ENHANCING POWER GRID CONNECTIVITY TO ACHIEVE AFFORDABLE AND CLEAN ENERGY FOR ALL

Some of the essential transformations needed to meet the SDGs are elaborated in the Global Sustainable Development Report (GSDR) 2019[i] and the political declaration of the High-level political forum 2019. These transformations are mutually reinforcing and strongly linked to the Sustainable Development Goals (SDGs). The report identifies six entry points and four levers to accelerate progress across all 17 SDGs at the global level,[1] one of them being *Energy decarbonization and universal access*.

In the context of Asia and the Pacific, the key issue for accelerating on energy-related Sustainable Development Goals and SDG 7 (Affordable and Clean Energy) in particular is *Enhancing Power Grid Connectivity to achieve affordable and clean energy for All*. This topic will be analysed through a sub-regional and regional lens rather than country-by country approach given its nature.

I. ENERGY CONNECTIVITY FOR SUSTAINABLE DEVELOPMENT IN ASIA AND THE PACIFIC

Countries in the Asia-Pacific region are confronted by a series of challenges in securing their energy needs into the future. Strong energy demand growth continues as the region's energy needs are expected to grow by 37 per cent between 2018 and 2030. Just as the needs for future energy must be met, the environmental and climate change impacts of energy use require a switch to more sustainable energy sources. The imperative to avoid dangerous climate change and to tackle the immediate challenges of chronic air pollution require an unprecedented response by countries of the region to move away from fossil fuels. In response to these pressures, and aided by rapid technological changes, a global "energy transition" is underway. The energy transition implies a series of shifts in technologies and paradigms for energy production and use. These are being manifested in areas such as the expanding use of low-cost renewables, advanced energy efficiency, decentralized energy, electrification of end-uses, energy storage and electric mobility.

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[1] Entry point 1 – Human well-being and capabilities , Entry point 2 – Sustainable and just economies, Entry point 3 – Food systems and nutrition patterns, Entry point 4 – Energy decarbonization and universal access, Entry point 5 – Urban and peri-urban development, Entry point 6 – Global environmental commons, Lever 1- Governance, Lever 2- Economy and Finance, Lever 3- Individual and Collective Action, Lever 4- Science and Technology

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"The international community should... reduce the risk of fragmentation by encouraging cross-border, cross-sector and cross-vector strategic partnerships to accelerate progress along net-zero carbon pathways, and to secure new opportunities for global trade in clean electrons and clean molecules (gas and liquids), including hydrogen". (World Energy Council, 2019)[ii]

Against this backdrop, the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change provide a framework for countries' efforts, to adopt sustainable energy approaches and to mitigate the emission of greenhouse gases. Sustainable Development Goal 7 (SDG7) of the 2030 Agenda includes a goal to ensure access to affordable, reliable, clean and modern energy for all by 2030. It provides targets for universal access to modern energy, increasing the share of renewables and improving energy efficiency. Under the Paris Agreement, countries have pledged to reduce their emissions with varying levels of ambition, with the focus of most commitments placed on energy sector transformations. However, in the Asia-Pacific region, countries are positioned differently in terms of development levels, geography and resource endowments. Each country's approach to sustainable energy development and emission reductions varies accordingly.

The success of the 2030 Agenda for Sustainable Development in the Asia-Pacific region will require a shift in the ways that we source, consume and distribute our energy resources. In the context of the region's rapidly expanding overall energy needs, a growing emphasis on electricity is emerging. As part of the broader energy transition to a future of low carbon energy, the development of the electricity sector is bringing to the fore a range of opportunities and challenges.

Cost reductions in renewables and development of other technological advances – such as the advent of ultra-high-voltage direct current transmission and "smart" grid management – are opening opportunities for the provision of electricity with lower emissions in ways that were previously either not possible or not financially viable. Meanwhile, technology developments in transport and industry, previously the domain of petroleum and natural gas, are creating new markets for electricity.

