Proceedings Summary

Policy Workshop on Achieving Energy Security in Asia: Diversification, Cooperation, and Renewable Energy

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This paper presents the workshop proceedings prepared by Prof. Farhad Taghizadeh-Hesary of Tokai University.

These contents emerged from a joint workshop organized by the CAREC Institute and the Asian Development Bank Institute (ADBI) on the topic of achieving energy security in Asia during 22-23 October 2019 in Almaty, Kazakhstan where renowned scholars and authors of the book titled "Achieving Energy Security in Asia: Diversification, Integration, and Policy Implications," and the CAREC government officials deliberated on the status of energy consumption, energy supply, import, export, energy cooperation with the neighboring countries, strategies for increasing a share of renewable energy, and analyzing the energy security levels in their respective countries.

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1. Background

Energy is a private good but a fungible commodity, while security is a public good. When two seemingly distinct goods are combined, the underlying characteristics of the composite good are multi-faceted. Although the concept of energy security is as diverse as the number of disciplines involved, **energy security could be simply an assurance of energy supply both in times of abundance as well as in times of scarcity**. A disruption or low assurance of energy supply in an economy is examined to understand how and to what extent it affects aggregate economic welfare. In addition to the significant impact of energy supply and energy price on macroeconomic variables (Bohi 1991[1], Ferderer 1996[2], Hamilton 1996[3], Killian 2008[4], Taghizadeh-Hesary et al., 2016[5]), insecurity of energy supply impacts other commodity prices as well, including food (Taghizadeh-Hesary et al., 2019[6]).

As evidenced by recent international developments, such as the PRC's deepening relations with resource-rich Middle Eastern and African nations and cooperation between the US and India on nuclear technology, the efforts to secure energy resources are believed to have shaped the relationships within and among energy-deficient and energy-abundant countries. In sum, energy security is not only an economic issue but an international/geopolitical one (Taghizadeh-Hesary et al., 2019[7]).

The multi-faceted characteristics of energy security range from the inherent economic aspect of energy security to the strategic and geopolitical nature of energy security. This in turn presents four broadly defined dimensions by which energy security could be defined:

- Economic
- Political
- Geopolitical
- Institutional, legal, regulatory

The first dimension is the economics of energy security, which mainly covers the consequences of import dependence and instability of energy markets. The second dimension is the political economy of energy security, which examines, *inter alia*, interrelations between crude oil-importing and oil-exporting countries. The third dimension is the geopolitics of international relations, which explores how geopolitics influence and shapes coalitions, cooperation and unilateral actions for energy security. The fourth dimension refers to the aspects of energy security in institutional, legal and regulatory frameworks in local, regional, and international contexts (Taghizadeh-Hesary et al., 2019b).

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[1] Bohi, D.R. (1991). On the macroeconomic effects of energy price shocks, *Resources and Energy*, 13(2): 145-162.

[2] Ferderer, J. P. (1996).Oil price volatility and the macroeconomy, *Journal of Macroeconomics*,18 (1): 1-26.

[3] Hamilton, J. D. (1996). This is what happened to the oil price-macroeconomy relationship, *Journal of Monetary Economics* ,38(2): 215-220.

[4] Killian, L. (2008). The economic effects of energy price shocks. Journal of Economic Literature, 46(4), 871–909

[5] Taghizadeh-Hesary, F., N. Yoshino, M. M. H. Abadi, and R. Farboudmanesh. (2016). the Response of Macro Variables of Emerging and Developed Oil Importers to Oil Price Movements. *Journal of the Asia Pacific Economy.* 21 (1), 91-102. *doi.org/*10.1080/13547860.2015.1057955

[6] Taghizadeh-Hesary, F., E. Rasoulinezhad, N. Yoshino (2019). Energy and Food Security: Linkages through Price Volatility, *Energy Policy*, 128: 796-806, doi.org/10.1016/j.enpol.2018.12.043

[7] Taghizadeh-Hesary, F., Yoshino, N., Chang, Y. and Rillo, A. (2019b). Introductory Remarks and Preface. In *Achieving Energy Security in Asia: Diversification, integration and policy implications*. Eds. Farhad Taghizadeh-Hesary, Naoyuki Yoshino, Youngho Chang, Aladdin Rillo. Singapore: World Scientific

Calling for development and utilization of locally available renewable energy along with intra-regional energy cooperation and energy integration will help mitigate individual country energy security risks in the context of climate change. Energy diversity is the most frequently employed aggregate energy security indicator that measures the sources of energy supply. However, when talking about the issue of energy security, several other topics such as availability of energy resources, applicability of technology, acceptability by society, and affordability of energy resources need to be considered (Yao and Chang, 2014[8]).

Deployment of renewable energy can increase the level of energy security mainly through increasing availability and acceptability and reducing the carbon emission levels (Taghizadeh-Hesary et al., 2019[9]). The technological progress enables reduction of energy generation costs through renewable resources; hence, the affordability and applicability of renewable energy technologies has a potential to increase the energy security.

However, there are several challenges that renewable energy projects are facing that slows their growth. The major challenges constitute higher risks and lower rate of return compared with fossil fuels. New ways of financing, such as community-based financing, or utilization of the capacity of institutional investors can help fill the financing gap, and raise the level of energy security (Yoshino, Taghizadeh-Hesary, Nakahigashi, 2019[10]).

