-chair Pierre Lizee conveyed his sincere apologies that he was unable to join the meeting.

Fellow at the Harvard University Belfer Centre for Science and International Affairs and former Deputy Director-General for Safeguards at the International Atomic Energy Agency (see Annex A). The Study Group built upon the first two meetings by introducing an interactive scenario planning exercise to generate two scenarios on the implications of the region's future energy mix and the potential to advance energy security through regional cooperation. Participants completed a daylong scenario planning exercise, guided by representatives from the Risk Assessment and Horizon Scanning office, National Security Coordination Secretariat, Singapore.[2] Based on these future scenarios, participants spent day two deliberating on policy options to bring about positive futures for regional energy security and measures to avoid negative futures.

Scenario Methodology

Scenario planning is a methodology that takes into account the uncertainty of future events and how to best plan and respond to them *today*. It is not predictive, but rather suggests narratives about the future and how to facilitate positive outcomes while mitigating the impact of negative scenarios. The future of regional energy security and the energy mix is inherently uncertain. How regional states act today, however, can help bring about positive future realities. This CSCAP Study Group meeting thus sought to use scenario planning methodology to gain a greater understanding about future scenarios of regional energy security and the energy mix, the impact of these scenarios, and what states should do to attain positive future scenarios while mitigating the impact of negative scenarios.

Scenario planning first determines the single most salient issue and the two most impactful and uncertain drivers that will shape the issue and its impact. In the Study Group context, issues are trends that affect regional energy security and the energy mix (e.g. investment in renewable technologies), and drivers are the security, technological, economic, environmental, political, and social forces that influence the trajectory and impact of the issue (e.g. national technology transfer legislation). With the two most important drivers for an issue, scenarios are built on a 2x2 axis, leading to four scenarios, each with a different arrangement of the two drivers. These four scenarios are created as 'narratives' about the future of the issue. Based on these narratives, policy recommendations can be made to bring about the positive scenarios and mitigate negative scenarios.

Recognizing the overarching goal as creating scenarios to address the future of regional energy security and the energy mix, it was determined that successful scenarios would have to include specifics about the energy mix. To achieve this, the exercise began with four track groups to discuss relevant topics that will significantly impact the region's energy mix. The four groups included 1) Nuclear energy; 2) Renewables; 3) Oil, coal, and gas; and 4) Unconventional sources (e.g., shale gas). The generation and discussion of issues was completed using the RAHS' online programme, Project Wikisense, as a way to track issues and collate responses. After the online issue generation stage, participants met in their respective track groups. Each track group determined the single most salient issue for their topic, and then deliberated on the key drivers. A set of guiding questions, derived from the Study Group's previous meetings, was provided to each track group to focus issue generation and driver development:

[2] For more information, see http://www.rahs.gov.sg/public/www/home.aspx

- Nuclear track: 1) Do we accept an inevitable turn to nuclear energy as a coming mainstay of our energy needs? 2) If so, what are the consequences for regional security of this turn to nuclear? 3) What are the prospects for implementing regional nuclear safeguards and security regimes to deal with (a) accidental leak of nuclear radioactivity (i.e. nuclear plant accident); (b) storage and disposal of spent fuel and other issues regarding the back-end of the nuclear fuel cycle?
- Oil/Coal/Gas track: 1) Will we continue to be heavily dependent upon fossil fuels/hydrocarbons as a principal source of our growing energy needs? 2) Is mitigating the CO2 footprint and its negative environmental impact by reducing dependence on hydrocarbons a regional security issue our Study Group should deliberate? If so, how?
- Renewables track: 1) What are the challenges to increasing the share of renewables in the national/regional energy mixes? 2) What are the prospects/options/alternatives for joint development of renewable energy sources?
- Unconventional track: 1) What are the prospects for joint R&D/investments in the development of unconventional energy sources? 2) What are the environmental and public health implications of hydraulic fracking?

Nuclear Energy

The nuclear energy group identified the main issue as regional nuclear safety as a precondition for implementing nuclear power production into the ASEAN region. The first driver identified was the level of independence in nuclear energy regulatory frameworks, and the second driver was human resource development, including competent operators, and technically knowledgeable personnel and supportive management systems.