In the face of rapidly rising power demand, regional cross-country power grid connectivity has the potential to sustainably increase the share of clean energy in the power generation mix. It enhances grid flexibility and addresses the geographic and temporal mismatches in energy demand and supply that currently limit the use of renewables. This can help to meet rising energy demands while reducing harmful greenhouse gas emissions that damage the environment and result in climate change. The United Nations General Assembly recognizes these opportunities and recently adopted the following resolution:

"UN GA calls for strengthened cooperation at the regional level to promote innovation and facilitate financing, support regional cross-border power grid connectivity, as appropriate, to advance economic integration and sustainable development and share best practices that are responsive to regional needs with regard to Sustainable Development Goal 7 and its interlinkages with the other Sustainable Development Goals, and in this regard encourages Governments to reinforce their energy interconnections, connecting regional energy markets and increasing energy security at the global level". (UN General Assembly Resolution 74/225)[iii]

Power grid connectivity, coupled with a rapid increase in the use of renewable energy, offers an appealing vehicle that is also compatible with economic and environmental goals. On the sub-regional scale, work has already commenced on taking advantage of these opportunities. Further and more ambitious interconnection prospects are emerging, and while many scenarios see grid interconnection playing an increasingly important role in the region's power development plans, the potential for interconnection to help accelerate uptake of renewables is, as yet, not fully appreciated.