2. Rationale

The energy insecurity has been a critical challenge facing Asia's economic growth. The energy supply pattern in CAREC region shows that some CAREC countries are rich in fossil fuels (oil, gas, coal) and hydro resources, others lack sufficient domestic resources to adequately cover their energy demand, and seasonal variability among countries is also particularly pronounced.

Le et al. (2019)[11] developed a comprehensive index for energy insecurity as well as examined the trends using a sample of 24 selected Asian countries for the period of 1990–2014. The study covered five CAREC members. The results yielded a trend of increasing energy insecurity in the PRC, and Pakistan. On the other hand, certain fluctuations but steady improvements in energy security were observed in Mongolia. While, Kazakhstan and Tajikistan demonstrated a trend of fluctuations and increasing energy insecurity.

Easing the regional energy trade in CAREC member countries will improve the accessibility and availability of energy contributing to improvement of the energy security status. The CAREC energy strategy 2030 stipulates that establishment of a large-scale energy infrastructure achieves economies of scale, instills a collaborative culture, and generates a strong drive towards common energy security through long-term regional relationships in the CAREC (ADB, 2019[12]).

[8] Yao, Lixia & Chang, Youngho, (2014). "Energy security in China: A quantitative analysis and policy implications," *Energy Policy*, 67: 595-604.
[9] Taghizadeh-Hesary, F., Rasoulinezhad, E. and Yoshino, N. (2019). Energy and Food Security: Linkages through Price Volatility. *Energy Policy*. https://doi.org/10.1016/j.enpol.2018.12.043
[10] Yoshino, N., Taghizadeh-Hesary, F., Nakahigashi, M. (2019). Modelling the social funding and spill-over tax for Addressing the green energy financing gap. *Economic Modelling*. DOI: 10.1016/j.econmod.2018.11.018
[11] Le T.-H, Y. Chang, F. Taghizadeh-Hesary and N. Yoshino (2019). Energy Insecurity in Asia: A multi-dimensional analysis. *Economic Modelling*. 83: 84–95, DOI: j.econmod.2019.09.036
[12] ADB (2019). CAREC Energy Strategy 2030: Common Borders, Common Solutions, Common Energy Future. Manila: Asian Development Bank

With this background, the CAREC Institute and the Asian Development Bank Institute (ADBI) organized a two-day regional workshop on "Achieving Energy Security in Asia: Diversification, Cooperation and Renewable Energy" during 22-23 October 2019 in Almaty, Kazakhstan.

The objective of the workshop was to review the status of energy security in the Central Asia and other Asian sub-regions and offer policy options on how a country or a region collectively can achieve energy security. The workshop had the following core objectives:

- review how energy security can be ensured in global and general contexts
- analyze how regional cooperation and energy trade can enhance energy security in the region
- provide case studies to evaluate how diversification, cooperation, and integration of energy market and deployment of renewable energy influence energy security
- conduct specialized discussions on energy security and insecurity in the CAREC
- enhance collaboration among the CAREC academics, practitioners, and policy makers
- present new and innovative policy options for development of renewable energy sources in the CAREC

Participants included government officials of the CAREC member countries. The resource persons were distinguished experts of the field, mainly authors of chapters in the book titled "Achieving Energy Security in Asia: Diversification, Cooperation, and Renewable Energy," edited by Farhad Taghizadeh-Hesary, Naoyuki Yoshino, Youngho Chang and Aladdin D. Rillo, published by the World Scientific in 2019 in Singapore.

The first session was the opening session where Dr. Naoyuki Yoshino, Dean and CEO of ADBI; Dr. Giovanni Capannelli, Country Director of the ADB Kazakhstan Resident Mission, and Mr. Eisa Khan Ayoob Ayoobi, Senior Knowledge Services Specialist of the CAREC Institute made opening remarks.

This summary of proceedings is a comprehensive report of the presentations and discussions.

3. Energy Security, Energy Cooperation, and Policy Implications

The second session was on energy security, energy cooperation, and policy implications. This session was moderated by Prof. Farhad Taghizadeh-Hesary (Waseda University, Japan) and Dr. Yergali Dosmagambet, former Deputy Director of the CAREC Institute.

The first presentation in this session was by Mr. Jiantao Arthur Yan (University of International Business & Economics, the PRC) titled "Multiple Gas Market Hubs, China's Energy Security and Regional Cooperation in Asia."

On 26 March 2018, the PRC launched Shanghai crude futures as part of its efforts to enhance the region's energy security. The PRC's crude futures performed far beyond the market's expectations in terms of liquidity, volume, and price signal, and reignited interest in launching natural gas futures. Any futures of natural gas or liquefied natural gas will be heavily derivatized from efficient benchmark price indexes, which are assessed and reported at the regional market hubs. Instead of having a few centralized exchange centers or virtual trading hubs, the web of efficient multiple regional physical and marketing hubs strategically located across the nation would contribute to regional cooperation between the PRC, Japan, and South Korea fundamentally changing global gas market dynamics, enhancing the PRC's energy security, and supporting Asian pricing index development. It is the prime time to fast track the

establishment of such market hubs in the PRC. Mr. Jiantao Arthur Yan explained the needs and functions of market hub participants, identified key success factors of establishing such market hubs, recommended what would make commercially viable and efficient hubs in the PRC in a 14-stage blueprint, and evaluated the major policy implications for the PRC, and the wider Asia.

