In 2016 and 2017, Asia saw the largest deployment of solar and wind power worldwide (IRENA 2018a). China and India have led the development of these technologies and have mobilized the largest amount of clean energy asset finance since 2010. These trends will continue in the future, as both countries aim to meet their ambitious renewable energy targets.

China’s targets include an installed capacity of at least 110 gigawatt (GW) of solar power and 210 GW of wind power by 2020. China will account for 40 percent of global renewable expansion between 2017 and 2022 (Figure 1).

India’s ambitious renewable energy targets are second only to China’s and include the development of 135 GW of utility-scale power. Utility-scale photovoltaic (PV) and wind power were significantly cheaper than fossil-fuel based alternatives in India by the end of 2017 and were expected to constitute most of the capacity that will be added between 2018 and 2022. Utility-scale renewables in India will provide investment opportunities of $53 billion during this period (Figure 2). In the past, debt from domestic and international banks and private and corporate equity provided most project finance in India. In 2018, the launching of several public offers by Independent Power Producers will open up the market to a broader group of investors (BNEF 2017). India’s renewable energy market has become increasingly attractive for investors due to factors that include low risk, medium to high growth, and high cash-flow stability (Jena et al. 2018).
Important opportunities also exist in the Association of Southeast Asian Nations (ASEAN) countries, where electricity demand is expected to grow 93 percent between 2018 and 2025 and where renewable sources look increasingly competitive based on wide availability of sun and wind resources, shortage of conventional power sources, and regional declines in the cost of renewable technologies (Gloystein and Eckert 2017; IRENA and ACE 2016). In 2017, the region also offered conducive regulatory frameworks, government support, strong developer and supplier interest, and abundant availability of domestic and international financing (Gloystein and Eckert 2017).

ITA (2017) identified China, India, Indonesia, Vietnam, Malaysia, the Philippines, and Thailand as having good market opportunities for U.S. firms in transmission and distribution (T&D), information communications technologies (ICT), and energy storage.

### Policy and Regulatory Environment

China is replacing its underfunded feed-in-tariffs (FITs) for renewable electric power generation with a quota system that includes green certificates. In March 2018, China’s National Energy Administration proposed a Renewable Portfolio Standards (RPS) policy under which each province is assigned two targets for 2018 and 2020, one including all renewables and another excluding hydro. Most provinces will need to either import renewable energy or increase generation to meet their targets. These changes combined with power market reforms, public investment in new transmission lines, and the expansion of distributed generation are expected to speed up deployment of solar and wind power (IEA 2017).

China is also seeking to improve unhealthy urban air quality by substituting renewable sources of electric power for coal.

In 2017, national and state renewable energy auctions helped India increase its cumulative, installed capacity of grid-connected PV by 84 percent to 12.3 GW. Economic Times (2018) reported that other actions to improve the financial health of utilities and address grid-integration challenges will help India meet its installed capacity target of 175 GW of renewable electric power by 2022, including 100 GW of solar power. India policies and fiscal incentives for renewables also include FITs in certain states, guaranteed grid access, tax reliefs, and net metering polices (OECD 2017).

ASEAN set an aggregate target across its member countries of 23 percent of primary energy from renewable sources by 2025. To meet this goal, electricity generation from renewable sources will need to increase from 20 percent in 2014 to 35 percent in 2025, and renewables will need to account for 57 percent of new capacity additions during this period, mostly from hydropower, PV, and wind (IRENA and ACE 2016). At the national level, most countries in Southeast Asia have adopted targets for renewable energy that will likely drive an ongoing increase in renewable energy adoption (Table 1).