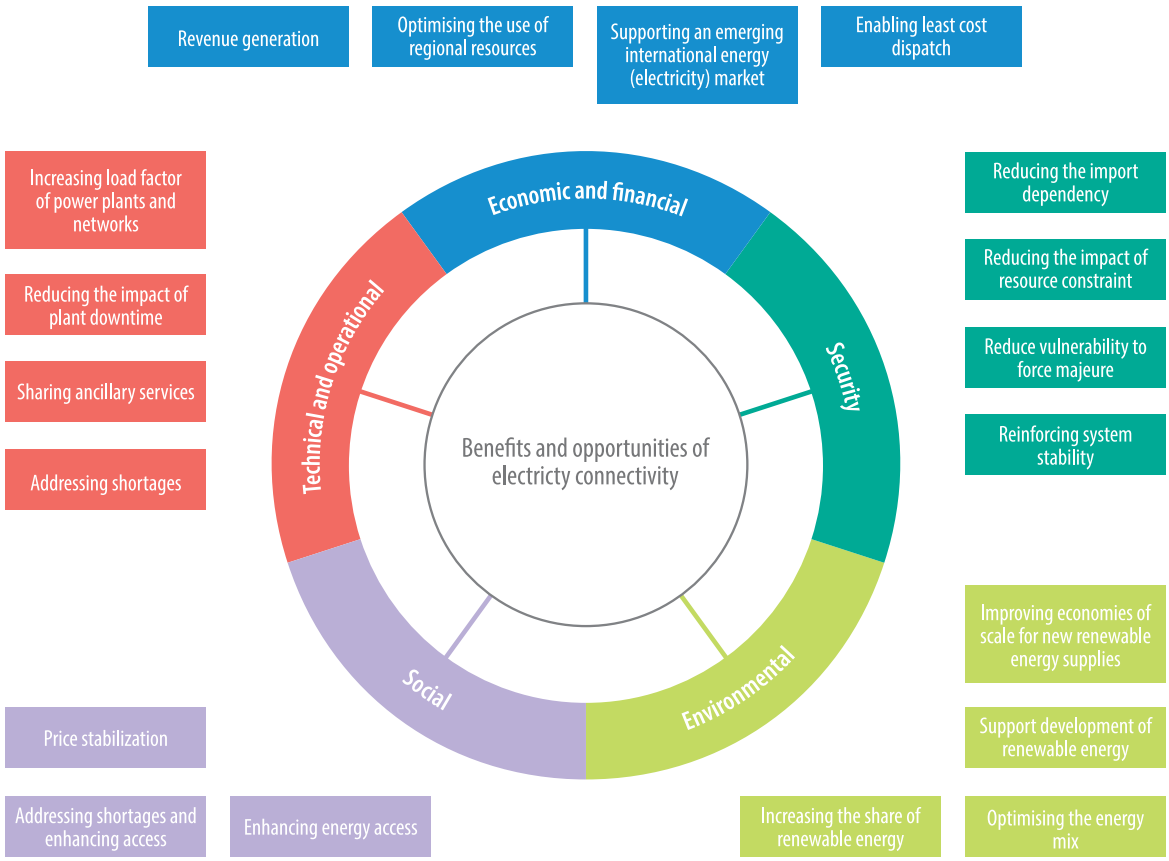
II. PROGRESS AND KEY CHALLENGES FOR ACCELERATION IN ASIA AND THE PACIFIC

Connectivity enables a range of economic advantages, including least-cost dispatch, price stabilization, and improving the economies of scale for new renewable energy supplies. It brings with it the potential for a range of social and environmental gains. It provides technical benefits, including reinforcement of system stability, opportunities for sharing of ancillary services and optimization of the energy mix, while reducing system vulnerabilities, fuel import dependencies and the impact of resource constraints. Figure 1 summarizes some of these benefits.

Development of renewable energy resources could replace or offset many planned thermal power plants without an increase in generation costs and, in some cases, even offer a reduction in cost. However, without power interconnection, these potentials will remain under-exploited due to a lack of adequate domestic demand. By providing long-term off-take opportunities, power interconnection can enhance the business case for new renewable energy developments, and economies of scale can then provide further advantages.

Connectivity can enhance access to clean energy resources and facilitate further growth of the renewable energy sector in other ways; new linkages to broader consumer bases can open renewable energy developers to alternate financial arrangements, and the reduction of risk can lower the cost of capital. Diversification of both suppliers and consumers can allow larger shares of variable renewables to be integrated into the grid. A recent study on interconnection in the ASEAN region noted that "establishing a scenario of enhanced energy interconnection among ASEAN, China and Bangladesh at a scale of approximately 10 per cent of total power exchange in ASEAN could lead to a 62 per cent share of clean energy in the power generation mix by 2050".[iv]