The second presentation was by Prof. Elena Shadrina (Waseda University, Japan) titled "Energy Cooperation and Security in CAREC Region: The Possible Synergy between Hydrocarbon-Rich and Water-Rich Countries."

Prof. Elena Shadrina discussed energy policies of the Central Asian economies by focusing on two member countries of CAREC - Kazakhstan and Kyrgyzstan. The two nations have dissimilar energy profiles; thus, each serves as a representative of the respective group. The first group is formed by the Central Asian countries who are endowed with hydrocarbon resources, but poor in hydropower resources (Kazakhstan, Turkmenistan, Uzbekistan). The second group is made up of the Central Asian countries who are endowed with hydro resources but deprived of hydrocarbon resources (Kyrgyzstan, Tajikistan).

Despite the fact that complementary characteristics of these two groups offer a case for synergy, reality differs. Prof. Elena Shadrina analyzed the issues that the group representatives, Kazakhstan and Kyrgyzstan, encounter in the field of energy security. She presented a comparative analysis of uncoordinated energy policies and argued that national energy security of an individual Central Asian state is inseparable from energy security of the entire Central Asian region as it is embedded into a broader regional context of resource sharing and nexus thinking. The dimensions for regional and international cooperation towards enhanced energy security in the Central Asia were also discussed.

The third presentation of this session delivered by Prof. Falendra Kumar Sudan (University of Jammu, India) was titled "Addressing Climate Change and Energy Security through Energy Cooperation: Challenges and Opportunities."

Prof. Falendra Kumar Sudan argued that the South Asia is at the crossroads with growing population, rising per capita income, expanding economies, and increasing energy demand. With growing industrial, commercial, and transport sectors along with rising urban and middle-income consumers, the energy use is increasing at unprecedented rates to meet the ambitious poverty reduction targets. All countries of the region are facing critical scenarios ranging from depleting indigenous energy resources for developing long-term energy cooperation plans to ensuring energy security.

The South Asian countries are highly dependent on imported fuels, especially liquid hydrocarbon, for transport. For instance, India, Pakistan, and Bangladesh meet little of their energy demand with indigenous sources and thus face mounting energy import bills. Maldives depends on oil products to meet its energy needs. Nepal and Bhutan have huge hydroelectric potential. At the same time, there is a wide variation in the energy consumption levels in South Asian countries.

The high potential of hydropower in South Asia can reduce reliance on fossil fuel imports, increase the demand from indigenous resources, raise the energy security levels, and reduce the emission levels. Therefore, energy security is vital for improved economic growth and poverty reduction. The context calls for development and utilization of locally available

renewable energy along with intraregional energy cooperation to help mitigate individual country energy security risks.

4. Energy Security, National, and Regional Perspectives and Solutions

Hometown Investment Trust Funds (HIT funds)

The first presentation in this session delivered jointly by Prof. Naoyuki Yoshino (Dean and CEO of the ADBI) and Prof. Farhad Taghizadeh-Hesary (Waseda University, Japan) was titled "Community-based Financing for Increasing Share of Renewable Energy in the CAREC Region."

The presenters argued that one of the main reasons behind the lack of development of renewable energy projects in CAREC, similar to other Asian sub-regions, is difficulties in accessing finance. Profs. Yoshino and Taghizadeh-Hesary proposed community-based financing solutions called hometown investment trust funds (HIT funds) that worked well in Japan and some other Asian economies for mitigating the financing gap of small-scale renewable energy projects.

In Japan, HITs are a newly created source of financing to support solar and wind power. The basic objective of HITs is to connect local investors with projects in their own locality where they have personal knowledge and interests. Individual investors choose their preferred projects and make investments via the internet. One of the major applications of HITs in Japan relates to wind- and solar power projects, which have raised money from individuals (about $100 to $5,000 per investor) interested in promoting green energy. Internet marketing companies provide the platforms for investment in these projects and are able to promote them.

Local banks started using information provided by HITs. If these projects are implemented properly and are received well by individual investors, banks can then start granting loans for these projects. This way, renewable projects get to be supported by HITs until they are able to borrow from banks. The use of alternative financing vehicles such as HITs has therefore assisted the growth of solar and wind projects in Japan, where the finance sector is still dominated by banks (Yoshino and Taghizadeh-Hesary, 2019[13]).

HITs have expanded from Japan to Cambodia, Viet Nam, and Peru. They are attracting attention from the Government of Thailand and Malaysia's Central Bank.

The Central Asia's finance sector is still dominated by banks. The venture capital market is generally not well developed. However, internet sales are gradually expanding and the use of alternative financing vehicles, such as HITs, will help risky sectors in Central Asia grow.

