Promoting Socially and Economically Just Energy Transformations in Asia

Possibilities, Challenges and the Road Ahead

Miranda A. Schreurs and Julia Balanowski

FRIEDRICH EBERT STIFTUNG

Contents

List of Tables

List of Abbreviations

CO_2	carbon dioxide
GDP	gross domestic product
GW	gigawatt
ISIS	Islamic State of Iraq and Syria
MW	megawatt
tCO_2e	tonnes of CO_2 equivalent
US	United States of America

Foreword

Tackling climate change will not be possible without a significant contribution from Asia. According to economic forecasts, Asia's share of global greenhouse gas emissions will grow dramatically in the coming decades due to increasing population rates and relatively robust economic growth. At the same time, millions of people in the region will be affected by climate change. Serious environmental pollution has resulted from the burning of fossil fuels. Health risks due to air pollution already affect millions of Asians.

There is growing interest in renewable energy in many parts of Asia as a result of energy security and environmental concerns and the need to deliver electricity to energy-poor regions. With dropping renewable energy prices, there is growing investment in the sector in Asia. This makes it increasingly possible to talk about the beginning of energy transitions in the region. Greater use of renewable energy may lead to more socially and environmentally just energy structures. We still know little, however, about the actual social and political contributions, costs and implications of renewable energy expansion.

Friedrich-Ebert-Stiftung has examined these questions with a series of country studies in Asia. The studies looked at the political and social factors that drive—but also hamper—socially just energy transitions. The authors of each case study in China, India, Indonesia, Japan, the Philippines, the Republic of Korea, Thailand and Vietnam worked with Miranda Schreurs, Professor of Environmental and Climate Policy in the Bavarian School of Public Policy, Technical University of Munich, to provide in-depth analysis of the situation in their respective countries. Julia Balanowski, a climate change consultant based in South-East Asia, supported the preparation of each country study and their review.

Two important questions that motivated this comparative study were whether renewable energy development was contributing to a more socially just energy structure and which factors foster and impede political acceptance of renewable energy development. Each country case study provides insights on the status of climate and energy policies, their socioeconomic implications and the actors involved in developing and implementing the policies.

The meta study, written by Miranda Schreurs and Julia Balanowski, highlights the most important commonalities and differences across the eight countries. While the countries have very different levels of economic development, government types and levels of energy dependency, the meta study shows that all of them are increasingly pushing for renewable energy use.

Drawing from the eight country studies, the meta study authors explore the factors promoting and inhibiting the transition towards renewable energy in these countries and analyse the policy environment behind the scenes. The meta study emphasizes a socioeconomic understanding of renewable energy and asks how new issues link to questions of economic and environmental benefits for a society.

We hope that this comprehensive overview provides a starting point for a learning process on the transition towards renewable energy in all eight Asian countries and encourages policy makers, academics and civil society to work together towards low-carbon development in Asia and beyond.

Yvonne Blos
Regional Coordinator for Climate and Energy in Asia
Friedrich-Ebert-Stiftung Vietnam

September, 2017

Country studies

Koos Neefjes and Dang Thi Thu Hoai, "Towards a Socially Just Energy Transition in Viet Nam: Challenges and Opportunities", Study commissioned by Friedrich-Ebert-Stiftung Vietnam, 2017.

Eka Afrina Djamhari and Maria Lauranti, "A Socially Equitable Energy Transition in Indonesia: Challenges and Opportunities", Study commissioned by Friedrich-Ebert-Stiftung Indonesia, 2017.

Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition", Study commissioned by Friedrich-Ebert-Stiftung China, 2017.

Hironao Matsubara, "Case Study on Climate Change Policy and the State of the Energy Transition in Japan", Study commissioned by Friedrich-Ebert-Stiftung Japan, 2017.

Udai S. Mehta, Ashwini K. Swain and Pratim Bose, "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study commissioned by Friedrich-Ebert-Stiftung India, 2017.

Puree Sirasoontorn, Koomsup Praipol, "Energy transition in Thailand: Challenges and Opportunities", Study commissioned by Friedrich-Ebert-Stiftung Thailand, 2017.

Roberto S. Verzola, Jose D. Logarta, Jr and Pedro H. Maniego, Jr, "Towards a Just Transition in the Philippine Electricity Sector", Study commissioned by Friedrich-Ebert-Stiftung Philippines, 2017.

Sun-Jin Yun and Yeon-Mi Jung, "Energy Policy at a Crossroads in the Republic of Korea", Study commissioned by Friedrich-Ebert-Stiftung South Korea, 2017.

Introduction

Asia has tremendous influence on the global environment and energy trends, with future developments to be even more strongly shaped by decisions made in this region. With nearly half of the world's population, national decisions in Asia regarding energy production and consumption, energy conservation and greenhouse gas mitigation will affect energy resource depletion trends, global greenhouse gas emission levels and environmental conditions. The energy choices made in the region will also have many social and health consequences that will impact job growth or decline in various sectors, the quality of jobs and the quality of the natural environment left to future generations.

This paper provides a summary of some of the key findings of a Friedrich-Ebert-Stiftung-funded international research project, Socially and Economically Just Energy Transformations in Asia, which examined recent developments related to renewable energy and low-carbon energy transitions in eight Asian countries: China, India, Japan, Indonesia, South Korea, the Philippines, Thailand and Vietnam. Individual country studies were prepared through the project. These eight countries are among the largest and most populated economies of Asia.

The project looked at the extent to which each of the eight countries are pursuing low-carbon, renewable-energy strategies, the factors that are promoting and inhibiting a transition in their power sector towards greater energy efficiency and more renewable energy use. This paper considers similarities and differences across the eight countries in terms of their renewable energy transitions, explores the reasons why renewable energy is making strong inroads into many of these economies, considers some of the barriers that confront renewable energy and examines the road ahead for the region.

Socially and economically just energy system transformations

Energy systems are at the core of modern economies. The structure of an energy system can enhance or impede social equality and economic potential. There are many reasons to favour a socially and economically just, low-carbon energy transformation.

Lack of access to electricity can inhibit economic development and limit possibilities for individuals and society as a whole. Thus, one aspect of a socially and economically just energy transition is the provision of power to all. Governments in Asia have made great progress in terms of the provision of electricity to rural areas. There are, however, still millions of people in the region with either no access or only poor and inconsistent access to electricity.

A second element of a socially and economically just energy sector transformation relates to the question of opportunity and the potential for new energy industries and actors to enter into markets traditionally dominated by fossil fuels, nuclear power and hydropower. Often, more centralized electricity systems concentrate the economic gains of electricity generation in the hands of large utilities. Market liberalization can bring more producers into the market, expanding options for consumers and driving down costs. In many countries, there are still barriers limiting the full access of renewable energy into the grid or giving dispatch priority to incumbent fossil fuel or nuclear energy.

A third element of a socially and economically just energy transition relates to the environmental and health footprints of different-generation sources. Fossil fuel use, and especially coal, is a major cause of air pollutants and global warming, which leads to climate change. Throughout Asia, air pollution is a serious problem that is contributing to the increased incidence of asthma and lung cancer and the reduced quality of life. Reducing dependence on heavily polluting fossil fuels could simultaneously help address air pollution problems and contribute to climate mitigation activities.

A further consideration is the real cost of different energy systems. The negative environmental and health externalities of fossil fuels are not adequately reflected in their prices. If the costs associated with fossil fuel, such as hospital visits, cancer, shortened life expectancy,

lost work time, damage to agricultural crops and damage to building materials, were calculated into the cost of fossil fuels, prices would be far higher. If the contribution of fossil fuels to climate change-related extreme weather events were considered, the true costs of electricity generation would look very different. The full costs of nuclear energy, including in relation to disaster insurance and final, long-term disposal costs of the radioactive waste that is generated, are also not reflected in its price.

Renewable energy has numerous socioeconomic and environmental benefits.[1] It can supply electricity in areas not yet connected to the grid and thereby save on grid extension costs. It is a clean form of energy. The energy that goes into producing a wind turbine and recycling it at the end of its 20- to 25-year lifetime is equivalent to just three months of its operating time.[2] The energy that goes into producing solar panels also sharply declines as production expands. A recent study by researchers in the Netherlands found that there has been a learning curve effect and that the energy to produce solar photovoltaics (PV) has declined dramatically. They argue: "Over the whole life cycle of a PV system, it pays back the energy invested and greenhouse gas emissions released during its production multiple times."[3]

Direct and indirect subsidies have been given for decades to fossil fuel and nuclear energy development.[4] Governments have, for example, poured research and development funding into fossil fuel and nuclear energy but have given far less support to renewable energy development. If renewable energy had received the same levels of research and development funding, it would have become cost competitive far earlier. Given the clean energy benefits of renewable energy, it makes sense to support renewable energy introduction through feed-in tariffs or other support mechanisms and to fund research and development of smart grids, electricity storage systems, new applications, and efficiency improvements. With the rapid drop in prices of various renewable energy technologies, many do not even need special financial support. Barriers to their use, however, need to be removed.

Depending on ownership structures, renewable energy can also help keep money in local economies. Rather than consumers paying to import fossil fuels, renewable energy development can keep investment in the local or national economy, thereby positively affecting economic conditions.[5]

Finally, renewable energy development and associated initiatives for energy conservation creates many new jobs. These include jobs in the manufacturing of solar photovoltaic cells or machine parts for wind turbines, the installation of rooftop photovoltaic cells, the installation of wind parks, consulting, maintenance, retail and the development of new applications.[6] With renewable energy rapidly expanding, there will be many new technological breakthroughs in the years ahead that will lead to new types of jobs, such as with smart grid technologies and battery storage systems.

As with any transformation, there will be winners and losers. Of particular concern are the people who could lose their jobs as a result of the transition away from fossil fuels to renewable energy. This underscores the importance of developing programmes to train workers in new job skills.

Shifting from old economic growth models towards more sustainable and inclusive models

Two major challenges to the acceptance of renewable energy within existing energy structures have been the strength of incumbent energy industries and governments that have focused on providing cheap energy to promote economic development with insufficient attention to negative externalities. Many regulatory structures were originally set up to accommodate older incumbent fossil fuel and nuclear energy interests. This can make it difficult for new players to enter the market. Although many governments in Asia have started to introduce regulations that are more favourable to renewable energy, obstacles remain.

The Asian countries that were examined in this project fall into different categories in terms of their stage of economic development and the energy sources they have used to drive their development. Still, across the region there is a common trend towards greater renewable energy use.

Japan and South Korea

Japan and South Korea are the wealthiest of the eight countries in this study. Japan is the world's third-largest economy, and Republic of Korea is the eleventh. Japan's per capita gross domestic product (GDP) was 38,917 US dollars in 2016, while it was 27,539 US dollars in South Korea.[7]

Japan and Republic of Korea are almost completely dependent on imports to meet their demands for oil, coal and natural gas. Both turned to nuclear energy to enhance energy security, although it is now a debated energy option and the industry's future is uncertain in many countries.[8]

In the wake of the 1973 Organization of the Petroleum Exporting Countries' oil embargo, the government of Japan began to invest heavily in nuclear power to expand its options for energy security. It also strongly promoted energy conservation and renewable energy development starting in the 1970s. By the beginning of the 1990s, Japan was a world leader in installed solar photovoltaics. In the early 2000s, despite the successful growth of solar photovoltaic installations, the government ended its support for the programme, and Germany overtook Japan as a world leader.[9] Instead of continuing with renewable energy development, the government set ambitious plans to expand nuclear energy generation capacity by 35 per cent. This was a core component behind the government's pledge made in 2010 to reduce carbon dioxide (CO_2) emissions by 25 per cent of 1990 levels by 2020.[10]

Both countries developed major export industries in such fields as electronics, automobiles and chemicals.[11] This industrialization was largely fuelled by coal, oil, gas, nuclear energy and some hydropower. In both countries, industrialization was accompanied by severe pollution problems.