Figure 1: **Benefits of regional power trade**

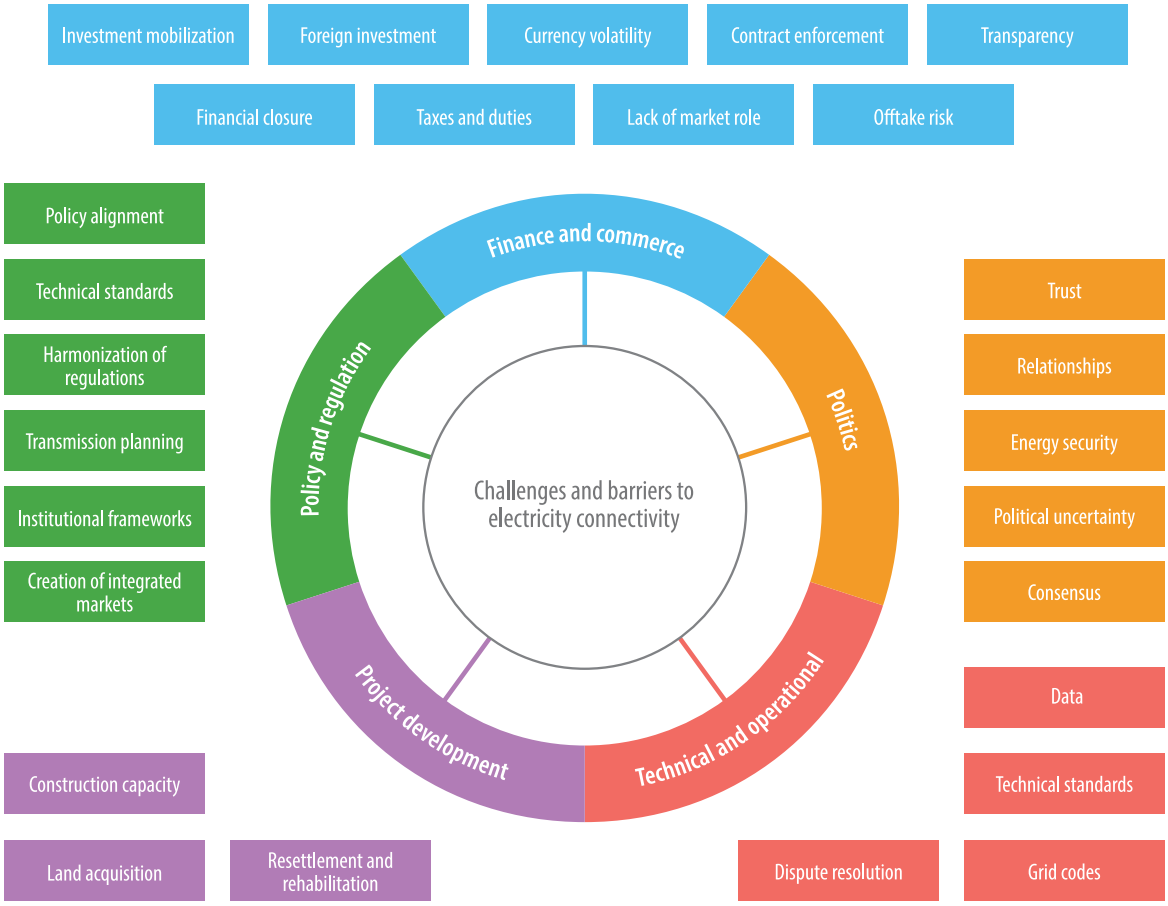


However, cross border trade of electricity faces barriers in areas such as politics, finance, and technical and operational risks. Connectivity requires the development of infrastructure, harmonization of technical and regulatory standards, coordination of policy, and the sharing of information and data.

Opportunities can be hampered by a lack of political will, concerns about energy security and difficulties in the alignment of technical regulations across borders. Nevertheless, the relationships developed in overcoming these challenges – in the development of shared infrastructure, harmonization of standards and sharing of information and data on grid operations – can open up further opportunities for regional cooperation in other spheres.

Electricity trade brings with it a heightened level of strategic importance due to its ties with a range of environmental factors, social and economic considerations, and national energy security concerns. The perceived risks – and the complexity – of electricity interconnection are thus greater than those of most commodity trade. These concerns produce a unique set of challenges and barriers, some of which are outlined in Figure 2.

Figure 2: **Challenges and barriers to connectivity**



III. EXISTING AND PLANNED SUB-REGIONAL INITIATIVES

At present, interconnectivity and trading of energy in the Asia-Pacific region is largely bilateral. Interconnections are not numerous and are generally of low capacity. These connections were often built for the purpose of near-border trading, not with the intention of integration to create international, sub-regional- or regional-scale power grids.

However, countries across the region have recognized the potential benefits of regional energy cooperation and cross-border electricity trade and are working together to enhance their cooperation through a range of sub-regional forums and initiatives.

South Asia, with its diversity of energy resources and development needs, offers one of the most attractive opportunities for an interconnected power system across the Asia-Pacific region. Movements towards this vision commenced as early as 1954 with an agreement to develop the Koshi hydropower project. In more recent decades, the South Asian Association for Regional Cooperation (SAARC) has continued to play a leading role in developing the vision.

India is now a hub of the sub-regional power sector. Multiple cross-border interconnections have been established with Bangladesh, Bhutan, Myanmar and Nepal. This interconnected system is expanding with expectations that its capacity will be doubled by 2023, while becoming more market-oriented and focused on the integration of participating grids. Achievement of this goal will require further effort across the political, legal, regulatory, policy, technical, operational and market dimensions. Further afield, a feasibility study has shown the technical and financial viability of interconnecting India and Sri Lanka through a submarine cable. Another feasibility study that investigated linking India to Pakistan is also under consideration by both Governments.