As for the examples of HIT funds, the Hokkaido Green Fund, established in 2000 to finance wind-power projects in northern Japan, was generated by donations. As banks financed only 20% of the total investments, the other 80% was obtained from individual investors and through donations. The community wind-power corporation sells electricity to the regional

[13] Yoshino, N. and F. Taghizadeh-Hesary (2019). Role of hometown investment trust funds and spillover taxes in unlocking private-sector investment into green projects. Handbook of Green Finance: Energy Security and Sustainable Development. J. Sachs, W.T. Woo, N. Yoshino and F. Taghizadeh-Hesary Eds. Tokyo: Springer

power company. In many cases, the price of the power produced by wind is 5% higher than that of other forms of electricity, but users are willing to pay extra to save the environment. More than 19 wind-power projects were constructed in northern Japan using a similar method. There are also examples of solar-power projects in Japan where local governments put money (seed money) into the community fund as an incentive for private investors. (Yoshino, Taghizadeh-Hesary, Nakahigashi, 2019)[14] .

Although HITs are a form of crowdfunding, there are significant differences between them and conventional crowdfunds: i) there is a "warm feeling" behind the HITs because investors are sympathetic to the company/project owners, who are not solely in it for profit; ii) investors are ready to receive products or services generated by the project (e.g. the electricity generated by wind power) instead of a share of profits; iii) the intermediator/assessor of HITs will monitor the project frequently so that investors do not lose money and instead provide advice when the project faces difficulties. This is unlike crowdfunding or venture capital where profit is the only purpose of investment (Taghizadeh-Hesary and Yoshino, 2019)[15].

The 4A Framework: Availability, Accessibility, Affordability, Acceptability

The second presentation of the session delivered by Prof. Youngho Chang (Singapore University of Social Sciences) was titled "Energy Security: Concepts, Measures, Applications and Policy Implications." He defined the term energy security and introduced 4As framework - a quantitative framework to calculate energy security levels.

Prof. Youngho Chang quoted studies which define energy security as an adequate and reliable supply of energy resources at a reasonable price (Bielecki, 2002[16]; Bohi and Toman, 1996[17]). Yergin (1988)[18] originally cited this definition during the crises of the 1970s and 1980s when oil embargoes globally disrupted the supply of cheap and reliable oil from the Persian Gulf. The contemporary discourse on the energy security, in general, implies availability of energy resources, which are further measurable under the concept of "diversification" (or hedging). There are three aspects of the interpretation of diversification - variety, balance, and disparity (Stirling 2010)[19]. Variety measures the economically available primary energy resources, and balance measures the reliance or dominance of these options in the overall energy mix. Disparity examines the differences among these various options in terms of delivery modes or characteristics.

The Asia Pacific Energy Research Centre introduced the 4As of energy security (availability, accessibility, affordability, and acceptability) as key dimensions of its contemporary definition

[14] Yoshino, N., Taghizadeh-Hesary, F., Nakahigashi, M. (2019). Modelling the social funding and spill-over tax for Addressing the green energy financing gap. Economic Modelling. 77:34-41. DOI: 10.1016/j.econmod.2018.11.018

[15] Taghizadeh-Hesary F., Yoshino N. (2019). The way to induce private participation in green finance and investment, Finance Research Letters, 31: 98-103, doi.org/10.1016/j.frl.2019.04.016

[16] Bielecki, Janusz. 2002. "Energy Security: Is the Wolf at the Door?" Quarterly Review of Economics and Finance 42: 235–50.

[17] Bohi, Douglas. R., and Michael. A. Toman. 1996. The Economics of Energy Security. Norwell, MA: Kluwer Academic Publishers.

[18] Yergin, Daniel. 1988. "Energy Security in the 1990s." Foreign Affairs 67(1): 110–132.

[19] Stirling, Andy. 2010. "Multicriteria Diversity Analysis: A Novel Heuristic Framework for Appraising Energy Portfolios." Energy Policy 38: 1622–34.

of energy security that address the "energy security paradigm shift" (APERC, 2007)[20] of the 2000s. Yao and Chang (2014)[21] developed the framework which encompasses the essential 4A dimensions - the availability of resources (AV), the applicability of technologies (AP), the acceptability by society (AC), and the affordability of energy resources (AF) - with four indicators in each to measure the energy security. The 4As framework, with its 16 energy security indicators, provides a rhombus plot. The plot helps visualize the trends and compare the dimensions, rendering a more holistic perspective on the direction of energy security.

Energy Security in Pakistan under the 4A Framework

The third presentation delivered by Prof. Farhad Taghizadeh-Hesary (Waseda University, Japan) was titled "Energy Security in Pakistan: Perspectives and Policy Implications from a Quantitative Analysis."

Pakistan imports nearly a third of its energy resources in the form of oil, coal, and liquefied natural gas (LNG). An import-driven energy policy is not sustainable for Pakistan, making it energy insecure in the long term. Besides being a drain on its foreign exchange reserves, it exposes the economy to international energy price shocks, putting the entire economy at risk through inflation. Inflationary pressures reduce the competitiveness of the country's exports, further constraining the economy's capacity to pay for energy imports.

The study analyzed Pakistan's energy security under the 4As framework over the 6-year period of 2011–2017. The 4A methodology attempts to measure and illustrate graphically the change in the energy security of a region by mapping it into four dimensions: availability, applicability, acceptability, and affordability. The analysis indicates that Pakistan's energy security improved initially over the first three years but then deteriorated over the next three years.