#### Table 1. Renewable Energy Targets and Policy Instruments in Selected Asian Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Renewable Power Target</th>
<th>Renewable Energy Target</th>
<th>Feed-In Tariff</th>
<th>Competitive bidding / auction</th>
<th>Tax incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>10% (2035)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambodia</td>
<td>26% (2035)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Indonesia</td>
<td>25% of primary energy (2025)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lao People’s Democratic Republic</td>
<td>30% of final energy consumption (2025)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Malaysia</td>
<td>9% (2020)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Myanmar</td>
<td>15%-18% (2020)</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Philippines</td>
<td>40% (2020)</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Thailand</td>
<td>20% (2036)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vietnam</td>
<td>5% (2020)</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>


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1 ASEAN member states are Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Thailand was the leading generator of solar power in Southeast Asia with an installed capacity of 2,700 megawatts (MW) in 2017. The Government of Thailand has mainly used FITs to encourage PV investments. Thailand has set a cumulative capacity target of 6,000 MW of PV by 2036. The Philippines also used FITs to help increase PV capacity from 22 MW in 2014 to 885 MW in 2017. The Philippines has a target of 3,000 MW of utility-scale solar power by 2022. Indonesia, Malaysia and Vietnam also offer FITs and have set PV capacity targets of 5,000 MW, 1,356 MW and 850 MW, respectively, by 2020 (IRENA 2018; AsianPower 2018; Tan and Asmarini 2016). In December 2017, Malaysia awarded 563 MW of solar power in its second large-scale solar auction (Kenning 2017). In March 2018, Malaysian utility Tenaga Nasional Berhad (TNB) signed 21-year power purchase agreements (PPA) for eight PV projects with a cumulative capacity of 240 MW awarded through the tender (Kenning 2018a).

Most ASEAN countries also exempted renewable energy investments from corporate income and import taxes, and Indonesia, Malaysia, and Thailand offered soft loans for developers. Countries that provided a combination of FITs with other incentives experienced the highest growth in renewable power between 2006 and 2016 (Tongsopit et al. 2017). Cambodia, Indonesia, Malaysia, and Thailand have started using competitive auctions and most countries in the region will likely implement auctions in the coming years (IRENA 2018b). In Vietnam, provinces have started developing PV plans and regulation for projects up to 50MW, offering better terms and options for investors than the national government (Kenning 2018b).

**SOLAR POWER**

Photovoltaic power potential is particularly high in Afghanistan, Pakistan, and southwestern China, all of which have areas with a yearly potential of more than 1,900 kilowatt hour/kilowatt peak (kWh/kWp) (Figure 3).

**Figure 3.** Solar Energy Resources in Asia and the Pacific (Photovoltaic Electricity Output)

The Levelized Cost of Energy (LCOE) for PV power in China and India were among the most competitive in the world in 2017. Japan’s LCOE for PV was more than double the cost of India’s (Figure 4).

**Figure 4. Solar Photovoltaic Levelized Cost of Energy in Asia Pacific Region in 2018 ($/MWh)**

The International Energy Agency (2016) projected that China and India would account for almost 70 percent of PV expansion in Asia between 2015 and 2021 (Figure 5). In 2018, China will install up to 60 GW of PV, potentially representing more than half of a global estimate of 113 GW. Installations were expected to peak around the FIT deadlines planned for the second and fourth quarters of 2018. India is poised to overtake the U.S. as the second largest PV market in the world (Osborne 2018). In other parts of Asia and the Pacific, deployment of solar power could accelerate as the Asian Development Bank signed in March 2018 a cooperation agreement with the International Solar Association and committed to provide $3 billion per year by 2020 for clean energy, including solar energy projects, in the region (Economic Times 2018b).

**Figure 5. Projected Photovoltaic Electric Power Capacity in Asia, 2015-2021**

*Source: IEA 2016.*
Indonesia, Lao PDR, Myanmar, the Philippines, Thailand and Vietnam have set national targets for wind power (Table 2).

**Table 2. National Wind Power Targets in Selected Countries**

<table>
<thead>
<tr>
<th>Country</th>
<th>National Target by 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>1.5 GW</td>
</tr>
<tr>
<td>Lao People’s Democratic Republic</td>
<td>73 MW</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2 GW</td>
</tr>
</tbody>
</table>

Source: IRENA 2018b.