In the western part of South Asia, Pakistan and Afghanistan are connected through Central Asia and import power from the Islamic Republic of Iran, Tajikistan, Uzbekistan and Turkmenistan. Pakistan and Afghanistan have signed agreements with Tajikistan and Kyrgyzstan to import electricity through the Central Asia-South Asia Electricity Transmission and Trade Project titled CASA-1000. Financial closure of this $1.16 billion transmission link has already been completed, signifying an important step toward realizing the planned Central Asia-South Asia Regional Electricity Market. Turkey is well-connected to Bulgaria, Greece, Syria, Georgia, the Islamic Republic of Iran, Iraq, Armenia and the European system of transmission networks. The Islamic Republic of Iran is also connected to Pakistan and Afghanistan, and Afghanistan's transmission system is connected to Uzbekistan, Turkmenistan and Tajikistan.

In the South-East Asian energy sector, the coming decades will be dominated by challenges in managing the growth of energy consumption and moving away from a fossil-fuel reliant energy mix. A widening gap between supply and demand will create new risks for security of supply and affordability, leading to growing import dependence. It is estimated that ASEAN oil import dependency will increase from 44 per cent in 2011 to 75 per cent in 2035. All ASEAN members are expected to become net importers of fossil fuels by 2030, with the exception of Brunei Darussalam and Indonesia. Increases in the use of fossil fuels will lead to CO_2 emissions to be grown from 1446 million tons in 2015 to 3464 million tons in 2040.[vi]

The development of the subregion's vast low-carbon energy resources could address these two challenges simultaneously, without increasing the cost. Previous work has identified more than 241 GW of feasible hydropower potential, amounting to more than ASEAN's total generation capacity in 2015, while South-East Asia is also highly suited for exploitation of solar and biomass energy resources. However, even the cost-effective hydropower and geothermal resources are presently underdeveloped.

Power grid connectivity offers an opportunity to connect these renewable resources to the growing demand centers of the subregion, thereby enabling their development.

ASEAN has established itself as a pioneer in regional energy connectivity due to its political integration architecture, and transboundary power trade is already quite common between countries in ASEAN. The ASEAN Power Grid (APG), a plan for interconnection across all 10 ASEAN members, has been placed among the top priorities of the regional integration agenda. Further extensions of the APG to neighboring countries are under development or active consideration: to China under the Greater Mekong Subregion (GMS) power framework; to Australia, which is actively investigating the potential of exporting solar electricity via a submarine HVDC cable to Singapore; and to countries in South Asia through the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation.

Likewise, much of the North-East Asia region is rich with conventional energy resources. There are abundant prospects for renewable energy resource development – particularly wind, solar and hydropower potential in China, hydropower potential in the Russian Federation, and solar and wind in Mongolia. The region exhibits excellent prospects for connectivity, with a combination of local seasonal resource excesses and shortfalls together with potential for development of flexible generation capacity. At present, electricity trade is primarily bilateral between the Russian Federation-Mongolia, Russian Federation-China and Mongolia-China. These interconnections were generally intended for near-border trading of electricity and most are of relatively low capacity. Most electricity trade is undertaken through bilateral arrangements and a range of bilateral intergovernmental commissions on economic and technical cooperation exist, providing reliable and government-supported cooperation channels.

It is clear that institutions play an important role in supporting connectivity initiatives. The International Renewable Energy Agency (IRENA), Renewable Energy and Energy Efficiency Partnership (REEEP), International Energy Agency (IEA), Renewable Energy Policy Network for the 21st Century (REN21), the International Solar Alliance (ISA) and various United Nations bodies including the Economic and Social Commission for Asia and the Pacific (ESCAP) are making significant contributions in this space and across the broader energy transition.

Multilateral power grid connectivity arrangements are beginning to develop among North-east Asian industrial, government and international partners. Institutes in Mongolia, the Republic of Korea, Japan, the Russian Federation and China have all signed MOUs and supported the completion of studies on the prospects of a North-East Asia-wide grid, Gobitec and the Asian Supergrid. (Gobitec proposes production of renewable solar and wind energy in the Gobi Desert – which holds potential of around 2,600 TWh –to supply high-demand regions via the planned Asian Supergrid connecting the Russian Federation, Mongolia, China, the Republic of Korea and Japan.) The North-East Asia Regional Power Interconnection and Cooperation (NEARPIC) forum, initiated by the China Electricity Council in 2016 and held annually in different countries of the subregion, provides an important platform for discussion of approaches and actions in promoting and developing power interconnection across the subregion.

