69. Harnessing energy efficiency is one of the most effective ways to meet growing energy demand and decrease upward pressure on energy prices while addressing climate change. The costs of deploying proven energy efficiency measures are normally lower than adding new supply or generation capacity. The potential of energy efficiency in Asia and the Pacific remains high, and many of the regions' large DMCs have taken determined measures to systematically address energy efficiency in their policies and regulation and have thus demonstrated declining energy intensities. ADB aims to become a leader in Asia and the Pacific for energy efficiency by utilizing innovative financing instruments and leveraging private sector resources.

70. The success of the quest for demand-side energy efficiency depends largely on policy actions in the public sector. ADB stands ready to provide the DMCs with technical assistance, grants, and loans to set up legal and regulatory framework, policies and programs that support energy efficiency and to develop incentive mechanisms for consumers, utilities, energy service companies and other market players to increase efficiency. ADB stands ready to support DMCs to resolve both downstream and upstream barriers to energy efficiency with respect to their national circumstances and to realize the long-term gains of energy efficiency. In particular, results-based loan instruments can be deployed to support DMCs in scaling up their energy efficiency programs.

71. ADB will also seek to support energy efficiency in its DMCs by collaborating with industry associations, banks, and specialized energy efficiency agencies, including through loans for onlending under the financial intermediary loan instrument. Funneling programs through such locally based entities and combining financing with capacity building and technical assistance can help reach the scattered opportunities in the industry, commercial, and residential sectors and to induce the necessary behavioral changes for energy conservation.

72. Energy efficiency targets and plans should be thoughtfully designed to meet the needs and enforcement structures of the individual DMCs. International references and best policy practices for energy efficiency measures are available. Those include, for instance, minimum energy performance standards set for appliances and equipment, fuel economy standards for vehicles, standards for electric motors in industry, mandatory energy audits and energy management policies for large industrial and commercial companies and building codes for various kinds of buildings. Codes, standards, and obligations, however, are not effective without properly planned enforcement mechanisms. Measures should also follow priority orders established by their effectiveness proven under local circumstances and consumer behaviors. They should take into consideration affordability in the targeted consumer group in light of trade-offs between the higher first costs of more efficient buildings, vehicles, appliances, etc., versus the benefits that accrue later through better energy efficiency.

73. Meanwhile, transmission and distribution loss and inefficiency remain a significant problem in many DMCs. ADB will continue supporting DMCs to increase supply-side energy efficiency and build on its experience in providing loss reductions in electricity transmission and distribution, including use of high temperature low sag conductors which can withstand higher operating temperatures, thus carrying higher power compared to conventional conductors. ADB also supports use of drones with advanced sensors for inspection and maintenance of transmission lines and identifying and mitigating risks in power distribution in advance. Moreover, ADB will support use of digital technologies such as smart meters to support demand side energy efficiency.

74. District heating through centralized heat production—often in combined heat and power plants or using waste heat, heat pumps, geothermal and natural gas, and through district or city-wide insulated distribution networks—is more efficient and cleaner than decentralized heating in buildings by smaller coal-based boilers. District heating for densely populated areas delivers higher energy efficiency, lower air-borne pollution levels, and more comfortable living conditions. Heating infrastructure is essential in most Central and East Asian DMCs. ADB therefore supports the construction, expansion, efficiency improvement, and rehabilitation of old district heating networks. Waste-to-energy plants can contribute to improved waste collection and sorting and is one supply-side option for centralized heat production.

75. The heating sector is today undergoing a transition as electricity and renewable energy have been introduced to the subsector to replace fossil fuels. This is leading to hybridized and distributed heating solutions that are connected to a network. ADB will work with the DMCs to support this transition. Heat pump technology is the key driver in the transition as it is powered by electricity, which is gradually becoming increasingly decarbonized and free from local pollution. Heat pumps can draw heat from a wide variety of sources, which is one of the technology's major competitive advantages. The most frequently used energy sources include outdoor air, building exhaust air, shallow ground geothermal, vertical heat wells, river water, sea water, city sewage water, industrial exhaust heat sources, and medium deep geothermal energy.