Group summary: Recognizing that the ASEAN region will have nuclear power plants in the next decade, the group unanimously agreed that the main issue associated with nuclear power would be the safe operation of the nuclear power plants. Given the proximity of countries in the region, the risk of another Fukushima nuclear accident would be devastating not only economically, but also to the wellbeing of populations in the region. The group further realized that to reduce the risk of nuclear accident, an independent regulatory framework (such as that pursued by ASEANATOM) and human resources including competent operators would be essential.

Renewables

The renewable energy group identified the main issue as levels of investment in renewables. The first driver identified was technology capacity and transfer, such as education programs, joint ventures, and infrastructure for production and transportation. The second driver was legislation/incentives for investment security, such as open markets, long-term and predictable legislation for renewables capacity/generation such as goals and target setting, full cost pricing of conventional sources, and financial incentives for renewable energy sources.

Group Summary: Recognizing diversification of the regional energy mix as a necessary trajectory, the group agreed that the success or failure of diversification would largely depend on investment in renewable sources. There is a strong need to actualize potential renewable energy sources, such as solar, on/offshore wind, bio-gas and bio-diesel, and geothermal. This will be largely dependent on having the necessary technologies in

place to benefit from these diverse sources, requiring investment in education, joint ventures, and necessary infrastructure. At the same time, these investments will require supportive legislation and incentives at the national level.

Conventional Sources
The conventional energy sources group identified the main issue as the region's reliance on, and overconsumption of coal as an energy source. The first driver identified was the future price of coal, and the second was regional development and implementation of clean coal technologies.

Group Summary: In the Asia Pacific region, coal is widely used to the point of overconsumption. The overconsumption of coal requires that the region address its ability (or inability) to move towards a more diverse energy mix. It also has a significant environmental impact on the region. To address this, the region should work to create more readily available and economically viable clean coal technologies to mitigate the environmental impact. To address overconsumption, there would need to be a rebalance in coal pricing to reduce coal use and thereby diversify the energy mix with renewable energy sources.

Unconventional sources
The unconventional energy sources group identified the main issue as the need for a diverse regional energy mix. The first driver identified was the cost of technology for diversifying the energy mix, and the second driver was public concern over environmental and social implications.

Group Summary: For the region to sustain its economic and social development, the states in the region have to diversify their energy sources. Recent technology development in the shale gas industry in the US is seen as an alternative to conventional energy sources due to its availability, especially in Canada, Europe, Asia and Australia. However, the choice of this technology is largely driven by two factors. Developing unconventional energy sources is primarily dependent on the cost competitiveness of the technology. The readiness of the Asia Pacific region in embracing unconventional resources is hampered by technical and technology capability in the development process. Large investments and technology transfers in hydraulic fracking are required to boost the production of shale gas, especially in China where huge reserves are located. Second, the environmental and social implications are controversial in shale gas explorations. The externalities of shale gas are yet to be internalized through Life Cycle Impact Assessment in order for countries to truly reap the benefits of shale gas. Only through stringent regulations can shale gas be a potentially sound environmental option.