Despite significant investments in the energy infrastructure over the last five years, Pakistan continues to be energy insecure. In line with the study, Prof. Taghizadeh-Hesary recommended the immediate and rapid adoption of green energy solutions, like distributed solar and smart metering, and increased conservation efforts, such as developing and implementing building insulation standards to mitigate energy insecurity.

Assessing Energy Security in the Caspian Region

The fourth presentation of this session was by Dr. Dina Azhgaliyeva (ADBI) on assessing energy security in the Caspian region by looking at the geopolitical implications of the European energy strategy. She explained that following the collapse of the Soviet Union, Western countries have signed several agreements on using hydrocarbon resources in the Caspian basin, aiming to diversify their energy suppliers. On the other hand, recession in the world economy and low oil prices deeply affected economies of the Caspian states, whose gross domestic product and exports are dominated by oil and oil products. Strongly dependent on export revenues from oil and gas, the economic growth of the Caspian states slowed, beginning from 2014.

[20] APERC. 2007. A Quest for Energy Security in the 21st Century. "https://aperc.ieej.or.jp/file/2010/9/26/APERC_2007_A_Quest_for_Energy_Security.pdf".
[21] Yao, Lixia., and Youngho. Chang. 2014. "Energy Security in China: A Quantitative Analysis and Policy Implications." Energy Policy 67: 595–604.

Although limited energy resources mainly lead to focus on security of supply, that is fundamentally understood as a continuity, and a low risk of interruption of energy import flows, it is the low oil prices that remained as one of the major challenges for the energy-producing economies in terms of securing stable energy export revenues. Moreover, geopolitical developments in the world, especially local armed conflicts, showed the importance of secure routes as armed conflicts present a significant threat for energy transportation.

Using the indicator-based approach and country-level data over the period of 2000–2017, Dr. Azhgaliyeva and her colleagues assessed the security of demand for oil and gas of three countries from the Caspian region: Azerbaijan, Kazakhstan, and Turkmenistan capturing the geopolitical situation and impact on energy transportation to the EU. The results demonstrate that the risk of energy security of demand is greater when political risks of energy-transporting countries are included in the measure of energy security of demand, i.e. risky external energy demand.

The sharp decline of political stability and absence of violence/terrorism index in Ukraine and Turkey increased the risk of security of energy demand in Azerbaijan, Kazakhstan, and Turkmenistan. The results of this study highlighted the necessity for cooperation not only between the EU and the Caspian region, but also with energy-transporting countries, e.g. Ukraine, Georgia, and Turkey. Proposals also included finding alternative routes bypassing countries with low political stability, e.g. through the trans-Caspian pipeline.

Indian Electricity Sector

The presentation titled the “Indian Electricity Sector: Diversification, Energy Security and Sustainability” was delivered by Prof. Gopal K. Sarangi (TERI University, India).

Prof. Sarangi argued that India is at a critical juncture in terms of its energy transition. While the country has witnessed commendable progress in various dimensions of energy sustainability and security, challenges abound on multiple fronts. His presentation was a result of a joint research with several other coauthors providing a holistic empirical assessment of the sustainability of the electricity sector in India by employing a sustainable development framework.

An indicator-based analysis was carried out for 12 Indian states over the time period of 10 years. The assessment reveals that the sector appears to be moving on a sustainable development trajectory, although disruptions are found when individual dimensions of sustainability are examined. The economic dimension of sustainability shows a nonlinear trend with multiple jerks, while the environmental and social dimensions of sustainability exhibit a declining trend initially but rise thereafter.

Regulatory and Policy Challenges on ASEAN Energy Security and Integration

Prof. Pornchai Wisuttisak (Chiang Mai University, Thailand) delivered a presentation titled “Regulatory and Policy Challenges on ASEAN Energy Security and Integration.”

The regulatory frameworks and policies are important facilitators (can also be inhibitors) for energy market integration and security in ASEAN. The ASEAN member countries have planned jointly development steps to assert regional energy integration and security. However, the

regional plan is faced with certain challenges and obstacles which stem from the ASEAN members' energy regulation frameworks and policies.

Dr. Pornchai Wisuttisak presented the obstacles and suggestions to help development of the ASEAN energy integration and security. He explored challenges in the regulation frameworks and policies which created barriers for energy market integration and security in the ASEAN. The challenges include conflicts between the regulations and policies which support energy integration and the regulations and policies which promote the national interest of state enterprises in the ASEAN energy sectors.

Improving Energy Security in the Context of Climate Change

Mrs. Le Ngoc Dang (Academy of Finance, Viet Nam) delivered a presentation on improving energy security in the context of climate change. She presented the weak points in the energy system that prevent Viet Nam from achieving energy security.

The fundamental impediments lie in the lack of energy efficiency in major industries, especially in export-oriented manufacturing and transport. Moreover, the insecurity is also derived from the growing reliance on fossil fuel imports for thermal power generation that threatens the local environment and generates an adverse impact on climate change. Extreme reliance on fossil fuel imports created a significant risk in the energy supply security for the country. In addition, with the phasing out of all nuclear power stations and negligible contribution of renewables (except for hydropower) in the electricity grid, primary energy supply is less diversified, and it is forecasted that half of electricity generation will be derived from coal by 2030.