After the Fukushima nuclear accident in March 2011, Japan found itself in another energy crisis. The country was heavily dependent on nuclear energy for electricity, obtaining more than a quarter of its power from nuclear reactors. After the accident, most of the country's nuclear power (and for a period of time, all of it) was taken off line to await approval to restart under a new safety regime. Approvals have been slow in coming, and some restarts have been stopped by court cases and local opposition.[12]

Before the accident, Japan had 54 operational nuclear reactors. As of today, only 42 nuclear reactors are still operational, and of them, only five are operating.[13)] The government is eager to restart more of the reactors and aims to return to a share of 20–22 per cent nuclear power in the electricity mix. But there is considerable public opposition to this plan, particularly in many communities located near to a nuclear power station.[14] A generous feed-in tariff that was initiated after the Fukushima accident to accelerate renewable energy growth has led to a boom in photovoltaic installations. The government has, however, scaled back the feed-in-tariff so that it is likely that the growth rate of new renewable installations will drop. Moreover, the electric utility companies are using their authority to cap the amount of renewable energy that they take into the regional grids that they operate ("allowable connection amounts") to block the approval of new renewable energy facilities.[15]

Like Japan, Republic of Korea is essentially dependent on imports to meet its oil, coal and natural gas demands.[16] But even more so than Japan, Republic of Korea is heavily dependent on nuclear energy, relying on it for about one third of its electricity.[17] As in Japan, there is a powerful nuclear industry, and the two countries have leading firms in this field. And also as in Japan, opposition to nuclear energy has been growing.[18] Moon Jae-In, who was elected president in May 2017, ran on a campaign to wean the country from nuclear power and imported coal and is eager to shift the country's energy structure towards natural gas and renewable energy.[19] As a first step in this process and in an effort to make the choice as democratic as possible—true to his roots as a student activist—Moon Jae-In's government has installed a committee to determine whether the construction of two partially built nuclear power plants should be continued. The nuclear industry is fighting back hard, and it is uncertain to what degree future energy directions will shift in the country.[20] Still, it is clear that in the coming years, Republic of Korea will be investing more heavily in renewable energy development.

China

Over the past 40 years, China has shifted from being a predominantly agriculture-based economy to a manufacturing-based economy. China manufactures everything from toys to petrochemicals, electronics, machines and automobiles.[21] China's impressive growth rates have been linked to the government's long-term planning and the hard work of the population. China has managed to pull hundreds of millions of people out of poverty and to raise income levels to the point that the country is now no longer categorized as a developing but rather as a transition economy. It also has the impressive status of being the world's second-largest economy.[22] Due to its extremely large population size, per capita income levels are moderate, at about 8,000 US dollars in 2016.[23] There are, however, still many challenges. Differences in economic development levels between the central and coastal regions, on the one hand, and the western regions, on the other, are large. Pollution and loss of natural areas have been two major negative side effects of China's rapid economic development. The costs of this pollution have been large in terms of human illness, agricultural losses and damage to buildings and equipment.[24]

Electricity demand has increased many times over in the past decades as the economy has grown at breakneck speed. China has relied heavily on coal to meet its power production needs.[25] For many years, China was building one new coal-fired power plant after another. The situation was further exacerbated when the central government transferred authority over thermal power generation to the provinces. There is now large excess in generation capacity, and many plants remain idle.[26] With growing concerns about pollution and climate change as well as the costs of building plants that then sit idle, the central government has stepped in and required provincial governments to halt the construction of many planned coal-fired power plants.[27] Although there is concern and criticism that Chinese companies are now shifting their attention to building coal-fired power plants overseas,[28] it may well be that coal has peaked in China—a welcome development for the environment.[29] As a result of this shift in China, the International Energy Agency has sharply cut its estimates for global coal demand.[30]

The shift away from coal will have many positive effects. It will reduce not only CO_2 emissions, but also sulphur dioxide emissions and particulates. And it will save lives. The coal mining industry has been plagued by workplace accidents and disasters, with thousands of people dying each year in coal mine collapses and other incidents. From 1996 to 2000, there were on average 7,619 deaths in coal mines each year. Standards have improved since then, and coal mining deaths have dropped. Yet, in 2014, there were still more than 900 coal mine deaths.[31] China has also invested heavily in dam construction and has the largest number of hydropower dams in the world. It also has one of world's largest hydropower dams—the Three Gorges Dam. This megaproject brought China considerable global visibility, both because the dam is an engineering marvel and because of its high social and environmental costs (more than a million people were relocated to build the dam, and large areas of biological and historical significance were submerged).[32]

The government more recently began steering the electricity structure in new directions. China has, by far, the largest nuclear power expansion plans in the world, with 37 reactors in operation, 20 under construction and even more envisioned.[33] Nuclear power, however, makes up a relatively small share of the country's electricity mix, and enthusiasm for the technology is not universal. Nuclear power plant construction is meeting with local protests.[34]

Without doubt, China is driving the global growth in renewable energy. There are many reasons behind this, including domestic environmental conditions, the relative speed with which renewable energy can be developed and the economic opportunities linked to the renewable industries. China now leads the world in the manufacturing of solar photovoltaics and wind turbines as well as in total installed capacity.[35]

India

India is the world's seventh-largest economy. Yet, per capita GDP is only 1,723 US dollars.[36] India has a large number of megacities, and it is in these cities that economic wealth is concentrated and where India's growing middle class lives. Many rural areas remain poor and continue to follow traditional, rural lifestyles. India's economy remains largely agriculturally based, with about

47 per cent of the population employed in agriculture, 22 per cent in industry and 31 per cent in services in fiscal year 2014. In contrast, 28 per cent of China's population was employed in agriculture, 29.3 per cent in industry and 42.4 per cent in services in 2015.[37]

The Indian economy is far less developed than the Chinese economy and is driven by its services sector, which contributes about half of the country's GDP.[38] India has a large information technology sector, which is a major developer of software. It also has a large automobile industry.

India is the second-largest consumer of coal, after China.[39] Yet, despite having large coal reserves, India is a net energy importer.[40] Like China, India also invested in the development of mega energy projects, like the Sardar Sarovar and the Narmada Sagar dams. These dams supply large amounts of electricity but were built at high costs to local communities and the environment.[41]

One of the ironies of the Indian electricity situation is that, despite areas suffering from lack of electricity, the country has an excess of generation capacity.[42] In Madhya Pradesh State, for example, the power demand is not even half of its generation capacity. If interstate power trade would be possible, the neighbouring states that have a requirement for power would benefit. This is especially interesting because Madhya Pradesh is a strong promoter of renewable energy. This indicates that one of India's bigger challenges is improving the grid infrastructure and working on technological, regulatory and economic solutions that would enable interstate transmission. Since 2017, India is also now a net electricity exporter, with cross-country interconnection lines to Nepal, Bangladesh and Myanmar.[43]

Pollution from the burning of coal is a major health and environmental concern in India. According to a report released by the Health and Environmental Alliance, a European non-profit organization, India spent 16.9 billion US dollars on oil, gas and coal subsidies in 2013 and 2014 but had air pollution-related health costs of 140.7 billion US dollars.[44] A Greenpeace India report suggests there are hundreds of thousands of deaths each year as a result of air pollution in India.[45]

Encouragingly, the Indian government is now calling for far greater investment in renewable energy and has plans for large-scale expansion of solar and wind power facilities.[46]

Thailand

In the 1980s, Thailand was known as an economic tiger and was one of Asia's fastest-growing economies. The financial crisis of 1997, however, hit Thailand extremely hard, and its economic performance since then has been inconsistent.[47] In 2016, Thailand ranked as the 25th-largest economy in the world. Per capita GDP in Thailand was 5,889 US dollars in 2016. Many rural areas remain poor and lack the investment needed for development.[48]

Thailand initiated a campaign to reduce its dependence on crude oil imports in the 1980s and through the 1990s. As a result, the country today has a far greater dependence on natural gas for its electricity supply than any other of the countries in our study. In 2015, Thailand generated 67 per cent of its electricity from natural gas, [49] with expectations this will decline to 51 per cent in 2028 [50] and to 37 per cent in 2038. About 18 per cent of the electricity consumed in Thailand in 2015 was supplied by hard coal and lignite.

There have been numerous energy-related plans issued. Renewable energy has not been a priority of the government in the past, but this is beginning to change as environmental awareness and concerns about energy security grow.[51] The government aims to achieve 20 per cent renewable energy in its electricity consumption by 2038, compared with about 5 per cent in 2015.[52]

Vietnam, Indonesia and the Philippines

Per capita income levels in Vietnam (the world's 46th-largest economy, with a per capita GDP of 2,173 US dollars), the Philippines (the 35th-largest economy, with a per capita GDP of 2,924 US dollars) and Indonesia (the 16th-largest economy, with a per capita GDP of 3,604 US dollars) are low but rising (tables 1 and 2).[53]

All three countries are among the world's fastest-growing economies. In the five years from 2012 to 2016, each one experienced annual growth rates of 5 per cent or more.[54] In contrast, the more mature economies of Japan and

Republic of Korea had slower growth rates, and Thailand had a rather mixed performance. The rapid economic development suggests that energy demand will rise as the middle class grows and as demand for consumer goods rises and manufacturing expands. A major challenge for these countries will be developing sufficient energy supply to meet growing demand while preventing the serious air pollution problems experienced throughout Asia.

Vietnam set a target under the Paris Agreement on climate to reduce its greenhouse gas emissions by 8 per cent in the period of 2021–2030 from a business-as-usual trend, using a 2010 baseline. Under the business-as-usual trajectory used in formulating this target, Vietnam would experience an increase in its greenhouse gas emissions, from 246.8 million tonnes of CO_2 equivalent (tCO_2e) to almost double this level in 2020 (at 474 million tCO_2e) and more than a tripling by 2030 (at 787.4 million tCO_2e). With international assistance, the government says it could raise this target to 25 per cent,[55] to be achieved through energy efficiency improvements and a diversification of energy sources, including more renewable energy, among other measures.[56]

The Philippine National Renewable Energy Program envisions expanding renewable energy capacity from 26 per cent in 2016 to 35 per cent by 2030.[57] Indonesia, which has become a net oil importer, also plans to meet its growing energy demand through additional fossil fuel capacity and greater reliance on renewable energy.[58]

Table 1: Nominal per capita GDP (US dollars)

Japan	38,917
South Korea	27,539
China	8,113
Thailand	5,889
Indonesia	3,604
Philippines	2,924
Vietnam	2,173
India	1,723

Source: International Monetary Fund, "World Economic Outlook Database," April 2017, accessed September 7, 2017, http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

Table 2: Economic growth rates, 1990–2016

	1990	2000	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
China	3.9	8.5	14.2	9.7	9.4	10.6	9.5	7.9	7.8	7.3	6.9	6.7
India	5.5	3.8	9.8	3.9	8.5	10.3	6.6	5.5	6.4	7.5	8.0	7.1
Indonesia	7.2	4.9	6.3	6.0	4.6	6.2	6.2	6.0	5.6	5.0	4.9	5.0
Japan	5.6	2.8	1.7	-1.1	-5.4	4.2	-0.1	1.5	2.0	0.3	1.2	1.0
South Korea	9.8	8.9	5.5	2.8	0.7	6.5	3.7	2.3	2.9	3.3	2.8	2.8
Philippines	3.0	4.4	6.6	4.2	1.1	7.6	3.7	6.7	7.1	6.1	6.1	6.9
Thailand	11.2	4.5	5.4	1.7	-0.7	7.5	0.8	7.2	2.7	0.9	2.9	3.2
Vietnam	5.1	6.8	7.1	5.7	5.4	6.4	6.2	5.2	5.4	6.0	6.7	6.2

Source: Based on World Bank, "World Development Indicators Series: GDP Growth," accessed April 17, 2017, http://databank.worldbank.org/data/download/GDP.pdf.