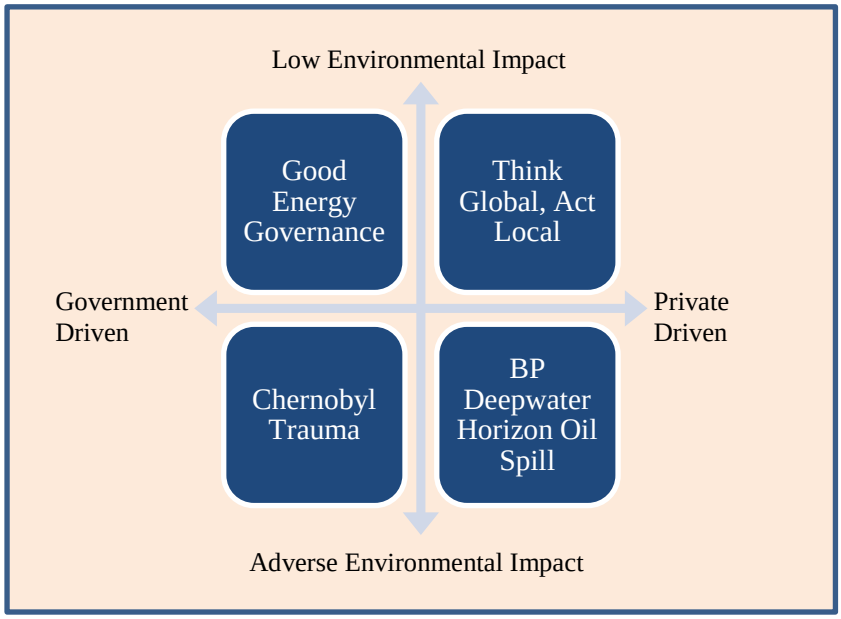
Constructing Scenarios
Once each track group determined one main issue and the two most impactful drivers, participants re-organized into four 'mixed groups,' where one member of each track group shared the top two drivers of their respective track. Bringing together representatives from each track, these mixed groups built comprehensive scenarios for regional energy security, cooperation, and the energy mix without being confined to any one technology or energy source. With participants from each of the four tracks, the mixed groups began with eight drivers, and reworked them into the two most impactful and uncertain drivers that could take into account the four main topics and regional energy security more generally. A guiding prompt was provided to direct the groups

from issue-specific considerations to more broad based ideas to support policy recommendations:

> What are future scenarios for regional energy security and the energy mix, and what are tangible policy options to move the region towards cooperation in the energy mix? What is the fall-out/consequence for regional security – both traditional and non-traditional – of our evolving national energy matrix/choices?

The mixed groups proceeded with a 2x2 axis scenario building process to identify how the drivers would impact regional energy security and the potential for regional cooperation in the energy mix over a ten-year period. Each group created four scenarios in narrative form, and presented the top two to the entire group.*

Group A



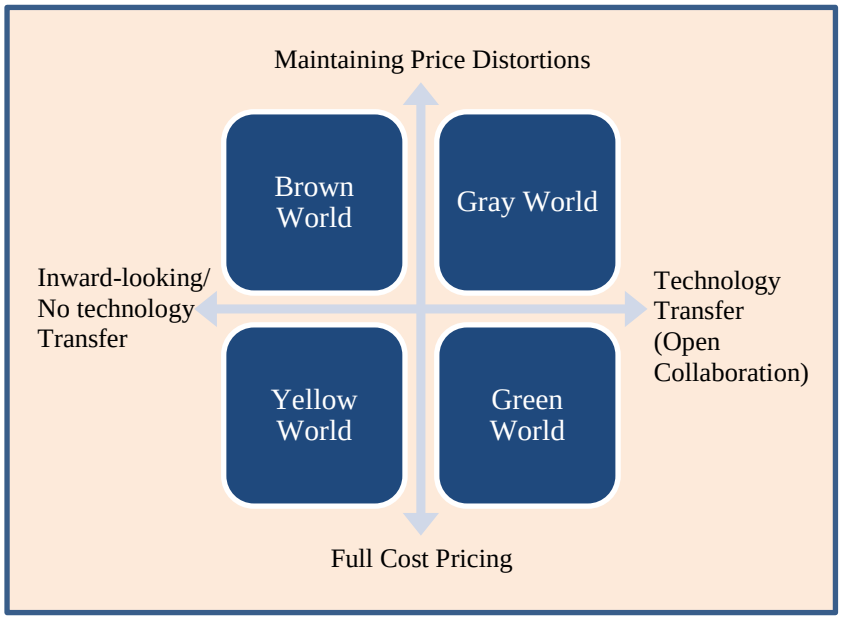
**Good Energy Governance:* Energy management is driven mainly by the state or state own enterprises (SOEs). Fiscal instruments such as carbon tax and tax exemption are employed to incentivize the development of alternative energies. There is high compliance with international regulatory frameworks. National energy development prioritizes energy access for all.