The implication is that improving energy efficiency in energy-intensive sectors must be the top priority for achieving energy security in the country, in which transport leaves a huge room for energy-use enhancement. In addition, reducing the barriers in renewable energy financing to attract more private investment is essential to unlock potential of deployment of renewable technologies which can bring multiple benefits for securing energy and reducing carbon emissions.

Role of Fiscal Policy in Development of Low-Carbon Sector

Dr. Juswanto Wawan (Ministry of Finance, Indonesia) delivered a presentation titled "Role of Fiscal Policy in Development of Low-Carbon Sector."

Strengthening energy security through clean energy provision with fewer emissions is among the strategic goals of the Indonesian Government. The Government budget alone cannot meet the financing needs for climate change actions, including renewable energy solutions. Innovative steps would be needed to scale up climate financing through:

i. developing innovative financing instruments
ii. improving access to global finance
iii. promoting investments

Ministry of Finance of Indonesia developed such instruments to facilitate involvement of philanthropist, donor, climate fund, green investors, MDBs, international agencies, commercial banks, sovereign wealth funds, and institutional investors. The SDG Indonesia One is an innovative financing instrument that will manage and leverage USD 2.34 billion to

facilitate 93 projects at a value of USD 18.2 billion. The fund involves six foreign government agencies, seven development banks, two climate funds, one equity investor, three commercial banks, one insurance company, two local philanthropist, and two international philanthropists.

The government recognizes the important role of the private sector in national development, as well as in developing the energy sector (renewable energy). Some incentives are facilitated by the government to attract the private funding, such as (i) public-private partnerships (PPP) / Kerjasama Pemerintah dan Badan Usaha (KPBU), (ii) tax incentives, and (iii) improving the ease of doing business. In the PPP schemes, government provides Project Development Facilities (PDF), Viability Gap Fund (VGF), and government guarantees.

5. Country Presentations

Azerbaijan

Mr. Shahmar Hajiyev, Leading Specialist, Center of Analysis of International Relations, and Mr. Jahid Mikayilov, Chief Advisor, Department of Energy Efficiency and Ecology, Ministry of Energy of Azerbaijan, delivered a joint presentation on renewable energy in Azerbaijan.

The current share of renewable energy in the total power generation of Azerbaijan is 17.85% or 1275.665 MW. The total power generation capacity of the country is 7146.565 MW. According to the strategic roadmap for the development of utilities (electricity and thermal energy, water and gas supply) of Azerbaijan, it is planned to increase the share of renewable energy to 20% by 2020, 25-30% by 2025 and 25-40% by 2030.

In order to achieve the goal for increasing the share of renewable energy in the power generation basket, the government is undertaking the following activities: preparation of a legal framework; involvement of international consultant companies; legislating law on renewable energy sources; adoption of Power Purchase Agreement (PPA), connection agreement, grid analysis and action plan to strengthen the integration of renewable energy sources into the grid; and selection and zoning of areas with the high potential for the renewable energy.

Georgia

Mr. Nikoloz Kholodov, Senior Specialist at the Renewable Energy Division, Energy Policy Department, Ministry of Economy and Sustainable Development of Georgia, and Ms. Elene Goksadze, Head of Analysis and Planning Division, Energy Policy Department, Ministry of Economy and Sustainable Development of Georgia, delivered a presentation titled “Energy Security and Renewable Energy in Georgia: Challenges and Opportunities.”

Georgia operates 87 hydropower plants with the total installed capacity of 3260.07 MW, one wind power plant with the installed capacity of 20.7 MW, and five thermal power plants with the installed capacity of 926 MW. There are untapped hydro resources in Georgia. The country ranks high on water resources per capita. There are 300 out of 26,000 rivers capable of providing excellent opportunities for hydropower production. Presently, only 22% of total hydro potential is utilized and hydropower plant Greenfield potential is 40 TWh.

One of the major reforms in the power generation sector of Georgia was reduction of grid losses. The total losses for transmission and distribution network in 2001 amounted to 18.53%

which was reduced to 13.20% in 2006, and to 7.21% and in 2017. There is a plan to continue reducing grid losses.

Afghanistan

Mr. Hamidullah Zahid, Deputy Chief Financial Officer, Finance Department, Da Afghanistan Breshna Sherkat (DABS) delivered the presentation on the state of energy security and challenges in Afghanistan.

The main players in the energy sector of Afghanistan are the Ministry of Energy and Water (MEW) that plays the key role in creating vision and policy, Da Afghanistan Breshna Sherkat (DABS) or the Electricity Corporation of Afghanistan, and Independent Power Plants (IPPs) or the privately owned companies generating energy to be sold to DABS.

Hydro and diesel are the main sources of energy generated locally. The DABS imports over 70% of total power demand. The wind and solar energy have been initiated recently with a potential to expand and increase self-sufficiency and energy security of the country.

Afghanistan has a huge solar potential. The annual average solar energy generation varies from 4 to 6.5kWh/m2/day. With over 300 days of sunshine a year, Afghanistan aims to increase domestic electricity generation by 2032 with a share of 5,000 MW of renewable energy, facilitated by the private investment. The Afghanistan Government has a plan to adopt the demand side management to reduce power demand and promote renewable energy in the total energy basket in line with the environmental protection and energy security goals.