A vulnerable region to climate change

Asia is increasingly feeling the impacts of climate change. Climate change is associated with rising average global temperatures and more extreme weather events, including droughts, typhoons, floods, tornados and heat waves. While it is not possible to link any particular extreme weather event with climate change, the growing frequency and severity of such events strongly suggests that, indeed, there is a climate change link.[59]

China has experienced severe droughts and worsening dust storms.[60] Summer after summer, India is experiencing unbearable heat extremes.[61] In 2016, in the city of Phalodi in the western state of Rajasthan, the mercury hit 51 degrees Celsius (123.8 degrees Fahrenheit).[62] Temperatures in the capital of New Delhi are more often hitting the mid-40 degrees Celsius (around 110–115 degrees Fahrenheit). Thousands of people have died due to the heat. There have also been heat-related deaths in China (during the extreme heat in Shanghai in July 2017). With ageing populations in China, Japan and South Korea, heat-related deaths among older persons are likely to become a more serious problem.[63]

There have been many deadly typhoons in Asia. The 2017 Typhoon Hato, for instance, led to at least 16 deaths in Macau and southern China.[64] The 2005 Typhoon Talim killed dozens in China. Typhoon Haiyan, known as Super Typhoon Yolanda in the Philippines, killed more than 6,000 people.[65] With the Philippines, Thailand and Vietnam considered some of the most climate-vulnerable regions in the world, more such disasters are likely to occur.

Growing concern about climate change

Global CO_2 emissions have remained largely flat for the past three years,[66] and this can be linked at least in part to China's reduced demand for coal and its energy efficiency improvements. China accounts for about half of global coal demand; at its peak, coal powered about 78 per cent of China's electricity.[67] By 2016, the percentage had dropped to 62 per cent. As noted previously, the country's leadership aims to shut inefficient and often dangerous coal mines and to make greater use of clean energy.[68]

Still, there is rising concern about climate change in the region and expectations that there will be a sharp increase in global CO_2 emission levels. A 2013 World Bank survey in the Philippines found that 85 per cent of persons polled were feeling the effects of climate change, although the survey also found low levels of understanding regarding what the expected impacts of climate change might be.[69]

An Ipsos/Reuters poll conducted in 24 countries on climate change in December 2015 found a high level of concern overall about climate change. India ranked as the seventh-most concerned country of those surveyed, with 92 per cent of the respondents saying climate change is a very serious (at 69 per cent) or somewhat serious problem (at 24 per cent). Elsewhere, 88 per cent of the South Koreans and 83 per cent of the Chinese who were surveyed also indicated a high level of concern. In contrast, the percentage of respondents with a high level of concern was 77 per cent in Germany. In the United States it was far lower, at 66 per cent—only one spot higher than bottom-ranked Russia, at 63 per cent.[70] A global Pew Center poll asked respondents about various issues (ISIS, climate change, cyberattacks, conditions of the global economy, refugees, United States power and influence, Russian power and influence and Chinese power and influence) and whether they posed a threat to their country. In India, concern was greatest for ISIS (at 66 per cent and second for climate change, at 47 per cent). In South Korea, climate change ranked second (at 79 per cent), after Chinese power and influence (at 83 per cent). For Japan, climate change ranked second (at 67 per cent), after cyberattacks (at 76 per cent). Respondents in Indonesia put climate change third (at 56 per cent), after ISIS (at 74 per cent) and conditions of

the global economy (at 58 per cent). For the Philippines, climate change ranked second (at 65 per cent), after ISIS (at 70 per cent). In Vietnam, climate change came in second (at 66 per cent), after China's power and influence (at 80 per cent).[71] Although these results suggest that climate change is increasingly becoming a topic in the public sphere, some studies found that there is a lack of awareness among people on how their own energy consumption behaviour is linked to growing greenhouse gas emissions and climate change. For example, while there is awareness in Indonesia that their cheap, subsidized energy prices lead to wasteful use of energy, the first attempts to promote energy efficiency by the government have had little effect.[72] In the public discourse, energy transition debates need to be linked more closely to climate change and environmental and health benefits. Awareness campaigns also need to be conducted.

Demographic trends and renewable energy transitions

As of 2015, Asia accounted for approximately 60 per cent of the global population (about 4.4 billion people). The eight countries in this study had a combined population in 2015 of about 3.4 billion people, with China at 1.4 billion and India at 1.3 billion. India is expected to surpass China as the world's most populous country around 2024.[73]

While population predictions can certainly prove wrong, they are helpful for planning purposes. The United Nations Department of Economic and Social Affairs projects a combined increase of 473 million people through 2050—in the eight countries of this study (table 3).[74] This is roughly equal to the population of the European Union in 2015 (at 508 million).[75] Clearly, this will lead to growing demands for energy and resources and will make the challenge of low-carbon energy transitions in the region both especially important and particularly hard.

China's population is expected to peak around 2030, at around 1.4 billion people. Thereafter, it could drop to around 1 billion by the end of the century.[76] But over the next 15–20 years, the country will need to focus on supplying adequate levels of electricity to the growing population.

The populations in India, Indonesia and Vietnam are not expected to peak until significantly later. India could increase its population by about 400 million people through 2050 and might not see a peak until around 2060, at nearly 1.7 billion people. The Philippines might add another 48 million people by 2050 and might not see a population peak until around 2080, at 173 million inhabitants. Indonesia may add another 65 million people, more than the population of France, through 2050 and might not experience a peak until around 2060, at almost 325 million people.[77]

In these countries, it will be important to plan new energy supply and infrastructure development. These countries could reduce future negative environmental and health externalities by investing more heavily now in renewable energy development to meet escalating future demands.

Demographic trends differ substantially in the region. The populations in China, Japan and Republic of Korea are ageing. Japan's population has already peaked and could drop by about 20 million people between 2015 and 2050 according to United Nations statistics. South Korea's population will also experience some decline, from about 52 million today to 50 million around 2050 and could experience sharp drops thereafter, depending on whether, for instance, the country opens its doors to more immigration or not.

Exacerbating this situation is rural flight. Japan's population, and therefore also its energy demand, is highly concentrated in the Kanto and Kansai plains. The greater Tokyo area contains an estimated 38 million people. Around a third of South Korea's population lives in the greater Seoul metropolitan region. Many rural areas in Japan and Republic of Korea are suffering from population decline as young people migrate from rural

areas to cities for jobs. Thus, despite being countries with relatively even income distributions, there is growing concern about gaps that are developing between urban and rural areas.[78] Population decline tends to be accompanied by loss of jobs, lack of investment and loss of social services. There is thus growing interest in both countries in how to promote rural renewal. Renewable energy could provide potential to create local jobs, value and benefits, so that more young people might choose to stay in their home regions.

This situation offers both many opportunities and challenges for a renewable energy transition. Rural areas could benefit from renewable energy investment, given the right conditions. This could require cooperation between the urban conglomerations and rural regions, in which rural regions develop renewable energy not only for their own consumption but also for export to urban centres, and thus benefit both sides in this arrangement.

There are also massive population shifts occurring from rural to urban areas in other countries in the region. In India, Indonesia, the Philippines, Thailand and Vietnam, people flock to the cities in search of jobs. In the case of China, this urbanization is partly supported through a structural reform programme initiated by the government to increase the nation´s economic output.[79] However, because there are many social and environmental problems combined with this rapid urbanization, finding new job and growth opportunities for rural areas is very important. Renewable energy can provide some opportunities.

Table 3: Current and projected populations, 2015, 2030 and 2050

	2015	2030	2050
China	1,376,049	1,414,545	1,348,056
India	1,311,051	1,527,658	1,705,333
Indonesia	257,564	295,482	322,237
Japan	126,573	120,127	107,411
South Korea	50,293	52,519	50,593
Philippines	100,699	123,575	148,260
Thailand	67,959	68,250	62,452
Vietnam	93,448	105,220	112,783
Total	**3,383,636**	**3,707376**	**3,857,125**

Source: United Nations, Department of Economic and Social Affairs, "World Population Prospects, 2015 Revision", accessed September 7, 2017, https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf.

Greenhouse gas emissions

The burning of fossil fuels causes CO_2 emissions, the most abundant of the greenhouse gases. Energy-related CO_2 emissions stem primarily from power generation, transportation, and residential and commercial buildings (mainly heating and cooling), and industrial production. Although all of these energy sectors are important, we focused for this study on the electricity sector and efforts to diversify electricity generation away from fossil fuels. Given that in the future, electric mobility is likely to become more important, the focus on the electricity sector makes sense. Specific attention is given to efforts in each country to increase the share of electricity from renewable sources as well as to improve energy efficiency.

Per capita CO_2 emissions in Asia have been historically much lower than those in Europe and North America, but the gap is narrowing.

On a per capita basis, emissions vary strongly across the region. In 1960, Japan had the highest annual per capita CO_2 emissions of the countries in this study, at 2 tonnes. This is higher than the per capita emissions in India, Indonesia, the Philippines and Vietnam today—more than 50 years later. This reflects the large income divide that still exists in the region.

Today, Japan's annual per capita CO_2 emissions (9.8 tonnes) have been overtaken by Republic of Korea (11.7 tonnes). China's per capita CO_2 emissions (7.6 tonnes) are also reaching levels similar to those in Europe, while Thailand stands in the middle, at 4.4 tonnes per person (table 4).[80] As a point of comparison, it is roughly said that, globally, each person can emit about 2 tonnes of CO_2 if there is to be an equitable distribution of "pollution rights", and global greenhouse gas emissions are to be held within still relatively manageable levels. Scientists warn that if, at an average, global temperatures rise much more than 2 degrees Celsius above pre-industrial levels, climate change-related extreme events could become increasingly frequent and dangerous and have catastrophic consequences.[81]

Table 4: Per capita CO_2 emissions (tonnes)

China	7,6
India	1,6
Indonesia	1,9
Japan	9,8
South Korea	11,7
Philippines	1,0
Thailand	4,4
Vietnam	1,7

Source: Based on data from the Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, see World Bank, "CO_2 Emissions (metric tons per capita)," accessed September 7, 2017, http://data.worldbank.org/indicator/EN.ATM.CO_2E.PC.

Even though per capita emissions in many of the countries are relatively low, Asia's contributions to global emissions are large and have been rapidly rising due to the large population sizes of the countries covered in this study. The eight countries together account for 44.5 per cent of global CO_2 emissions.[82] China is by far the largest emitter in the group, with its CO_2 emissions accounting for about 29.5 per cent of the global total. China's emissions rose sharply between 1990 and 2015. The reasons for this include population growth, rapid and sustained economic development, reliance on coal for the majority of electricity production and the growing demand for modern appliances and automobiles.