FITs and priority grid connections have encouraged wind project development in the Philippines, Thailand, and Vietnam, resulting in nearly 1 GW of collective installed capacity as of 2017 (IRENA 2018b). Afghanistan, China, India, and Pakistan also have significant wind resources (Figure 6).

**Figure 6. Wind Power Density in Asia at 100 Meters**

As in the case of PV, the average LCOE for onshore wind in China and India was among the most competitive in 2017. Japan, Thailand, and Indonesia had the highest LCOE in the region (Figure 7). By 2021, almost 94 percent of Asia’s onshore wind installed capacity will be located in China and India (Figure 8). Offshore wind will likely increase in the coming years. India has a target of 5GW by 2022, up from zero in 2018. In April 2018, the government invited private firms to participate in a process to shortlist prospective developers for a 1 GW offshore wind energy project in the Gulf of Khambat, off the coast of Gujarat (Saluja 2018). China had 2,641 MW of offshore wind by 2017 and will have an estimated 6,800 MW by 2021 (IRENA 2018a; IEA 2016).
Figure 7. Onshore Wind Levelized Cost of Energy in Asia Pacific Region in 2018 ($/MWh)

Source: Bloomberg New Energy Finance

Figure 8. Projected Installed Capacity of Onshore Wind Power in Asia, 2015-2021

Source: IEA 2016.
SMART GRIDS

In 2017, high transmission and distribution (T&D) losses ranging from 15 and 50 percent in Indian states jeopardized the financial position of many utility companies, which include firms owned by the central government, state governments, and the private sector. Smart-grid technologies could reduce these losses. According to a 2017 survey, two-thirds of Indian power utilities cited digitization of manual processes as one of the biggest drivers of growth and indicated interest in investing in technology to increase their organizational flexibility and agility. Among Indian utilities, cloud platforms for data management, Internet of Things, and utilization of data within 3D visualizations were particular priorities for organizations looking at new areas of technology investment (Economic Times 2017). India’s electricity market had the second largest customer base in the world in 2017 and is generally open to international vendors (Northeast Group 2017).

China plans to invest $270 billion to improve T&D through 2020, including construction of 144 GW of long-distance, high-voltage lines (BNEF and UK Aid 2017). Northeast Group (2016) identified wide area measurement (which combines the functions of metering devices and the abilities of communications systems) and automation of data collection and analysis as market segments in China where international suppliers were competitive.

Energy storage will offer increasing business opportunities in Asia. China will become the second largest energy storage market in the world in 2019 and will remain in this position through 2022, with cumulative deployments of around 10,000 MWh between 2013 and 2022. India will be the second largest emerging economy in the energy storage market segment and will rank seventh among all countries (Manghani and McCarthy 2018).

The Government of the Philippines is committed to making the electricity grid fully interconnected by 2020. ITA (2017) identified good opportunities for U.S. firms offering software and hardware to integrate variable renewable energy into the grid, smart metering, consumer interface technologies, Supervisory Control and Data Acquisition systems (SCADA) to improve grid automation, and microgrids for remote islands. Malaysia is an upper-middle income country that needs to expand electric power capacity and generation in the near future. ITA (2017) identified T&D as an area with large opportunities for U.S. firms in Vietnam.

The expansion of ASEAN’s regional grid will offer additional opportunities for T&D services and products. The ASEAN Power Grid (APG) will increase its capacity by 3,300 MW between 2018 and 2021 to a cumulative 8,512 MW. The APG could reach a capacity of more than 20,000 MW if multi-country projects are implemented. The first of these projects, the Lao PDR-Thailand-Malaysia (LTM project) Power Grid connection, was in construction in 2017. The ASEAN Plan of Action for Energy Cooperation 2016-25 aims to initiate multilateral electricity trade through the APG in at least one sub-region by 2018 (OECD 2017).


———. 2018a. “TNB signs PPAs for another 60MW of Malaysian PV projects,” (March 30). PVTECH.