Kyrgyzstan

Ms. Gulzar Kasymova, Leading Specialist, Department of Macroeconomic Forecast and Analysis, Ministry of Economy of Kyrgyzstan, and Mr. Beknur Maratbekov, Chief Specialist, Department of Renewable Energy Development and Energy Saving, State Committee for Industry, Energy and Subsoil Use of Kyrgyzstan, delivered a joint presentation on achieving energy security in Kyrgyzstan.

The main source of power generation in Kyrgyzstan is hydro resources whose potential is estimated at 142.5 billion kWh annually. As for the fossil fuels, there are 70 coal deposits accounting for the total reserve of 1.3 billion tons. At the same time, imports account for approximately 78% of the annual consumption of coal. The self-sufficiency in oil and petroleum products is less than 30% and the country relies on importing oil and derivatives. Only 120 thousand tons of crude oil and 30-40 million cubic meters of natural gas are produced domestically.

Kyrgyzstan is the only country in the Central Asia whose water resources are almost completely formed on its own territory, which constitutes its advantage. The hydropower potential of the rivers is about 174 billion kW/h, which is approximately 38% of the resources of the Central Asia, and the capacity of which is estimated at 19,8 million kW. Huge volumes of water resources are concentrated in 6580 glaciers whose reserves are about 760 billion cubic meters.

Challenges of the energy sector of Kyrgyzstan are primarily infrastructural which translate into depreciated distribution network (50%), and hydroelectric power stations and thermal power

plants which were commissioned more than 40-50 years ago. The cash shortage is another challenge. Payments for consumption are not made on time, therefore energy companies cannot cover their obligations timely. The ineffective tariff policy is the third challenge. There is a budget deficit in the energy sector and corruption schemes. The high dependence on water resource represents the fourth challenge. With low levels of the Toktogul reservoir and the Naryn River (which also depends on climatic factors), the country faces electricity shortage.

There is the Green Economy Development Program 2019-2023 in Kyrgyzstan which includes equitable access to natural resources, sharing benefits and minimizing risks for various social groups, forecasting energy demand and optimizing the fuel and energy complex, and implementing policies in the field of energy conservation.

Pakistan

Mr. Sheraz Anwar Khan, Director (Wind), Power Projects, Alternative Energy Development Board, and Mr. Hammad Raza, Section Officer, Power Division, Ministry of Energy, from the Government of Pakistan delivered a presentation on the state of energy security and challenges in Pakistan.

The Pakistan energy sector has suffered greatly due to the lack of strategy. The main focus has been on capacity addition at an exuberant cost overseeing important factors, such as energy security, improvements in generation mix, augmenting indigenous supply, up-scaling of T&D system, and institutional development.

The presenters argued that re-adjustment of the generation mix should be at the heart of remedial plans. Based on the existing energy mix, Pakistan's dependence on the fossil fuel is 63%, out of which 55% is imported fuel. This represents a serious threat to the country's energy security. Pakistan would need to quickly and heavily truncate the share of thermal power generation in the supply mix replacing it with indigenous supplies.

The Pakistani Government adopted the Alternative and Renewable Energy Policy 2019. The main objectives of which is to: protect the environment by increasing the share of green energy in the overall energy mix, achieve low cost in the on-grid power generation, fast track and open up the power market, develop skilled human resource and achieve technology transfer, enable the private sector investment and participation in the on-grid and off-grid renewable energy solutions, apply innovative supply solutions, and ease pressure on the public purse by expanding investments in the power system.

The People's Republic of China

Mr. Wang Weiyun, Program Officer, Department of International Cooperation, National Energy Administration of the PRC, and Mr. Xinxing Ji, Program Officer, Department of Development Planning, National Energy Administration of the PRC, delivered a presentation on the PRC's energy status and future cooperation plans.

In 2014, President Xi Jinping put forward a new energy security strategy named "Four Revolutions and One Cooperation" which aimed at achieving energy security under the conditions of the PRC's opening up and ongoing reforms. By 2018, non-fossil energy, natural gas and other clean energy consumption accounted for 22.1% in the total energy consumption mix, which exceeded the 2012 indicators by 7.6%. The coal consumption accounted for about

59% in the total energy consumption mix, which was less than 2012 indicators by 9.5%. The installed capacity of non-fossil power accounted for about 40% of the total installed capacity, and the power generation of non-fossil energy accounted for about 30% of the total power generation.

By 2018, the PRC's energy efficiency has improved significantly, and energy intensity (energy consumption per unit of GDP) was cumulatively 23% lower than that of 2012. The coal consumption per kWh of coal power generation with 6000 kW and above was 308 gce, and it was less than the 2012 indicator by 17 gce.

By 2018, the PRC has phased out more than 800 million tons of coal production capacity. In recent years, the PRC closed down more than 110 million kilowatts of small coal-fired units with high pollution and low efficiency. Its installed capacity of renewable energy was 728 million kilowatts, including 352 million kilowatts of hydropower, 184 million kilowatts of wind power, and 174 million kilowatts of solar PV. Intelligent and unmanned technology for coal mining was introduced successfully.