**Think Global and Act Local*: Market instruments such as carbon trading scheme (EUTS) is used to leverage the carbon emission between countries. CDM allows technology transfer (renewable energies) and capacity building from developed to developing countries. At the local level, decentralized energy systems are developed for community-based consumption. Cooperation exists between the government and private sector to develop new energy technologies such as battery and clean coal technology or small reactors, as well as synergies of nuclear and renewables.

Chernobyl Trauma: Due to the lack of transparency and access to information from the government and no explicit protocol, the system is weak in compliance. The patronage system enables cronyism and a lack of accountability and enforcement. The energy dead lock occurs as subsidies prevail and incur high energy consumption. There is no incentive for new technology development.

BP Deepwater Horizon Oil Spill: This profit driven energy market is operating with low credentials and a lack of regulatory frameworks. The incumbents are resistant to any niche energy development such as renewables. There is a huge gap of cost competitiveness of alternative energies. Investments in R&D are focused on discovery and exploration rather than environmental concerns.

Group B



Brown World: Price distortions (e.g., fossil fuel subsidies) prevail while technology transfer across the region is limited. This benefits carbon-intensive fossil fuels. In particular, coal will continue to play a dominant role in the energy mix. Resulting environmental and public health problems destabilise societies and governments. There is limited potential for shale gas and renewables, nuclear safety suffers from national approaches. This scenario scores worst in reducing carbon emissions. It is the most optimistic for coal (without CCS). Nuclear and renewables are of medium importance.

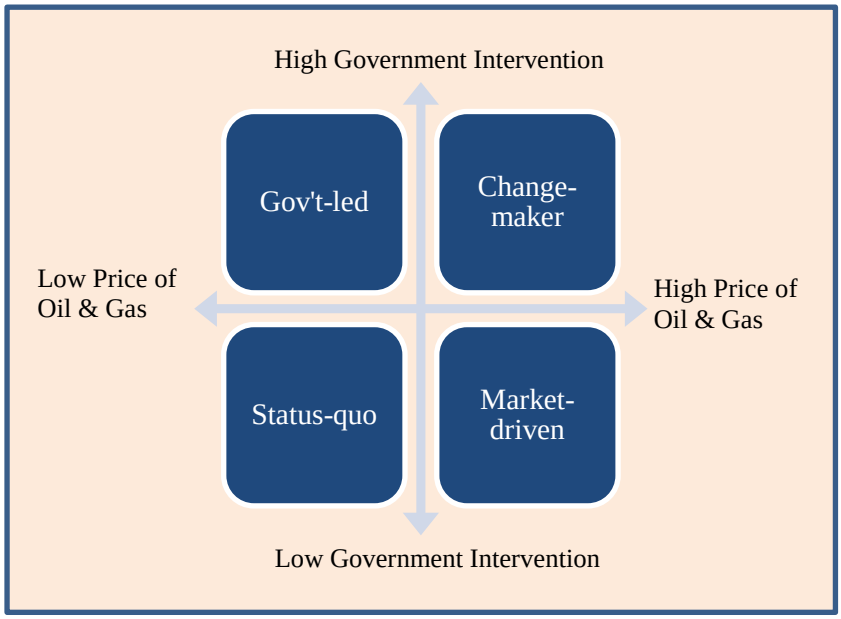
**Grey World*: Price distortions prevail but in an open market with high-levels of technology transfer between countries in the region. Traditional fossil fuels will remain important but due to transfer of new technologies, shale gas and nuclear energy will become more important in the energy mix. This effect is more pronounced for shale gas due to the lack of carbon pricing. Environmental problems will not decrease significantly and transboundary problems will continue to pose a security threat (e.g., environmental security and health security), possibly affecting bilateral relations. This scenario is the most beneficial for nuclear and shale gas. Coal will remain important (without CCS) at the expense of the environment. The scenario does not offer much improvement for renewables and large GHG reductions.