Although India's population will soon outnumber China's population, its emissions are substantially smaller. Nevertheless, India is the world's third-largest emitter, accounting for another 6.8 per cent of global emissions, which are expected to grow steadily in the coming years. Several of the other countries in our study are also among the larger global emitters. Japan is in fifth place, Republic of Korea is eighth, and Indonesia is eleventh. Thailand, Vietnam and the Philippines are much smaller emitters but still are among the top-36 largest emitters globally (table 5).[83]

Table 5: CO_2 emissions

Global Rank	Country	CO_2 emissions (kt) 2015	% global total
1	China	10,641,789	29.51
3	India	2,454,986	6.81
5	Japan	1,252,890	3.47
8	South Korea	617,285	1.71
11	Indonesia	502,961	1.39
21	Thailand	279,253	0.77
28	Vietnam	206,028	0.57
36	Philippines	113,035	0.31

Source: Jos G.J. Olivier, Greet Janssens-Maenhout, Marilena Muntean and Jeroen A.H.W. Peters, Trends in Global CO_2 Emissions: 2016 Report (The Hague: PBL Netherlands Environmental Assessment Agency and European Commission Joint Research Centre Institute for Environment and Sustainability, 2016), http://edgar.jrc.ec.europa.eu/news_docs/jrc-2016-trends-in-global-co2-emissions-2016-report-103425.pdf..

Access to electricity

Consistent with the differences in wealth across the countries that we examined, there are substantial differences in terms of the share of the population with access to electricity. There is universal or near universal access to electricity in China (at 100 per cent), Japan (at 100 per cent), South Korea, Thailand (at 99 per cent) and Vietnam (at 98 per cent).[84]

In India, Indonesia and the Philippines, however, substantial shares of the population still lack connection to larger electricity grids. Both the Philippines and Indonesia are archipelagos with a large number of inhabited islands. In less developed islands, such as Papua and Sulawesi in Indonesia, large shares of the population lack access to electricity. In Indonesia, there is a national electrification rate of 84 per cent, which means that there are still 41 million people who lack access to electricity. And the urban-rural divide is great. Whereas 96 per cent of people living in urban areas have access to electricity, only 71 per cent have access in rural areas. In the Philippines, the national electrification rate is higher, at 89 per cent. Here, too, there is a rural-urban divide, albeit narrower than its neighbour's, with a 94 per cent electrification rate in urban areas but only 85 per cent in rural areas. In many of the smaller islands, people must rely on diesel-powered grids for electricity. Electricity supply is unstable and blackouts are not uncommon.[85]

While most villages in India now have access to electricity, this situation does not extend to all households. There is a national electrification rate of 81 per cent, meaning that an estimated 244 million people are still without electricity. The electrification rate is high in urban areas (96 per cent) but still low in rural areas, at 74 per cent.[86] The Indian government has launched a plan called Power for All to redress the problem of access to a stable electricity supply, which is seen as critical for the country's long-term economic development and in particular to improve economic conditions in rural regions.[87]

As a result of its strong economic growth, Asia is experiencing rising economic levels and a steady and impressive decline in overall poverty in the region. Still, there is a worrisome trend towards greater inequality in the distribution of wealth. This unequal distribution of wealth means that the ability to pay for energy varies across the region's populations. Income inequalities are especially pronounced in China, the Philippines, Thailand and Vietnam. In the Philippines and Thailand, income disparities are high but have shown some decline. Particularly troubling is the sharply rising income inequality in the most populated countries of Asia: China, India and Indonesia.[88]

In addition, substantial portions of the region's populations live in poverty as defined by the national poverty line: India (21.9 per cent), the Philippines (21.6 per cent), Indonesia (10.9 per cent), Thailand (10.5 per cent) and Vietnam (7 per cent).[89] Energy transformations must have inclusivity as one of their major goals. Progressive electricity tariff systems that charge users based on their electricity consumption levels exist in some of the countries analysed in this study. Poorer parts of the population, however, tend to be disadvantaged with regard to education about climate change and energy measures and the affordability of energy-efficient devices. Capacity building at the local level and in less well-off regions can promote societal participation in energy choices. Hence, it is important to provide education and to create support schemes and incentives for poor households so they can be part of the energy transformation.

Shifting energy policy making in more sustainable directions

Asian countries are diverse in their economic, geographic and political contexts, which opens up different opportunities and constraints for low-carbon energy transitions. The region varies in terms of political systems and the relationships that exist among governments, industries and civil society. Throughout much of the region, national authorities tend to be quite strong and civil society closely controlled or relatively weak and fragmented.

In many of the countries examined in this study project, governments issue five-year development plans or establish various energy plans and programmes with directional vision. A noticeable change in these plans is the growing attention given to sustainable development, green growth and renewable energy development. Also apparent is that in many of the plans, the targets set for renewable energy are shifting upwards as renewable energy deployment outpaces the targets set in previous plans and the costs of renewable energy declines.

Thailand, for example, has issued various energy-related plans with renewable energy targets. The Power Development Plan, which is a 21-year investment road map for the electricity sector, aims to reduce dependence on natural gas through investment in both more coal and renewable energy. The Alternative Energy Development Plan sets a target of 30 per cent renewable energy sources in the final energy mix by 2030 and 20 GW of installed capacity by 2036—one of the most ambitious renewable energy plans in South-East Asia. Since 2009, four versions of the renewable energy plan have been proposed, with each one setting more ambitious renewable energy targets. Thailand has also set a target to expand the share of renewable energy in its electricity mix, to 20 per cent by 2036.[90]

India wants to achieve 175 GW of renewable energy by 2022. This goal includes 40 GW of megapark solar projects, 40 GW of solar rooftop projects and 20 GW of utility-scale solar projects and 60 GW of wind, 10 GW of biomass and 5 GW of small hydropower sources. India also aims to increase the share of renewable energy in its power capacity to around 40 per cent by 2030 (up from about 30 per cent currently).[91] While implementation may prove to be a challenge, it is encouraging to see India investing in climate change actions.

China's 13th Five-Year Plan for Power Sector Development (2016–2020) calls for the addition of 40 GW hydropower, 79 GW of wind and 68 GW of solar capacity. This would bring the total installed capacity of hydropower to 340 GW by 2020, wind power to 210 GW and solar to 110 GW (largely to be distributed solar as opposed to large-scale photovoltaics). [92]

India's National Electricity Plan states that the country will not need to construct any other coal power plants in the next 10 years beyond the 50 GW of coal power plants already planned and under construction since before 2016. It then ups the targets for renewable energy found in previous plans, setting a target for 175 GW of renewable energy capacity by 2022 (100 GW from solar, of which 40 GW should be from rooftop solar), 60 GW from wind, 20 GW from biomass and 5 GW from small hydropower). [93]

In 2014, the government of Indonesia issued a National Energy Policy with a plan to increase the provision of primary energy by 2025. It includes a target of 23 per cent from new and renewable energy sources, a growth of 17 per cent over 10 years.[94]

Vietnam has issued various plans and strategies that specify sustainable development and renewable energy. The Renewable Energy Development Strategy 2016–2030 and the National Action Plan on Green Growth 2014–2020, for instance, discuss the importance of renewable energy development. The original version of the Power Master Plan VII reflected an increase in renewable energy, from 3.5 per cent of total electricity production in 2010 to 4.5 per cent in 2020 and 6 per cent in 2030. It was later revised with more ambitious targets: 6.5 per cent for 2020 and 11 per cent for 2030.[95]

Investments in renewable energy and capacity expansion

The trends in many of the countries in our study suggest that interest in renewable energy is growing in the region. More countries in Asia are introducing renewable energy targets and regulatory measures to further expand renewable energy in the electricity sector. China, India and Japan have been experiencing a renewable energy boom for the past several years. Japan introduced support mechanisms for renewable energy after the Fukushima nuclear accident.[96] China and India are investing heavily in wind and solar power to meet growing energy demand.[97] South Korea´s Moon government, which was elected in May 2017, announced its intentions to make a striking 180-degree turnaround in its energy policies away from nuclear energy and towards a renewable energy pathway.[98] Vietnam has opened its renewable energy sector to foreign investors,[99] and the Philippines' renewable energy sector is booming.[100] Thailand has announced plans to undertake a transition, Thailand Energy 4.0, focusing on 'smart' technology, and Indonesia has expressed increasing interest in renewable energy investments.[101] There are predictions that there will be strong growth in renewable energy demand in South-East Asia in the coming years as well.

Particularly big changes are visible in China and India. China has become the world's renewable energy leader in terms of installed capacity. Total installed wind energy capacity in China was 169 GW in 2016, accounting for 34.7 per cent of the global total. By comparison, the second-ranked United States has 82 GW and the third-ranked Germany has 50 GW. Fourth-ranked India has 28.7 GW installed wind energy capacity, equating to 5.9 per cent of the global total.[102]

Looking at investment trends in 2016, Asia dominated in terms of newly installed capacity. The region accounted for 58 per cent of new renewable energy additions in 2016.[103] This included 23 GW of wind capacity in China, which equates to 42.8 per cent of all newly installed capacity globally. Also in 2016, India installed an additional 3.6 GW of wind energy capacity.[104]

In terms of new solar photovoltaic installations in 2016, the top 10 countries included five that we focused on: China (34.5 GW), Japan (8.6 GW), India (4.1 GW), Republic of Korea (0.9 GW) and the Philippines (0.8 GW). Thailand came in shortly after and added 0.7 GW. [105]

Although investments in renewable energy in China and Japan declined in 2016, Vietnam experienced a 143 per cent increase in investment over 2015, reaching 700 million US dollars. Indonesia had an 84 per cent increase in renewable energy investment, at 500 million US dollars.[106]

Also noteworthy are the efforts being made to attract investment interest in renewable energy in South-East Asian countries and in India. To make good on the goals it set in its 2014 National Energy Policy, the government of Indonesia has begun to host annual renewable energy conferences, such as the Renewable Energy for Indonesia conference in November 2017. India hosted the Renewable Energy World India 2017 conference to showcase its renewable energy plans and technological abilities, and Vietnam organized the Solar Energy Summit 2017.

Vietnam, which already obtains a large share of its electricity from hydropower, added 1.1 GW of additional capacity in 2016, bringing its total to 16.3 GW of generation capacity and its global ranking to fifth in terms of new hydropower capacity additions. Vietnam also sold industrial pellets from palm kernel shells that were used as bioenergy for co-firing with coal in power generation in Japan. Vietnam also ranks number two in the world in terms of new biogas plant installations (adding 247,902 installations from 2014 to 2016).[107]

Indonesia, Japan and the Philippines are volcanic archipelagos subject to earthquakes. They also all possess geothermal energy potential. Some islands in the Philippines already obtain substantial energy from geothermal sources. In 2016, the Philippines had the second-highest level of installed geothermal power capacity (at 1.9 GW) globally, Indonesia had the third highest, and Japan was tenth. Indonesia also led the world in terms of investments in geothermal production capacity additions, while Japan was in fifth place.[108]

Paris Agreement on climate

International expectations related to the Paris Agreement on climate have been a driving force for greater national action on climate mitigation and renewable energy development. China was responsible for a still relatively limited share of greenhouse gas emissions when the Kyoto Protocol was negotiated. It was not an Annex I country and was not required to reduce its greenhouse gas emissions. A decade later, around 2006, China's greenhouse gas emissions surpassed those of the United States. By the time the Paris Agreement was negotiated, China was responsible for close to 30 per cent of global greenhouse gas emissions. During this time frame, the Chinese government became increasingly concerned about its domestic energy security and the population about pollution.[109] Improving energy efficiency, reducing reliance on coal and expanding renewable energy have become increasingly important policy goals for the Chinese leadership.