The first 3rd-generation nuclear plants have been put into commercial operation. The commercial demonstration projects of high temperature gas-cooled reactor nuclear plants have been advanced steadily. The key technologies of solar thermal power generation have been introduced. The equipment and safety level of power transmission and transformation technology correspond with world standards. Progress has been made in offshore wind power, unconventional natural gas, and clean development and utilization of coal.

The reform of the electricity system has achieved positive results. In 2018, market-oriented trading electricity was about 2.1 trillion kWh, accounting for about 30% of the total electricity consumption in the PRC. The green and low carbon was declared as the strategic direction. The long-term goal is to form an energy structure with clean energy as the main body.

By 2020, the consumption of non-fossil energy and natural gas will account for 15% and 10% respectively in the energy mix, with a planned increase to reach 20% and 15% respectively by 2030. The PRC upholds the concept of extensive consultations, joint contributions, and shared benefits to promote the Belt and Road construction. The PRC has built five major international oil and gas cooperation zones and four major oil and gas import strategic channels in line with the Belt and Road Initiative (BRI).

Tajikistan

Mr. Jamshed Bobozoda, Senior Specialist, Infrastructure Development Department, the President's Office of Tajikistan, and Mr. Saidakbari Homidzoda, Leading Specialist, Electroenergy Department, the Ministry of Energy and Water Resources of Tajikistan, delivered a presentation on the state of energy security and challenges in Tajikistan.

The Tajikistan government adopted a long-term strategy for development of the energy sector. Achieving independence in the energy sector was defined by the Government of Tajikistan as one of three main strategic tasks in the strategic framework leading to 2030. The aim is to increase the installed capacity of the power production to 10 GW, reduce technical and commercial losses in the power grids to less than 10%, increase exports of the electricity, diversify generation sources, and generate more than 500 million kWh per year from renewable energy sources and energy efficient technologies.

The unique geographical position, mountainous area, the huge potential of large and small rivers for hydropower, and solar energy make it possible to deploy renewable energy technologies in Tajikistan. Unfortunately, only 3-4% of the hydropower potential is currently used (the Vakhsh River hydropower plants). Last 28 years, with the involvement of the local capital and foreign investments, 286 small-scale hydropower plants were launched, with a total capacity of more than 26 MW. Guided by the 2030 agenda on sustainable development, Tajikistan plans development of the green energy sector to reduce the carbon emission levels.

Mongolia

Mr. Batzorig Damdinpurew, Head of Electricity Division, Policy Implementation and Coordination Department, Ministry of Energy of Mongolia, and Mr. Anar Sanjiijalav, Officer, Policy and Planning Department, Ministry of Energy of Mongolia delivered a presentation on the state and challenges of energy security in Mongolia.

In 2015, the Mongolian parliament approved the state policy on energy which stipulates that Mongolia has to ensure reliable operation of the energy sector, energy security, sustainable development and economic growth of the country, and become an energy exporting country with efficient and environmentally friendly technologies based on regulated and competitive market dominated by the private sector.

The policy is expected to deliver energy safety resources and backup capacity, establish a foundation for the development of renewable energy, and improve legal environment by 2023. The installed power capacity shall double, and modern technology shall be deployed. The hydro power is expected to reach at least 10% of the total installed power capacity, backup capacity shall be increased to 10%, foundation for the development of the renewable sector shall be created, and the tariff system shall be enhanced.

Between 2024 and 2030, the objective is to export secondary energy and develop the renewable sector sustainably. The backup capacity of the power system shall reach 20%, where the share of renewables is expected at 30%. The integrated smart energy system will be created by connecting regions with high capacity transmission lines. The state-owned power companies will become a public company. Distribution and supply service will be privatized, and energy sector will work as a competitive market under the state regulation. The secondary energy will be exported by connecting the North-East Asian countries with high capacity DC lines. Key projects which require urgent implementation include generating resources to stabilize load fluctuation, such as: hydro power plants (e.g. HPP, Erdenburen HPP), gas turbines (creating gas turbine units using infrastructure of existing CHP), and storage in the central power system (hydro pumped storage at 100 MW or above and big size battery storage at 100 MW).

6. Book Launch and Panel Discussion

The book titled “Achieving Energy Security in Asia: Diversification, Cooperation and Renewable Energy” published by the World Scientific Publishing in Singapore was presented to the workshop participants by Prof. Naoyuki Yoshino (Dean and CEO, ADBI), Co-Editor of the book, Prof. Farhad Taghizadeh-Hesary (Waseda University, Japan), Chief Editor of the book, and Prof. Youngho Chang (Singapore University of Social Sciences), Co-Editor. The book could be purchased here: https://www.worldscientific.com/worldscibooks/10.1142/11382

The book presents a critical review of the status of energy security in Asia and suggests how a country or a region collectively can achieve energy security in two broad aspects:

- It analyzes how regional cooperation and energy trade can enhance energy security
- It reviews how energy security can be ensured in national and regional contexts

This book asserts that diversification and integration are key to ensuring energy security. It presents policy implications for enhancing energy security, especially in resource-rich as well as resource-poor developing countries in Asia.

Reviewing experiences of different countries in implementing energy security policies can provide valuable policy implications for CAREC member countries.

Energy security workshop participants in Almaty