Yellow World: There is little technology transfer, but a high degree of full cost pricing by internalizing externalities (e.g., through emissions trading scheme and/or phasing out of fossil fuel subsidies). The result is limited environmental improvements, in particular through the development of decentralised and mostly regional renewable energy sources. There will be low CCS development and the share of coal will decrease due to rising prices. National approaches to nuclear safety will lead to lower penetration of

nuclear power, and shale gas scores the worst in this scenario. Energy prices are likely to increase significantly.

**Green World*: Full cost pricing together with open markets lead to a strong transition from dirty/fossil fuels to clean energy and low-carbon energy sources. New and cheaper renewable technologies will boom, but nuclear will also become more competitive compared to fossil fuels. Without the development of CCS, coal will be under significant pressure. However, chances for CCS development are of the highest of all scenarios, and the role of shale gas will increase. This is the scenario with the lowest CO2 footprint. Regional governments pay more attention to energy security collaboration to improve regional relationships.

Group C



**Government-led*: Government regulation is high while the market prices of oil are low. Because of low oil prices, there is no incentive for investment in alternative sources of energy such as shale gas, coalbed, methane, and renewables. States will continue to focus heavily, if not exclusively, on traditional sources such as oil and gas. But due to a highly regulated policy environment, some activities in renewable and unconventional energy technology will still be carried out. Such activities are solely driven by the state because private corporations are unlikely to pursue such activities due to the prospect of low profitability.

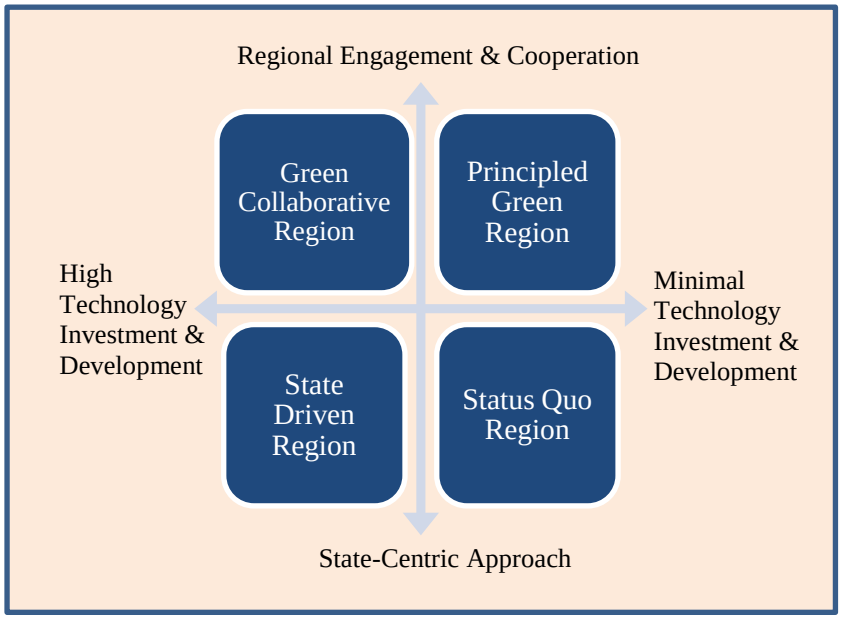
**Change-maker*: With high oil prices and strong government regulation to promote clean energy supplies, including renewables and nuclear power, there is greater clean energy investment, including capacity building and technology investments. Energy supplies are diversified and there is little reliance on hydrocarbons. Energy market development under this scenario will be the most environment-friendly, especially in terms of carbon emissions.

Status Quo: The status quo involves low government regulation and leadership, and low oil prices. There is minimal investment in clean energy technology such as nuclear and renewables. There are few incentives to develop alternative energy sources and states remain dependent on oil. As a result, without government leadership or a buoyant

market this produces the least progress on environmental concerns and is the worst case scenario for achieving sustainable energy security.

Market-driven: In this scenario, there is low government intervention, and the price of oil and gas is high. There will be incentives on the consumer side for substituting oil with alternatives including renewables and nuclear sources. At the same time, the industry is motivated to work on exploration of new sources including shale gas. Exploration of oil and gas is also expanded. As a result, this scenario would not see much progress in GHG emission reduction. Investment in low-carbon technology happens to a lesser extent than scenarios with higher government intervention, but there is more investment in fossil fuel exploration to remain competitive in the market.