In September 2018, President Khaltmaagiin Battulga of Mongolia proposed the establishment of an organization to formulate a comprehensive policy and prepare relevant agreements and negotiations on the North-East Asian Supergrid project with the appropriate involvement of Mongolia, the Russian Federation, China, Japan, the Republic of Korea and the Democratic People's Republic of Korea.[vii] The ADB in 2019 undertook detailed technical studies which concluded that the project would support development of renewable energy capacity of up to 100 GW at a lower cost than that of alternatives options.

The power systems of the Central Asian Republics (CAR) were largely designed under the former Soviet Union, taking into account the natural advantage of available fuel and energy resources and seasonal electricity exchange across the subregion. As a result, they feature a high degree of cross-border interconnection. Climate and natural conditions of the subregion provide ample opportunities for the use of renewable sources, which will play an increasingly important role in diversifying the energy balance, energy security and reducing harmful emissions into the atmosphere going forward.

Intergovernmental relationships in Central Asia are primarily bilateral. Intergovernmental commissions on trade, economic and scientific and technical cooperation are prominent supporters of bilateral cooperation in the energy sector, supporting harmonization of regulations together with cooperation on power plant and transmission infrastructure development, fuel supply, energy conservation, equipment procurement and environmental protection. The Coordination Dispatch Center Energiya (CDC) is a multilateral institution that was established in 2003 as a non-governmental, non-profit organization overseeing power transmission activities of Kazakhstan, Uzbekistan, Kyrgyzstan and Tajikistan. Another multilateral arrangement is the Electric Power Council of the Commonwealth of Independent States (CIS), consisting of all Central Asian countries and Armenia. Its work includes the harmonization of standards and codes across the subregion together with making sure that appropriate legal and commercial conditions are in place to ensure the success of power system cooperation.

Looking forward, the bilateral arrangement structure will be strengthened and will provide a reliable and state-supported channel for cooperation in the Central Asian energy sector. In some cases, the transition from a bilateral form to a multilateral form of cooperation and agreements will allow the countries of the subregion to increase the reliability and economy of the energy systems.

Member States have recognized the opportunity for connectivity to contribute to the acceleration that is needed to deliver the goals of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change. ESCAP was tasked with developing a draft regional roadmap on power grid connectivity, which was presented to the Second Committee on Energy who agreed with the draft and recommended the document be submitted for endorsement by ESCAP member States at the seventy-sixth session of the Commission.

The draft roadmap is based on a set of nine reference strategies (listed in the policy recommendations below). The overall objective of the roadmap is to eventually create a pan-Asian interconnected grid that offers a more reliable, affordable and sustainable electricity supply while aligning power system connectivity with the Sustainable Development Goals, in particular in meeting the SDG7 targets.

In addition to the strategies for electricity connectivity identified in the roadmap, member states at the Third Forum of Ministers and Environment Authorities of Asia Pacific, Singapore, 23-25 January 2019 identified a number of energy-related issues including:

- National Cooling Action Plans can be adopted to reduce green-house gas emissions;
- There is a need for reinforced and scaled-up regional and global coordination for science and technology transfers including for energy efficiency;
- Tracking of energy efficiency in buildings and taking action to increase energy efficiency can save significant money, which makes green buildings a viable investment. Green building action plans can be used to encourage more investment in this sector.

IV. POLICY RECOMMENDATIONS FOR ACCELERATION

Member states recognize the enormous opportunity for connectivity to contribute delivering the goals of the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change.

The following recommendations for acceleration on Enhancing Power Grid connectivity to achieve affordable and clean energy for All are extracted from the draft roadmap and the energy-related issues at the Third Forum of Ministers and Environment Authorities of Asia Pacific.[viii] (see above).