China's Nationally Determined Contribution under the Paris Agreement sets important clean energy targets. CO2 emissions are to peak by 2030 or earlier, the carbon intensity of GDP is to be reduced by 2030 to 60–65 per cent below 2005 levels, and the share of non-fossil energy in the total primary energy mix is to rise to around 20 per cent. [110]

Thailand plans to reduce by 2030 its greenhouse gas emissions by 20 per cent, compared with the business-as-usual trajectory, with a 2005 reference year. Indonesia has targeted a 29 per cent reduction in emissions by 2003, compared with its business-as-usual trajectory. The Japanese Nationally Determined Contribution sets out a reduction of 26 per cent below 2030 levels, while Republic of Korea targets a reduction by 37 per cent, compared with business as usual. Vietnam has an unconditional target of 8 per cent below 2010 levels by 2030, and the Philippines intends to pursue efforts of a 70 per cent reduction by 2030, compared with business as usual.[111]

Energy efficiency improvements

There is still great potential for energy efficiency improvements in much of Asia. Strengthening energy efficiency is certainly very important because it reduces the need for energy inputs, thereby saving on costs and reducing the need for new infrastructure. Japan, which has long ranked as one of the most energy efficient countries in the world, discovered after the Fukushima nuclear accident that possibilities exist for energy efficiency improvements and energy savings. In the aftermath of the Fukushima accident, the public and corporations responded with various energy-saving measures, which sharply reduced demand for electricity. [112]

In an effort to modernize its energy system, China has also strongly emphasized energy efficiency improvements. As noted, the government set targets to reduce by 2030 the energy intensity of its economy (measured in relation to GDP) by 60–65 per cent from its 2005 level. Similarly, India has a goal to reduce the energy intensity of its economy by 30–35 per cent in the same time period. Under the Paris Agreement, Vietnam has an energy-intensity improvement target of 20 per cent, compared with the 2010 level.[113] Thailand has initiated an Energy Efficiency Plan with a 2036 target to reduce the country's energy intensity by 30 per cent below the 2010 level.

Local-level initiatives

Many local areas are pursuing renewable energy expansion. Ilocos Norte Province in the northern Philippines is taking the lead as a low-carbon energy centre and already obtains half of its electricity from renewable sources.[114] Fukushima aims to transform itself into a 100 per cent renewable energy region by 2040.[115] There are also many municipalities in Japan rich with geothermal energy, which combined with small hydropower and wind sources, began obtaining 100 per cent renewable electricity even before the Fukushima accident.[116]

One commonality across many of the countries that we examined is the heavy concentration of population in urban centres. Many of the world's largest cities, such as Tokyo, Seoul, Shanghai, Delhi, Guangzhou, Shenzhen, Suzhou, Jakarta, Xi'an, Bengaluru, Bangkok, Nanjing, Dongguan, Chongqing, Quanzhou, Shenyang, Hyderabad, Ho Chi Minh, Hong Kong, Fuzhou, Chennai, Changsha, Wuhan, Tianjin, Hanoi, Qingdao, Foshan, Zunyi, Ahmedabad and Shantou (all with populations of more than 5 million people), are in the countries we studied. Such megacities can strongly influence the trends because of their sheer size.

For many years, Seoul's mayor, Woon Soon Park, has led a campaign—One Less Nuclear Power Plant—that has promoted energy conservation and solar energy in the city. The Tokyo Metropolitan government launched a Tokyo Metropolis Renewable Energy Expansion Task Force with a 10-year goal to increase the share of renewable energy in the city's electricity consumption by 2020, in time for the Summer Olympics. The plan is to use the event to highlight the potentials of renewable energy. [117] Efforts are being made to make Shanghai a leader in pursuing low carbon development.[118] Indonesia initiated the Sumba Iconic Island Project in 2010, a joint initiative by the central and local governments, the private sector, development banks and civil society organizations. The target of the programme is to advance renewable energy on the remote island for improving electricity access while creating new value for the region and generating health benefits by eliminating the need for diesel generators. The electrification ratio increased from 24.5 per cent in 2010 to 42.7 per cent in 2015, and in 2016, the total capacity of renewable energy reached 6.8 MW and had the investment value of 160 billion Indonesian rupiah (12 million US dollars).[119] In Thailand, there is a similar programme ongoing on Koh Samui: In 2013, the island´s government, together with local actors, developed a plan that includes quantified targets for the reduction of carbon emissions, called Moving Samui Low Carbon. The strategy claims to be "people-centred" and envisions a low-carbon and eco-friendly lifestyle, protection of the environment, preservation of natural resources and enhanced value for the local economy and investment.[120]

Renewable energy and jobs

The International Renewable Energy Agency (IRENA) estimated that there were 8.1 million renewable energy jobs globally in 2016 and that these jobs have shifted towards Asia (3.5 million jobs in China, 416,000 jobs in India, 388,000 jobs in Japan). They estimated 8,200 jobs exist in solar photovoltaic manufacturing and distribution in South Korea. They also estimated many jobs in liquid biofuels in the South-East Asian countries we examined: 94,800 in Indonesia, 76,900 in Thailand and 9,700 in the Philippines in 2015. Reacting to United States and European Union duties on panel imports from China, Chinese module suppliers have started locating new facilities in other Asian countries, such as India, Republic of Korea and Thailand.[121]

Supportive measures by governments have been important for renewable energy job growth. The Indian government is supporting the creation of jobs in solar photovoltaic through local content requirements and the setting of targets.[122] Changes in support mechanisms or international market conditions, however, can also threaten renewable energy jobs. There was a sharp drop in the number of jobs in the liquid biofuel sector in Indonesia after a collapse in the export market for palm oil biofuels, so that the number of jobs dropped by more than 128,000 between 2014 and 2015. Changes in Japan's feed-in tariff system will also likely lead to a drop in the number of jobs in the photovoltaic branch if new capacity development slows, as is expected in the coming years.[123]

Conclusions

Much of Asia's past economic growth has been fuelled by fossil fuels, and Asia accounts for close to half of global CO_2 emissions. Asia's share in global emissions is also expected to rise as population growth continues. Electricity systems are at the core of modern economies. Renewable energy is likely to become increasingly important to the economies of Asia as they address energy security and environmental concerns. And as electrification expands into new areas, such as mobility, coupled with growing populations and economies, demands on the power systems will also grow. This makes it important to consider what kind of electricity future should be pursued in Asian countries. This study worked from the assumption that renewable energy can and should have an increasingly large role in Asian electricity systems.

There are increasing signs of interest in renewable energy in the region. Renewable energy is the fastest-growing source of new power generation in the world as well as in many parts of Asia. Consider that in 1975, total global installed photovoltaic capacity was only around 1 megawatt. At the end of 2016, it was at least 300 GW. Asia has had a major role in this expansion, and now Asia has some of the world's most ambitious renewable energy plans.

Renewable energy is becoming significantly more attractive as its efficiency improves and prices decline. Countries are also learning from each other's experiences. There is a clear process of diffusion occurring with more Asian countries introducing renewable energy targets for their electricity systems and creating support mechanisms for renewable energy.

This is a welcome trend. Renewable energy can help address pollution and climate change and help develop a more just and equitable electricity system.

Notes

1 A.K. Akella, R.P. Saini and Mahendra Pal Sharma, "Social, Economic and Environmental Impacts of Renewable Energy Systems," Renewable Energy 34, no. 2 (2009): 390–396.

2 See Global Wind Energy Council, http://gwec.net/global-figures/wind-in-numbers/.

3 Atse Louwen, Wilfried G.J.H.M. van Sark, André P.C. Faaij and Ruud E.I. Schropp, "Re-assessment of Net Energy Production and Greenhouse Gas Emissions Avoidance After 40 Years of Photovoltaic Development," Nature Communications, no. 13728 (2016), doi:10.1038/ncomms13728.

4 See, for example, Susan Kraemer, "A Closer Look at Fossil and Renewable Energy Subsidies," Renewable Energy World, 10 June 2015, http://www.renewableenergyworld.com/articles/2015/06/a-closer-look-at-fossil-and-renewable-energy-subsidies.html.

5 Mita Bhattacharya, Sudharshan Reddy Paramati, Ilhan Ozturk and Sankar Bhattacharya, "The Effect of Renewable Energy Consumption on Economic Growth: Evidence from Top 38 Countries," Applied Energy 162 (2016): 733–741.

6 International Renewable Energy Agency, Renewable Energy Capacity Statistics 2017(Abu Dhabi, 2017), http://www.irena.org/News/Description.aspx?mnu=cat&PriMenuID=16&CatID=84&News_ID=1486.

7 International Monetary Fund, "World Economic Outlook Database", accessed April 5, 2017, http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

8 Hironao Matsubara, "Case Study on Climate Change Policy and the State of the Energy Transition in Japan," Study series commissioned by Friedrich-Ebert-Stiftung Japan, 2017; Sun-Jin Yun and Yeon-Mi Jung, "South Korea´s Energy Policy at a Crossroads", Study series commissioned by Friedrich-Ebert-Stiftung South Korea, 2017.

9 Sanjeeda Chowdhury, Ushio Sumita, Ashraful Islam and Idriss Bedja, "Importance of Policy for Energy System Transformation: Diffusion of PV Technology in Japan and Germany," Energy Policy 68 (2014): 285–293.

10 Fukuya Lino and Darek Gondor, "Japan Should Jump Over its Kyoto Climate Target," Our World online, May 21, 2010, https://ourworld.unu.edu/en/japan-should-jump-over-its-kyoto-climate-target.

11 Wenyu Zang and Mark Baimbridge, "Exports, Imports and Economic Growth in South Korea and Japan: A Tale of Two Economies," Applied Economics 44, no. 3 (2012): 361–372.

12 Masatsugu Hayashi and Larry Hughes, "The Policy Responses to the Fukushima Nuclear Accident and Their Effect on Japanese Energy Security," Energy Policy 59 (2013): 86–101.

13 World Nuclear Association, "Nuclear Power in Japan," July 2017, www.world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.aspx.

14 Masatsugu Hayashi and Larry Hughes, "The Policy Responses to the Fukushima Nuclear Accident and Their Effect on Japanese Energy Security," Energy Policy 59 (2013): 86–101.

15 ibid.

16 See Energy imports at World Bank, "World Development Indicators Database," https://data.worldbank.org/indicator/EG.IMP.CONS.ZS?view=chart.

17 Ministry of Trade, Industry and Energy, Second National Energy Master Plan Up to 2035 (Seoul: Government of the Republic of Korea, 2014).

18 Sun-Jin Yun and Yeon-Mi Jung, "South Korea´s Energy Policy at a Crossroads," Study series commissioned by Friedrich-Ebert-Stiftung South Korea, 2017.

19 ibid.

20 ibid.

21 National Bureau of Statistics of China, China Statistical Yearbook (Bejing, 2016).

22 Asian Development Bank, Transforming Towards a High-Income People's Republic of China: Challenges and Recommendations (Manila, 2017), https://www.adb.org/publications/high-income-prc-challenges-recommendations.

23 International Monetary Fund, "World Economic Outlook Database", accessed April 5, 2017, http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

24 Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition," Study series commissioned by Friedrich-Ebert-Stiftung China, 2017.

25 National Bureau of Statistics of China, China Statistical Yearbook (Bejing, 1991–2015).

26 Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition," Study series commissioned by Friedrich-Ebert-Stiftung China, 2017.

27 Colin Smith, "Why China's New Coal Plants Won't Stop It from Meeting Its Climate Goals," Energy Post, November 24, 2016, http://energypost.eu/chinas-new-coal-plants-wont-stop-meeting-climate-goals/.

28 Hiroko Tabuchi, "As Beijing Joins Climate Fight, Chinese Companies Build Coal Plants," New York Times (New York), July 1, 2017, www.nytimes.com/2017/07/01/climate/china-energy-companies-coal-plants-climate-change.html.

29 Tim Buckley, "IEEFA Update: China is Now Three Years Past Peak Coal: Declines in Consumption and Production Show an Economy Decoupling from Energy Demand," February 28, 2017, accessed September 7, 2017, http://ieefa.org/ieefa-update-china-now-three-years-past-peak-coal/.