Group D



**Green Collaborative Region*: In the Green Collaborative Region there is a high level of regional cooperation boosted by technological advancements and investments. The region will synchronize regulations, and advance technology sharing and investments. It promotes diversification of the energy mix, leading to renewable energy sources, and requires significant regional political will and regional commitments.

Principled Green Region: The Principled Green Region experiences high regional cooperation with low technology investment. The region advances norm and value based systems to encourage lower and more sustainable consumption. It uses regional carbon caps and efficiency standards. It is advanced by institutional commitments, using institutions such as ASEAN to promote norms and regional commitments to promote smarter consumption and environmental protection.

**State Driven Region*: The State Driven Region has high technological commitments with little regional cooperation. Technology is used to advance national interests and economic benefit, involving reliance on nuclear energy, clean coal, and fracking. It establishes regulatory frameworks at a national level, and cultivation of strong human resources. It benefits national interests, not the region.

Status Quo Region: The Status Quo Region experiences low regional cooperation and low technological investment, reflecting the status quo. It involves a state-based

approach to energy security where individual countries look after their own economic, security, and political interests. It involves reliance on conventional sources such as oil, coal and gas, and states regulate the market to support these conventional sources. It involves minimal technology sharing and R&D, resulting in a negative environmental impact.

After each group presented its top two scenarios to the full Study Group on day two of the meeting, participants agreed that the scenarios presented by Group D offered the most comprehensive approach, and should be built upon as the final two scenarios for the Study Group, from which policy recommendations could be made. The scenarios were reworked with input from participants, and policy recommendations were made to move towards the preferred scenario (Green Collaborative Region) and to mitigate potential fallout from the less favourable scenario (Tech-Driven State-Centric Region).

4. Final Scenarios & Recommendations

The Study Group's policy recommendations for Asia-Pacific cooperation and collaboration on energy security follow from the two scenarios it drew up:

Green Collaborative Region
Narrative: The Green Collaborative Region cooperates for a more energy efficient world that is climate friendly and protects the planet. States in the region recognize the need to cooperate both at a technological level and through norms and institutions. There is high regional investment in renewable technologies to diversify the energy mix away from conventional sources with a high CO2 footprint, leading to greater energy efficiency. The region uses institutional structures such as ASEAN to enhance regional cooperation and promote climate friendly norms. Open market forces encourage high levels of cross-investment in energy efficient industries. There is high connectivity through institutions, people to people engagement, and infrastructure commitments.

Policy Recommendations: Study group members recommended several policy measures to attain this scenario:

(a) There should be more cross investment, public private partnerships, and joint research and development initiatives in the field of renewables and other low-carbon energy sources.

(b) Regional states should further facilitate information sharing and promote transparency and confidence of our energy choices.

(c) State and non-state stakeholders should enhance infrastructure cooperation and interconnectivity (e.g., power grids, pipelines, and regional oil and gas storage/reserves).

(d) Within the Asia-Pacific, there should be sub-regional cooperation on specific energy security issues potentially leading to wider regional cooperation. Also, a network of centres of excellence on nuclear energy should be established to foster cooperation in regional nuclear safety governance.

Tech-Driven State-Centric Region

Narrative: In the Tech-Driven State-Centric Region, states will continue to rely on conventional energy sources with a high CO2 footprint, as they do now. At the same time, state investments in technology are advancing to ensure national energy security and national benefits. These include sources such as nuclear power, unconventional (especially fracking), clean coal technology, and renewable sources (when competitive with conventional sources). Regulatory frameworks support national efforts by promoting these industries in the domestic energy market. Protectionist measures are adopted to benefit the national economy. States focus on national interests in energy production rather than regional cooperation or the environment.

Policy Recommendations: Study group members cited a number of policy consequences from the second scenario and measures to mitigate negative outcomes:

(a) There is a need for regional states to uplift environmental protection awareness and to realise that the diversification of energy sources will benefit employment, public health and environment as well as social stability in states.