1. Strengthen political commitment for enhancing power grid connectivity. This can be achieved through a number of specific actions. To build trust, political consensus and promote continuous dialogue, a regular regional meeting on power system integration could be delivered. Harmonizing policy and regulatory frameworks could be achieved by identifying gaps in policy, regulations and standards and by developing sub-regional associations of national regulators. Ensuring coherence with the Sustainable Development Goals is another priority where political will is required, through the adoption of a set of principles to enable assessment of power grid projects against sustainability criteria.

2. Strengthen regional cooperation. Regional cooperation is essential to ensure power grid connectivity and all its benefits in terms of achieving affordable and clean energy for All. In particular, the development of a regional Masterplan would allow the identification of existing cross-border transmission and generation assets and the development of a blueprint for planned intra- and inter-sub-regional grid connection is recommended. Developing new intergovernmental agreements would also vastly facilitate regional cooperation, including an intergovernmental body for the Northeast

Asian subregion and at least one additional sub-regional interconnection agreement. The launch of the International Solar Alliance, which provides a mechanism for cooperation on renewable energy[2] will also strengthen regional cooperation. Further, reinforced and scaled-up regional and global coordination for science and technology transfers including for energy efficiency is recommended. Lastly, coordination of transmission planning and operation would be needed for the development of common codes, technical regulations, transmission plans, protection schemes and feasibility studies.

3. Ensure that adequate finance, trade and innovation agreements are in place. Of critical importance for acceleration on Enhancing Power Grid connectivity is to ensure that adequate finance and trade agreements are in place. Investment can be mobilized through the creation of sub-regional platforms for financial institutions, utilities and government. Additional relevant innovations-based initiatives could be developed such as Green Building Action Plans and National Cooling Action Plans. The tracking of energy efficiency in buildings and increases in energy efficiency have the potential to save significant resources, which makes green buildings a viable investment. Green Building Action Plans, together with Cooling Action Plans will contribute significantly to the CO_2 reductions in the residential sector and can also be used to encourage more investment in this sector. Finally, from a trade perspective, delivering studies to evaluate social, economic and environmental benefits of multilateral trade and competitive markets for cross-border trade of electricity could advance the work towards multilateral trade and the creation of competitive markets.

4. Share learnings and build capacity. Developing capacity-building, knowledge generation and data support plans with identified resources are key elements to support enhanced power grid connectivity in Asia and the Pacific.

ACKNOWLEDGEMENTS

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END NOTES

[i] https://sustainabledevelopment.un.org/content/documents/24797GSDR_report_2019.pdf

[ii] World Energy Council, (2019). The sustainable supply and use of energy for the greatest benefit of all people. World Energy Issues Monitor 2018. London.

[iii] https://undocs.org/en/A/RES/74/225

[iv] ESCAP, (2018). Integrating South Asia's Power Grid for a Sustainable and Low Carbon Future. Bangkok: United Nations Economic and Social Commission for Asia and the Pacific. Available at https://www.unescap.org/sites/default/files/Integrating South Asia's Power Grid for a Sustainable and Low Carbon Future_WEB.pdf.

[v] IEA, (2019). Establishing Multilateral Power Trade in ASEAN. Paris: International Energy Agency.

[vi] ASEAN Centre for Energy (2017). The Fifth ASEAN Energy Outlook 2015-2040. Available at http://www.aseanenergy.org/resources/the-5th-asean-energy-outlook/.

[vii] Batmunkh, Yeren-Ulzii (2018). Role and expectation of Mongolia in promoting energy cooperation in North-East Asia. North-East Asia Regional Power Interconnection Forum. Ulaanbaatar 2018. Available at https://www.unescap.org/sites/default/files/Session%2034.%20Mongolia-Ministry%20of%20Energy.pdf.

[viii] https://www.unenvironment.org/events/conference/third-forum-ministers-and-environment-authorities-asia-pacific

[2] Note also that the International Renewable Energy Agency (IRENA), Renewable Energy and Energy Efficiency Partnership (REEEP), International Energy Agency (IEA), Renewable Energy Policy Network for the 21st Century (REN21) and various United Nations bodies including ESCAP are making significant contributions in supporting the energy transition across the region.