30 Simon Evans, "Analysis: IEA Cuts Coal Growth Outlook in Half as China Peaks," November 16, 2016, www.carbonbrief.org/analysis-international-energy-agency-cuts-coal-growth-outlook-in-half-china.

31 Michael Lelyveld, "China Cites Rise in Coal Deaths Despite Drive to Cut Output," Radio Free Asia, August 15, 2016, www.rfa.org/english/commentaries/energy_watch/china-coal-08152016150446.html.

32 Yun Li, Yanbin Li, Pengfei Ji and Jing Yang, "The Status Quo Analysis and Policy Suggestions on Promoting China's Hydropower Development," Renewable and Sustainable Energy Reviews 51 (2015): 1071–1079

33 See www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx.

34 Chris Buckley, "Thousands in Eastern Chinese City Protest Nuclear Waste Project," New York Times (New York), August 8, 2016, www.nytimes.com/2016/08/09/world/asia/china-nuclear-waste-protest-lianyungang.html.

35 Tim Buckley and Simon Nicholas, China´s Global Renewable Energy Expansion (Cleveland, OH: Institute for Energy Economics and Financial Analysis, 2017), last modified September 1, 2017, http://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion_January-2017.pdf.

36 International Monetary Fund, "World Economic Outlook Database", accessed April 5, 2017, http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

37 See Labor Force: By Occupation at Central Intelligence Agency, "The World Factbook," accessed April 2017, www.cia.gov/library/publications/the-world-factbook/fields/2048.html.

38 Statistics Times, "Sector-wise contribution of GDP of India", March 21, 2017, http://statisticstimes.com/economy/sectorwise-gdp-contribution-of-india.php.

39 Enerdata, Global Energy Statistical Yearbook, 2017, https://yearbook.enerdata.net/

40 Udai S. Mehta, Ashwini K. Swain and Pratim Bose, "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung India, 2017.

41 Hugh Brody, "Assessing the Project: Social Impacts and Large Dams," Contributing paper for the World Commission on Dams, Thematic I (1999).

42 The Times of India, "Madhya Pradesh: Power Generation by State-Owned Units Just 40% of Capacity", March 25, 2017, http://timesofindia.indiatimes.com/business/india-business/india-becomes-net-exporter-of-power-for-the-first-time-government/articleshow/57889280.cms.

43 The Times of India, "India Becomes Net Exporter of Power for the First Time: Government", March 29, 2017, http://timesofindia.indiatimes.com/city/bhopal/mp-power-generation-by-state-owned-units-just-40-of-capacity/articleshow/57819318.cms.

44 Jayashree Nandi, "Health Costs of Pollution in India 8 Times Govt's Fuel Subsidy: Study," The Economic Times, Aug. 31, 2017.

45 Greenpeace India, Coal and Dirty Development in China & India Leads to 1.6 Million Extra Air Pollution Deaths a Year (Delhi: Greenpeace India, 2016).

46 Udai S. Mehta, Ashwini K. Swain and Pratim Bose, "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung India, 2017

47 World Bank, Country Overview Thailand (Bangkok, 2017).

48 International Monetary Fund, "World Economic Outlook Database", accessed April 5, 2017, http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

49 Energy Policy and Planning Office, Energy Statistics of Thailand 2016 (Bangkok, 2016).

50 Organisation for Economic Co-operation and Development and International Energy Agency, Thailand Electricity Security Assessment 2016 (Paris: IEA, 2016), www.iea.org/publications/freepublications/publication/Partner_Country_Series_Thailand_Electricity_Security_2016_.pdf.

51 Puree Sirasoontorn, Koomsup Praipol, "Energy Transition in Thailand: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Thailand, 2

52 Energy Policy and Planning Office, Thailand Power Development Plan 2015–2036 (Bangkok: Ministry of Energy, 2015).

53 International Monetary Fund, "World Economic Outlook Database", accessed April 5, 2017, http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

54 See GDP growth at World Bank, "World Development Indicators Database, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

55 Ministry of Natural Resources and Environment, Viet Nam's Intended Nationally Determined Contribution (Hanoi: Government of Vietnam, 2015).

56 SR Viet Nam, Plan for Implementation of the Paris Agreement (Hanoi, 2016).

57 Department of Energy, National Renewable Energy Program (Manila: Government of the Philippines, 2017), https://www.doe.gov.ph/national-renewable-energy-progr

58 Eka Afrina Djamhari and Maria Lauranti, "A Socially Equitable Energy Transition in Indonesia: Challenges and Opportunities," Study series commissioned by Friedrich-Eb Stiftung Indonesia, 2017.

59 C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor and P.M. Midgley, eds., Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Chang (Cambridge, UK and New York, NY: Cambridge University Press, 2012), https://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap3_FINAL.pdf.

60 Qi Lu and Sen Wang, "Dust-Sand Storms in China: Disastrous Effects and Mitigation Strategies," Paper submitted to the XII World Forest Congress (Québec City, Canada, 2013), http://www.fao.org/docrep/ARTICLE/WFC/XII/0859-B5.HTM.

61 The Times of India, "Extreme Weather Events the New Normal? Experts Take Stock," August 30, 2017, http://timesofindia.indiatimes.com/india/extreme-weather-events-the-new-normal-experts-take-stock/articleshow/60294095.cms.

62 Huizhong Wu, "Mercury Rising: India Records Its Highest Temperature Ever," CNN, May 23, 2016, http://edition.cnn.com/2016/05/20/asia/india-record-temperature/inde html.

63 Tiantian Li, Radley M. Horton, Daniel A. Bader, Maigeng Zhou, Xudong Liang, Jie Ban, Qinghua Sun and Patrick L. Kinney, "Aging Will Amplify the Heat-related Mortality Risk under a Changing Climate: Projection for the Elderly in Beijing, China," Nature.Com, no. 28161 (2016), doi:10.1038/srep28161, www.nature.com/articles/srep28161.

64 The Guardian, "Typhoon Hato kills 12 in Macau and southern China", August 24, 2017, https://www.theguardian.com/world/2017/aug/23/typhoon-hato-hong-kong-battens-down-as-storm-closes-schools-and-stock-market.

65 Disasters Emergency Committee, "Philippines Typhoon Facts and Figures," accessed April 5, 2017, https://www.dec.org.uk/articles/facts-and-figures.

66 International Energy Agency, "IEA Finds CO2 Emissions Flat for Third Straight Year Even as Global Economy Grew in 2016," March 17, 2017, https://www.iea.org/newsroom/news/2017/march/iea-finds-co2-emissions-flat-for-third-straight-year-even-as-global-economy-grew.html.

67 International Energy Agency, World Energy Outlook 2013 (Paris, 2013).

68 Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition," Study series commissioned by Friedrich-Ebert-Stiftung China, 2017.

69 World Bank, "Survey: 8 of 10 Filipinos Personally Experience Impacts of Climate Change," June 21, 2013, www.worldbank.org/en/news/press-release/2013/06/20/survey-8-of-10-Filipinos-Personally-Experience-Impacts-of-Climate-Change.

70 Ipsos, "Global Warming Issue Unites World Opinion: 82 per cent View Climate Change as Major Threat", December 2015, www.ipsos.com/sites/default/files/2016-06/043.1-G per cent40-Climate-Change.pdf.

71 Jacob Poushter and Dorothy Manevich, "Globally, People Point to ISIS and Climate Change as Leading Security Threats," accessed August 1, 2017, www.pewglobal.org/2017/08/01/globally-people-point-to-isis-and-climate-change-as-leading-security-threats/.

72 Eka Afrina Djamhari and Maria Lauranti, "A Socially Equitable Energy Transition in Indonesia: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Indonesia, 2017.

73 Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision, Key Findings and Advance Tables (New York: United Nations, 2015), Working Paper No. ESA/P/WP.241, https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf.

74 ibid.

75 See http://ec.europa.eu/eurostat/documents/2995521/6903510/3-10072015-AP-EN.pdf/d2bfb01f-6ac5-4775-8a7e-7b104c1146d0.

76 Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision, Key Findings and Advance Tables (New York: United Nations, 2015), Working Paper No. ESA/P/WP.241, https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf.

77 ibid.

78 Mizuho Research Institute, "Japan's Inequality Today and Policy Issues," Mizuho Economic Outlook & Analysis, September 30, 2015, www.mizuho-ri.co.jp/publication/research/pdf/eo/MEA151007.pdf. See also Mizuho Research Institute, "Asia's Wealth Gap: Income Inequality and the Need for Inclusive Growth," Global Asia 11 (2016).

79 Sara Hsu, "China´s Urbanization Plans Need to Move Faster in 2017", December 28, 2016, https://www.forbes.com/sites/sarahsu/2016/12/28/chinas-urbanization-plans-need-to-move-faster-in-2017/#6b66e29d74db.

80 World Bank, "World Development Indicators Database," accessed April 17, 2017, http://databank.worldbank.org/data/download/GDP.pdf.

81 See http://shrinkthatfootprint.com/carbon-targets-for-your-footprint.

82 See PBL Netherlands Environmental Assessment Agency and European Commission, Joint Research Centre and Institute for Environment and Sustainability, "Trends in Global CO2 Emissions: 2016 Report (The Hague, 2016), http://edgar.jrc.ec.europa.eu/news_docs/jrc-2016-trends-in-global-co2-emissions-2016-report-103425.pdf.

83 ibid.

84 See International Energy Agency, "World Energy Outlook Database 2016," accessed August 5, 2017, www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/.

85 ibid.

86 ibid.

87 Udai S. Mehta, Ashwini K. Swain and Pratim Bose, "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung India, 2017.

88 Sonali Jain-Chandra, Tidiane Kinda, Kalpana Kochhar, Shi Piao and Johanna Schauer, Sharing the Growth Dividend: Analysis of Inequality in Asia, IMF Working Paper (Washington, D.C.: International Monetary Fund, 2016), www.imf.org/external/pubs/ft/wp/2016/wp1648.pdf.

89 Asian Development Bank, "Basic Statistics 2017," accessed August 5, 2017, www.adb.org.

90 International Energy Agency, Thailand Electricity Security Assessment 2016 (Paris, 2016), www.iea.org/publications/freepublications/publication/Partner_Country_Series_Thailand_Electricity_Security_2016_.pdf.

91 Central Electricity Authority, Draft National Electricity Plan, Vol. 1 (New Delhi: Government of India, 2016), www.cea.nic.in/reports/committee/nep/nep_dec.pdf.

92 Jorrit Gosens, Tomas Kåberger and Yufei Wang, "China's Next Renewable Energy Revolution: Goals and Mechanisms in the 13th Five-Year Plan for Energy," Energy Science & Engineering 5, no. 3 (2017): 141–155, http://onlinelibrary.wiley.com/store/10.1002/ese3.161/asset/ese3161.pdf;jsessionid=E53479C99A6200420B8AB872A37EF71E.f02t01?v=1&t=j70y7e8n&s=9ca21189295345fdd8b1ded06352704f9e0eaa3c.

93 Central Electricity Authority, Draft National Electricity Plan, Vol. 1 (New Delhi: Government of India, 2016), www.cea.nic.in/reports/committee/nep/nep_dec.pdf.

94 Asian Development Bank, "Summary of Indonesia´s Energy Sector Assessment", Asian Development Paper No. 09 on Indonesia (Manila, 2015), https://www.adb.org/sites/default/files/publication/178039/ino-paper-09-2015.pdf.