(b) Beyond CO2, there is a need to address the environmental, public health, and safety concerns of state-centric approaches, including air pollution, damning, nuclear accidents, and downstream pollution to ensure states comply with a minimum CO2 footprint by reducing their reliance on fossil fuels and increase state investment to clean energy technology and efficiency, so as to realise rapid emission reduction as suggested at the Paris Climate Change Summit.

(c) In this state-centric scenario there remains a need to address the traditional security considerations of securing cross-border production and transportation of conventional energy sources.

Annex A: Keynote Address by Dr Olli Heinonen, 26 October 2015

The meeting began with a keynote address by Dr Olli Heinonen, Senior Fellow at the Harvard University Belfer Centre for Science and International Affairs and former Deputy Director-General for Safeguards at the International Atomic Energy Agency. He addressed the Study Group on *Safety, Security and Safeguards in the Asia-Pacific*.

Dr Heinonen began by tracing some of the main shocks to nuclear security and safety, and how they impacted the work of the IAEA. The first significant shock was Chernobyl, which precipitated the IAEA's promotion of a nuclear safety culture. The next shock was Iraq in the early 1990s, when the IAEA discovered Iraq's nuclear program in parallel with its civilian program. The IAEA couldn't address this issue under its normal access rights. This changed the IAEA's safeguards process to become much more investigative. Around the same time, the collapse of the Soviet Union raised concern over the possibility of floating nuclear material; eventually leading the IAEA to increase its focus on nuclear security. The next shock was Fukushima, which brought about the IAEA Action Plan on Nuclear Safety.

Dr Heinonen then addressed the shift in nuclear power production towards Asia. The United States remains the largest holder of operating nuclear reactors, at close to 100. China, however, aims to have 130 by 2030. The amount of electricity production that will be produced by China will remain modest in relation to its energy needs, but this advancement changes the pivot in nuclear energy towards Asia, which is increasingly looking to nuclear energy production. The region will face challenges with 'newcomer states' becoming involved in nuclear power production, such as Bangladesh, Vietnam, Indonesia, and Malaysia. From the safety perspective, many of the new NPPs will be built, owned, and operated by an external body, often Russia. This will pose challenges to the local regulatory bodies, which must assess the quality and production of the NPPs.

While there is significant regional concern over nuclear safety and security, the region has the benefit of a relatively young population to be trained in nuclear engineering, safety, and security. This will take a concerted effort to implement strong education and training programs. Dr Heinonen further highlighted the need for regional information and knowledge sharing, suggesting that ASEAN could play a role in facilitating this flow of information, which would also serve as a confidence building measure.

Dr Heinonen then addressed non-proliferation in the context of Asia. At the weapons level, India and Pakistan are producing plutonium for weapons purposes, and are diversifying their nuclear assets by introducing nuclear weapons to cruise missiles. China has never clearly indicated whether it produces plutonium for nuclear weapon purposes.

There is also a non-proliferation aspect to the introduction and expansion of nuclear energy in the region. When nuclear energy is introduced into the region on a greater scale, there will necessarily be greater demand for nuclear fuel. China is the only country in the region with significant uranium enrichment services, but it will not likely be enough for the entire region as more countries progress with NPP production. In terms of uranium resources, Australia has resources that it ships out for enrichment. The question, then, is if there is a need for uranium enrichment in Asia despite there being a global overproduction of enriched uranium. Dr Heinonen suggested that there is a need in order to minimize the transportation of nuclear material, which presents significant

security risks. If the region chooses to pursue enrichment, it will need to decide whether it is done at the national level or the regional level.

The last regional concern of non-proliferation that Dr Heinonen addressed was Japan's stockpile of plutonium. He suggested that shipping it away to France, the UK and elsewhere does not solve many problems. Shipping it to the UK, for example, is not conclusive since the UK has no use for it. The US, on the other hand, does not have proper storage facilities to accept more plutonium. He suggested that an alternative is burning plutonium at the capacity of 400-500 kilograms per year.