76. With growing economic prosperity and global warming, the demands for cooling buildings and maintaining cold chains in product deliveries are rapidly increasing in Asia and the Pacific. Air conditioners and electric fans globally represent one-fifth of the total electricity consumption of buildings. This escalating growth in the use of air conditioners causes stress and investment needs for electricity distribution and power generation and contributes to higher GHG emissions. To manage this process in alignment with the Policy Principle one, ADB is ready to support DMCs in devising policies and investment programs needed to introduce new technologies, including energy efficient air conditioners and renewable energy for cooling solutions. At the same time, energy efficiency measures should not lead to expanded use of fluorocarbons including hydrofluorocarbons (HFCs) for cooling, contributing to higher GHG emissions. Phase-down/phase-out of fluorocarbons and energy efficiency measures need to be coordinated across the life cycle of fluorocarbons.[24] ADB will support its DMCs in achieving the phase-down of HFCs as scheduled by the Kigali Amendment to the Montreal Protocol. As absorption chillers are driven almost entirely by heat, their cooling capacity does not contribute to the peak electricity demand. Therefore, many new solutions introduced for district heating are also applicable for cooling large buildings or driving district cooling systems for shopping malls, educational institutions, hospitals, hotels, and residential complexes. These include waste heat from industrial processes, solar collectors, and geothermal heat.

Accelerating Renewable Energy Deployment

[24] ADB is a signatory of the Initiative on Fluorocarbons Life Cycle Management. The life cycle management of fluorocarbons requires (i) development, manufacture, and use of refrigerants with zero or low global warming potential as an alternative to fluorocarbons including replacement of old cooling equipment (upstream), and (ii) recovering, recycling, and destructing the discarded fluorocarbons (midstream and downstream).

77. The energy sector transition to a low-carbon pathway includes coal being replaced by renewable primary energy sources in electricity production. In parallel, electricity will also increasingly replace fossil fuels as an energy carrier in the final energy consumption. This two-fold strategy focuses on expanding the capacity of the power sector while ensuring a transition to sustainable power supply. This will require increased investments in renewable electricity generation capacity and ensuring the ability to integrate more variable renewable electricity into power systems.

78. Final energy consumption remains dominated by direct use of fossil fuel, with limited share of electricity in final consumption, reflecting that industry accounts for the largest share in total final consumption. Many industrial processes are difficult to decarbonize, including those requiring very high temperatures that cannot be met by heat pumps or solar thermal and those requiring fuel to contribute to a chemical process. Therefore, decarbonization solutions must include interventions beyond the power sector to decarbonize the various direct uses of fossil fuels through modern electricity-based processes and green hydrogen. As such, in parallel with supporting a decarbonized power system, ADB will support knowledge sharing and demonstration of these new technology options for the more difficult to decarbonize industrial segments.

79. ADB will support a transition to cleaner power systems by supporting accelerated deployment of renewable energy including sustainable hydropower,[25] solar PV installations and concentrated solar facilities for power, solar energy from collectors to heat, and on-shore and off-shore wind power. In addition to wind and solar, long-term decarbonization targets are expected to require investment in a wide portfolio of technologies, including sustainably sourced bioenergy for fuels and power and geothermal energy for heating and power. ADB also recognizes the importance of next-generation renewable energy technologies, such as technologies that harness tidal and wave energy, for meeting the targets under the Paris Agreement, and will support their deployment in ADB's DMCs.