95 Margareth Sembriring, "Vietnam's Vision for a Renewable Energy Future," East Asia Forum, August 12, 2016, www.eastasiaforum.org/2016/08/12/vietnams-vision-for-a-renewable-energy-future/.

96 Hironao Matsubara, "Case study on Climate Change Policy and the state of the Energy Transition in Japan", Study series commissioned by Friedrich-Ebert-Stiftung Japan, 2017.

97 Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung China, 2017; Udai S. Mehta, Ashwini K. Swain and Pratim Bose, "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung India, 2017.

98 Sun-Jin Yun and Yeon-Mi Jung, "South Korea´s Energy Policy at Crossroads", Study series commissioned by Friedrich-Ebert-Stiftung South Korea, 2017.

99 Dang Thi Thu Hoai and Koos Neefjes, "Towards a Socially Just Energy Transition in Viet Nam: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Vietnam, 2017.

100 Roberto S. Verzola, Jose D. Logarta, Jr and Pedro H. Maniego, Jr, "Towards a Just Transition in the Philippine Electricity Sector", Study series commissioned by Friedrich-Ebert-Stiftung Philippines, 2017.

101 Puree Sirasoontorn, Koomsup Praipol, "Energy transition in Thailand: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Thailand, 2017.

102 See Global Wind Energy Council, http://www.gwec.net/wp-content/uploads/2017/04/5_Top-10-cumulative-capacity-Dec-2016-1.jpg

103 International Renewable Energy Agency, Renewable Energy Capacity Statistics 2017 (Abu Dhabi, 2017), http://www.irena.org/News/Description.aspx?mnu=cat&PriMenuID=16&CatID=84&News_ID=1486.

104 See Global Wind Energy Council, www.gwec.net/wp-content/uploads/2017/04/4_Top-10-new-installed-capacity-Jan-Dec-2016.jpg.

105 Renewable Energy Policy Network for the 21st Century, Renewables 2017 Global Status Report (Paris, 2017).

106 ibid.

107 ibid.

108 ibid.

109 Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung China, 2017.

110 World Resources Institute, "CAIT Climate Data Explorer, Paris Contributions Map," accessed April 5, 2017, http://cait .wri.org/indc/.

111 ibid.

112 Hironao Matsubara, "Case Study on Climate Change Policy and the State of the Energy Transition in Japan", Study series commissioned by Friedrich-Ebert-Stiftung Japan, 2017.

113 World Resources Institute, "CAIT Climate Data Explorer, Paris Contributions Map," accessed April 5, 2017, http://cait .wri.org/indc/.

114 Roberto S. Verzola, Jose D. Logarta, Jr and Pedro H. Maniego, Jr, "Towards a Just Transition in the Philippine Electricity Sector", Study series commissioned by Friedrich-Ebert-Stiftung Philippines, 2017.

115 Hironao Matsubara, "Case Study on Climate Change Policy and the State of the Energy Transition in Japan", Study series commissioned by Friedrich-Ebert-Stiftung Japan, 2017.

116 Institute for Sustainable Energy Policies, Renewables 2016 Japan Status Report (Tokyo, 2016), www.isep.or.jp/en/wp/wp-content/uploads/2016/10/JSR2016Summary-EN.pdf.

117 Junko Movellan, "Tokyo's Renewable Energy Transformations to be Showcased in the 2020 Olympics," Renewable Energy World, June 17, 2015, www.renewableenergyworld.com/articles/2015/06/tokyo-s-renewable-energy-transformation-to-be-showcased-in-the-2020-olympics.html.

118 Donghui Liu, Xiduo Chen, Honglin Wu, Xue Lan and Junjie Zhang, "Achieving a Socially Equitable Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung China, 2017.

119 Eka Afrina Djamhari and Maria Lauranti, "A Socially Equitable Energy Transition in Indonesia: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Indonesia, 2017.

120 Puree Sirasoontorn, Koomsup Praipol, "Energy transition in Thailand: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Thailand, 2017.

121 International Renewable Energy Agency, Renewable Energy and Jobs, Annual Review 2016 (Abu Dhabi, 2016), www.irena.org/DocumentDownloads/Publicatio
IRENA_RE_Jobs_Annual_Review_2016.pdf

122 Udai S. Mehta, Ashwini K. Swain and Pratim Bose, "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung India, 2017.

123 International Renewable Energy Agency, Renewable Energy and Jobs, Annual Review 2016 (Abu Dhabi, 2016), www.irena.org/DocumentDownloads/Publicatio
IRENA_RE_Jobs_Annual_Review_2016.pdf

Bibliography

Asian Development Bank. Basic Statistics 2017. Manila, 2017. https://www.adb.org/publications/basic-statistics-2017.

Asian Development Bank. Summary of Indonesia´s Energy Sector Assessment," Asian Development Paper No. 09. Manila, 2017b. https://www.adb.org/sites/default/files/publication/178039/ino-paper-09-2015.pdf.

Asian Development Bank. Transforming Towards a High-Income People's Republic of China: Challenges and Recommendations. Manila, 2017c. https://www.adb.org/publications/high-income-prc-challenges-recommendations.

Akella, A. K., R. P. Saini, and Mahendra Pal Sharma. "Social, Economic and Environmental Impacts of Renewable Energy Systems," Renewable Energy 34, no. 2 (2009): 390–396.

BBC online. "Typhoon death toll rises in China," September 5, 2005. http://news.bbc.co.uk/1/hi/world/asia-pacific/4214390.stm.

Bhattacharya, Mita, Sudharshan Reddy Paramati, Ilhan Ozturk, and Sankar Bhattacharya. "The effect of renewable energy consumption on economic growth: Evidence from top 38 countries," Applied Energy 162 (2016): 733–741.

Brody, Hugh. "Assessing the Project: Social Impacts and Large Dams", Contributing Paper for the World Commission on Dams, Thematic I. Cape Town, 1999.

Buckley, Chris. "Thousands in Eastern Chinese City Protest Nuclear Waste Project," New York Times, August 8, 2016, https://www.nytimes.com/2016/08/09/world/asia/china-nuclear-waste-protest-lianyungang.html .

Buckley, Tim. "IEEFA Update: China is Now Three Years Past Peak Coal: Declines in Consumption and Production Show an Economy Decoupling From Energy Demand," February 28, 2017. http://ieefa.org/ieefa-update-china-now-three-years-past-peak-coal/.

Buckley, Tim, and Simon Nicholas. China´s Global Renewable Energy Expansion. Cleveland, OH: Institute for Energy Economics and Financial Analysis, 2017. http://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion_January-2017.pdf.

Central Electricity Authority. Draft National Electricity Plan, Vol. 1. New Delhi: Government of India, 2016. http://www.cea.nic.in/reports/committee/nep/nep_dec.pdf.

Central Intelligence Agency. The World Fact Book. Washington, D.C., 2017. https://www.cia.gov/library/publications/the-world-factbook/fields/2048.html.

Chowdhury, Sanjeeda, Ushio Sumita, Ashraful Islam, and Idriss Bedja. "Importance of Policy for Energy System Transformation: Diffusion Of PV Technology in Japan and Germany," Energy Policy 68 (2014): 285–293.

Department of Energy. "National Renewable Energy Program." Manila: Government of the Philippines, 2017, https://www.doe.gov.ph/national-renewable-energy-program.

Disasters Emergency Committee. "Philippines Typhoon Facts and Figures," last modified September 1, 2017. https://www.dec.org.uk/articles/facts-and-figures.

Djamhari, Eka Afrina and Lauranti, Maria, "A Socially Equitable Energy Transition in Indonesia: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Indonesia, 2017.

Enerdata. "Global Energy Statistical Yearbook 2017",2017, last modified September 1, 2017. https://yearbook.enerdata.net/coal-lignite/coal-world-consumption-data.html.

Energy Policy and Planning Office. Energy Statistics of Thailand 2016. Bangkok: Ministry of Energy, 2016.

Energy Policy and Planning Office. Thailand Power Development Plan 2015–2036 Bangkok: Ministry of Energy, 2015.

Evans, Simon. "Analysis: IEA Cuts Coal Growth Outlook in Half as China Peaks," November 16, 2016. https://www.carbonbrief.org/analysis-international-energy-agency-cuts-coal-growth-outlook-in-half-china.

Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley, eds. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge, UK, and New York, NY: Cambridge University Press, 2015. https://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap3_FINAL.pdf.

Gosens Jorrit, Kåberger Tomas and Yufei Wang, "China's Next Renewable Energy Revolution: Goals and Mechanisms in the 13th Five Year Plan for Energy," Energy Science & Engineering 5, No. 3 (2017): 141–155. http://onlinelibrary.wiley.com/store/10.1002/ese3.161/asset/ese3161.pdf;jsessionid=E53479C99A6200420B8AB872A37EF71E.f02t01?v=1&t=j70y7e8n&s=9ca21189295345fdd8b1ded06352704f9e0eaa3c.

Government of the Republic of South Korea, Ministry of Trade, Industry & Energy (2014): 2nd National Energy Master Plan up to 2035.

Global Wind Energy Council. "Wind in Numbers," last modified September 1, 2017. http://gwec.net/global-figures/wind-in-numbers/.

Global Wind Energy Council. "Top 10 Cumulative Capacity December 2016," last modified September 1, 2017. http://www.gwec.net/wp-content/uploads/2017/04/5_Top-10-cumulative-capacity-Dec-2016-1.jpg.

Global Wind Energy Council. "Top 10 New Installed Capacity Jan-Dec 2016," last modified September 1, 2017. http://www.gwec.net/wp-content/uploads/2017/04/4_Top-10-new-installed-capacity-Jan-Dec-2016.jpg.

Hayashi, Masatsugu, and Larry Hughes. "The Policy Responses to the Fukushima Nuclear Accident and Their Effect on Japanese Energy Security," Energy Policy 59 (2013): 86–101.

Hsu, Sara. "China´s Urbanization Plans Need to Move Faster in 2017," December 28, 2016. https://www.forbes.com/sites/sarahsu/2016/12/28/chinas-urbanization-plans-need-to-move-faster-in-2017/#6b66e29d74db.

International Energy Agency. World Energy Outlook 2013. Paris, 2013.

International Energy Agency. "IEA Finds CO_2 Emissions Flat for Third Straight Year Even as Global Economy Grew in 2016." https://www.iea.org/newsroom/news/2017/march/iea-finds-co2-emissions-flat-for-third-straight-year-even-as-global-economy-grew.html.

International Energy Agency. World Energy Outlook 2016. Paris, 2016.

International Energy Agency. Thailand Electricity Security Assessment 2016. Paris, 2016. https://www.iea.org/publications/freepublications/publication/Partner_Country_Series_Thailand_Electricity_Security_2016_.pdf.

International Energy Agency, World Energy Outlook database (2016), International Energy Agency, last modified September 01, 2017, http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/.

International Monetary Fund. "World Economic Outlook Database." Accessed September 1, 2017. http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx.

Institute for Sustainable Energy Policies. Renewables 2016 Japan Status Report. Tokyo, 2016. http://www.isep.or.jp/en/wp/wp-content/uploads/2016/10/JSR2016Summary-EN.pdf.

Ipsos. "Global Warming Issue Unites World Opinion: 82% View Climate Change as Major Threat." https://www.ipsos.com/sites/default/files/2016-06/043.1-G%40-Climate-Change.pdf.

International Renewable Energy Agency. Renewable Energy Capacity Statistics 2017. Abu Dhabi, 2017. http://www.irena.org/News/Description.aspx?mnu=cat&PriMenuID=16&CatID=84&News_ID=1486.

International Renewable Energy Agency. Renewable Energy and Jobs, Annual Review 2017. Abu Dhabi, 2017. https://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2017.pdf.