80. ADB's approach to supporting large hydro power plants (including pumped storage) with seasonal storage reservoirs with multipurpose benefits will be highly selective. ADB will only support large hydropower schemes that have been evaluated as part of a robust strategic environmental and social assessment that has considered both alternative locations and designs. This assessment will need to have been informed by current environmental and social baseline data, with particular attention paid to assessing cumulative impacts on aquatic and terrestrial ecology and affected communities. At a project level, independent environment, social, and dam safety experts shall be involved from the start in project design and implementation, with particular attention paid to ensuring eco-sensitive design, such as an ecologically led e-flow assessment and the inclusion of fish passes, ecological offsets, compensation for land acquisition and resettlement, and livelihood restoration in accordance with ADB's safeguards as well as international good practice for large hydropower. In view of the number of ageing hydropower plants in the region and the associated risks, ADB will support DMCs in rehabilitating or replacing electrical, mechanical, and electro-mechanical equipment in these facilities.

81. ADB will support the deployment of various kinds of energy storage, be it for electricity or heat, increasing demand-side flexibility and system capacity to integrate variable renewable electricity into the systems. The declining cost of storage technologies, especially

[25] Sustainability of hydropower can be assessed with the Hydropower Sustainability Tools governed by a multi-stakeholder body, the Hydropower Sustainability Assessment Council.

battery energy storage system, allows for applying the technology to smooth the load curve of renewable energy generation, provide peaking and reserve capacity, and help maintain frequency. This helps critical services continue operations and thus replaces diesel-powered generation sets. Behind-the-meter household batteries also contribute to managing peak demand, improving load factor, and reducing network congestion. It is noted, however, that use of battery energy storage system will lead to a build-up of used batteries over time, a hazardous waste, which most DMCs do not have the capacity to dispose of. Left unaddressed, this could well become a major environmental issue. Therefore, as ADB supports energy storage, it will also offer support to DMCs for developing battery waste management systems at both policy and operational levels.

82. ADB will support waste-to-energy investments provided that the feedstock for combustion prudently follows the waste management's order of priority, which considers first reducing waste generation, then opportunities for materials re-use and recycling, then using waste to generate energy or basic material (such as in civil construction), followed by landfilling as the last option. Support for waste-to-energy investments and waste value chains, as they provide an opportunity for integrated cross-sectoral projects that can create sustainable livelihoods for the poorest-of-the-poor working in the waste value chain and at landfills. Waste-to-energy investments also improve local environments and health in cities and rural areas, by removing the environmental hazards caused by open waste dumping. Potential environmental and social impacts of waste-to-energy investment can be managed through appropriate design and operation using international best available technologies. A detailed guidance note will be issued to staff in processing waste-to-energy projects.

83. ADB's safeguard policies help DMCs to address environmental and social risks in energy projects and to minimize, mitigate, and avoid adverse project impacts on people and the environment. The low-carbon transition will increase the amount of solar and wind energy in use. It will also expand electricity transmission networks and set new requirements for mitigating projects' environmental and biodiversity impacts and sensitivities, which differ from those of past fuel-based projects or hydropower. Solar, wind, and transmission projects, for example, have little effect on inland waters, but they cover more expansive areas of land and sea and have an impact on birdlife. Most risks can be mitigated and avoided through effective early planning, ensuring developments will be sited at areas or zones of low biodiversity and other sensitivities.

Role of Specific Energy Sources

84. Coal consumption accounted for 43% of final energy use in industry in Asia and the Pacific in 2019. The projections of international agencies for carbon neutrality by the middle decades of this century include assumptions of (i) rapid transition of power systems to renewable energy, (ii) increased use of electricity in industry and transport; (iii) application of carbon capture, utilization and storage technologies to remaining coal and natural gas operations; (iv) shifting to the use of hydrogen and hydrogen-derived synthetic fuels; and (v) using more sustainable alternative fuels and feedstock such as bioenergy.[26]

85. ADB will supports DMC in preparing long term energy plans, roadmaps, strategies and policies, that include the rapid phase-out of coal from their power generation subsector

[26] International Energy Agency. 2020. Energy Technology Perspectives 2020. Paris.