International Renewable Energy Agency. (2016), Renewable Energy and Jobs, Annual Review 2016. Abu Dhabi, 2017. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf.

Kraemer, Susan. "A Closer Look at Fossil and Renewable Energy Subsidies," Renewable Energy World, October 2015. http://www.renewableenergyworld.com/articles/2015/06/a-closer-look-at-fossil-and-renewable-energy-subsidies.html.

Lelyveld, M. "China Cites Rise in Coal Deaths Despite Drive to Cut Output," Radio Free Asia, August 15, 2016. http://www.rfa.org/english/commentaries/energy_watch/china-coal-08152016150446.html.

Li, Yun, Yanbin Li, Pengfei Ji, and Jing Yang. "The Status Quo Analysis and Policy Suggestions on Promoting China's Hydropower Development," Renewable and Sustainable Energy Reviews 51 (2015): 1071–1079.

Lino, Fukuya and Darek Gondor. "Japan Should Jump Over its Kyoto Climate Target," Our World online, May 21, 2010. https://ourworld.unu.edu/en/japan-should-jump-over-its-kyoto-climate-target.

Liu, Donghui, Chen, Xiduo, Wu, Honglin, Xue Lan, and Junjie Zhang. "Achieving a socially equitable energy transition." Study series commissioned by Friedrich-Ebert-Stiftung China, 2017.

Louwen, Atse, Wilfried G.J.H.M. van Sark, Andre P.C. Faaij, and Ruud E.I. Schropp. "Re-Assessment of Net Energy Production and Greenhouse Gas Emissions Avoidance After 40 Years of Photovoltaic Development," Nature Communications, No. 13728 (2016). doi:10.1038/ncomms13728.

Lu, Qi and Sen Wang. "Dust-Sand Storms in China: Disastrous Effects and Mitigation Strategies." Paper submitted to the XII World Forest Congress, 2003, Québec City, Canada. http://www.fao.org/docrep/ARTICLE/WFC/XII/0859-B5.HTM.

Matsubara, Hironao. "Case Study on Climate Change Policy and the State of the Energy Transition in Japan", Study series commissioned by the Friedrich-Ebert-Stiftung (FES) Japan, 2017.

Mehta, Udai S., Ashwini K. Swain, and Pratim Bose. "In Pursuit of a Low Fossil Energy Future: Interrogating Social, Political and Economic Drivers and Barriers in India's Energy Transition", Study series commissioned by Friedrich-Ebert-Stiftung India, 2017.

Mizuho Research Institute. "Japan's Inequality Today and Policy Issues," Mizuho Economic Outlook & Analysis, September 30, 2015. https://www.mizuho-ri.co.jp/publication/research/pdf/eo/MEA151007.pdf.

Ministry of Natural Resources and Environment. Viet Nam's Intended Nationally Determined Contribution—Technical report. Hanoi: Government of Vietnam, 2015.

Movellan, Junko. "Tokyo's Renewable Energy Transformations to be Showcased in the 2020 Olympics," Renewable Energy World, June 17, 2015, http://www.renewableenergyworld.com/articles/2015/06/tokyo-s-renewable-energy-transformation-to-be-showcased-in-the-2020-olympics.html.

Nandi, Jayashree. "Health Costs of Pollution in India 8 Times Govt's Fuel Subsidy: Study," The Economic Times, August 2, 2017, http://economictimes.indiatimes.com/news/environment/pollution/health-costs-of-pollution-in-india-8-times-govts-fuel-subsidy-study/articleshow/59807107.cms.

National Bureau of Statistics. China Statistical Yearbook. Bejing, 2016.

National Bureau of Statistics. China Statistical Yearbook. Bejing, 1991–2015.

Neefjes, Koos and Dang Thi Thu Hoai. "Towards a Socially Just Energy Transition in Viet Nam: Challenges and Opportunities", Study series commissioned by Friedrich-Ebert-Stiftung Vietnam, 2017.

Organisation for Economic Co-operation and International Energy Agency. Thailand Electricity Security Assessment 2016. Paris, 2016. https://www.iea.org/publications/freepublications/publication/Partner_Country_Series_Thailand_Electricity_Security_2016_.pdf.

PBL Netherlands Environmental Assessment Agency and European Commission, Joint Research Centre, Institute for Environment and Sustainability. Trends in Global CO_2 Emissions: 2016 Report. The Hague: PBL Netherlands Environmental Assessment Agency, 2016. http://edgar.jrc.ec.europa.eu/news_docs/jrc-2016-trends-in-global-co2-emissions-2016-report-103425.pdf.

Phys.org. "Hottest Day Ever in Shanghai as Heat Wave Bakes China", July 21, 2017, https://phys.org/news/2017-07-hottest-day-shanghai-china.html.

Poushter, J., and Dorothy Manevich. Globally, People Point to ISIS and Climate Change as Leading Security Threats. Washington, D.C.: Pew Research Center, 2017. http://www.pewglobal.org/2017/08/01/globally-people-point-to-isis-and-climate-change-as-leading-security-threats/.

Renewable Energy Policy Network for the 21st Century. Renewables 2017 Global Status Report. Paris: REN21 Secretariat, 2017. http://www.ren21.net/wp-content/uploads/2017/06/17-8399_GSR_2017_Full_Report_0621_Opt.pdf.

Sirasoontorn, Puree and Koomsup, Praipol. "Energy Transition in Thailand: Challenges and Opportunities". Study series commissioned by Friedrich-Ebert-Stiftung Thailand, 2017.

Smith, Colin. "Why China's New Coal Plants Won't Stop It From Meeting Its Climate Goals," Energy Post, November 24, 2016, http://energypost.eu/chinas-new-coal-plants-wont-stop-meeting-climate-goals/.

Sonali, Jain-Chandra, Tidiane Kinda, Kalpana Kochhar, Shi Piao, and Johanna Schauer. "Sharing the Growth Dividend: Analysis of Inequality in Asia," IMF Working Paper. Washington, D.C., 2016. https://www.imf.org/external/pubs/ft/wp/2016/wp1648.pdf.

SR Viet Nam. Plan for Implementation of the Paris Agreement. Hanoi, Government of Vietnam, 2015.

SR Viet Nam. Prime Minister Decision 428/QD-TTg, 18/03/2016, on Approval of Adjustments of the National Power Development Plan for the 2011–2020 Period with a Vision to 2030. Hanoi, Government of Vietnam, 2016.

Statistics Times. "Sector-wise contribution of GDP of India", March 21, 2017, http://statisticstimes.com/economy/sectorwise-gdp-contribution-of-india.php.

Tabuchi, Hiroko. "As Beijing joins Climate Fight, Chinese Companies Build Coal Plants," New York Times online, July 1, 2017, https://www.nytimes.com/2017/07/01/climate/china-energy-companies-coal-plants-climate-change.html.

The Guardian. "Typhoon Hato kills 12 in Macau and Southern China", August 24, 2017, https://www.theguardian.com/world/2017/aug/23/typhoon-hato-hong-kong-battens-down-as-storm-closes-schools-and-stock-market.

The Times of India. "Extreme Weather Events the New Normal? Experts Take Stock", August 30, 2017, http://timesofindia.indiatimes.com/india/extreme-weather-events-the-new-normal-experts-take-stock/articleshow/60294095.cms.

The Times of India. "India Becomes Net Exporter of Power for the First Time: Government", March 29, 2017, http://timesofindia.indiatimes.com/city/bhopal/mp-power-generation-by-state-owned-units-just-40-of-capacity/articleshow/57819318.cms

The Times of India. "Madhya Pradesh: Power Generation by State-owned Units Just 40% of Capacity", March 25, 2017, http://timesofindia.indiatimes.com/business/india-business/india-becomes-net-exporter-of-power-for-the-first-time-government/articleshow/57889280.cms.

Tiantian, Li, Radley M. Horton, Daniel A. Bader, Maigeng Zhou, Xudong Liang, Jie Ban, Qinghua Sun, and Patrick L. Kinney. "Aging Will Amplify the Heat-related Mortality Risk under a Changing Climate: Projection for the Elderly in Beijing, China", Nature.com, Scientific reports 6, Article No. 28161 (2016), doi:10.1038/srep28161, https://www.nature.com/articles/srep28161.

United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. New York, 2015. https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf.

Verzola, Roberto S., Jose D. Logarta Jr., and Pedro H. Maniego, Jr. "Towards a Just Transition in the Philippine Electricity Sector", Study series commissioned by the Friedrich-Ebert-Stiftung Philippines, 2017.

World Bank. "World Development Indicators Database," last modified September 1, 2017, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

World Bank. Country Overview China. Washington, D.C., 2017. http://www.worldbank.org/en/country/china/overview.

World Bank. Country Overview Thailand. Washington, D.C., 2017. http://www.worldbank.org/en/country/thailand/overview.

World Bank. "Survey: 8 of 10 Filipinos Personally Experience Impacts of Climate Change," June 21, 2013, http://www.worldbank.org/en/news/press-release/2013/06/20/survey-8-of-10-Filipinos-Personally-Experience-Impacts-of-Climate-Change.

World Nuclear Association. "Nuclear Power in Japan," last modified July 31, 2017, http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.aspx.

World Nuclear Association. "Nuclear Power in China," last modified July 31, 2017, http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx.

World Resources Institute. "CAIT Climate Data Explorer, Paris Contributions Map," last modified September 1, 2017, http://cait .wri.org/indc/.

Wu, Huizhong. "Mercury Rising: India Records Its Highest Temperature Ever," CNN, May 23, 2016, http://edition.cnn.com/2016/05/20/asia/india-record-temperature/index.html

Yun, Sun-Jin, and Yeon-Mi Jung. "Energy Policy at a Crossroads in the Republic of Korea", Study series commissioned by Friedrich-Ebert-Stiftung South Korea, 2017.

Zang, Wenyu, and Mark Baimbridge. "Exports, Imports and Economic Growth in South Korea and Japan: A Tale of Two Economies." Applied Economics 44, no. 3 (2012): 361–372.

About the author

Prof. Dr. Miranda A. Schreurs is the Chair for Environmental and Climate Policy, Bavarian School of Public Policy, School of Governance, Technical University of Munich.

Julia A. Balanowski has a postgraduate degree in Public Management, with a focus on International Energy and Climate Policy awarded by the University of Potsdam.

Imprint

7 Ba Huyen Thannh Quan | Ba Dinh | Hanoi | Vietnam
IPO Box 44

Responsible:
Yvonne Blos | Regional Coordinator for
Climate & Environment in Asia and
Deputy Resident Director FES Vietnam Office

Phone: +84 24 3845 5108
Website: www.fes-vietnam.org
Facebook: @FriedrichEbertStiftung.Vietnam

To order publication:
info@fes-vietnam.org

Friedrich-Ebert-Stiftung (FES) is the oldest political foundation in Germany.
Founded in 1925, FES is named after Friedrich Ebert, the first democratically elected president of Germany. With an international network of more than 100 offices worldwide, it contributes to fostering the core values of social democracy - freedom, solidarity and social justice. Promoting sustainable development models for many decades, FES established a new global working line focusing on climate justice and social-ecological-transformation in 2010.

FES opened its Vietnam Office in Hanoi in 1990. It was one of the first international non-profit organisations to work in Vietnam. As a political foundation, it works on the principles of promoting social justice and political participation. The Vietnamese partner organisations of FES are central actors in the fields of politics, economic development and political education.

Since 2015, FES Vietnam has also served as a regional hub in the field of climate change, energy, and the environment for the work of Friedrich-Ebert-Stiftung in Asia.

www.fes-asia.org

EFQM
Committed to excellence