

GUIDE

IN-DEPTH 02 SHARED LEADERSHIP, SHARED OUTCOMES: CLIMATE COOPERATION BETWEEN CHINA AND VULNERABLE COUNTRIES

The five countries featured in this issue represent opportunities not only to realize domestic transformation but also to establish a new era of diplomacy through active solidarity with vulnerable nations. The five economies featured in this story are indicative of the potential inherent in the 55-country strong Climate Vulnerable Forum (CVF), which represents over 1.4 billion people today. Individually, they may be insignificant, but taken together, such a market size brings not only obvious global gains when prosperity is achieved together without harming the planet's climate. They also generate spurs that can likewise help accelerate China's transformation – as a market for modernizing transitions in energy and industry, but also as a source of experience in establishing resilience and sharing adaptation expertise that can benefit the growing number of vulnerable populations in China.

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IN-DEPTH REPORT

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China and Climate Cooperation with Vulnerable Countries

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CONSTANTINO

SHARED LEADERSHIP, SHARED OUTCOMES:

CLIMATE COOPERATION BETWEEN CHINA AND VULNERABLE COUNTRIES

■ by RENATO REDENTOR CONSTANTINO

The five countries featured in this issue represent opportunities not only to realize domestic transformation but a chance to establish a new era of diplomacy through active solidarity with vulnerable nations. The five economies featured in this story are indicative of the potential inherent in the 55-country strong Climate Vulnerable Forum, which represents over 1.4 billion people today. Individually, they may be insignificant, but taken together, such a market size brings not only obvious global gains when prosperity is achieved together without harming the planet's climate.

They also generate spurs that can likewise help accelerate China's

transformation –as a market for modernizing transitions in energy and industry, but also as a source of experience in establishing resilience and sharing adaptation expertise that can benefit the growing number of vulnerable populations in China.

The window open to China today requires bold consideration, but the risk of staying on status quo pathways weighs increasingly heavier for China's leadership, which is aware it needs to speed up reforms and play a larger role in global climate diplomacy as well as for vulnerable countries tired of managing the habit of broken promises from the West.


There were expectations months ago, as countries like the US, Germany, and Australia went through the pain of climate-induced disruption, that a greater sense of solidarity might come out of the governments of developed countries. By the time COP26 rolled in, it was clear this set of expectations was a chair that stood only on two legs – one seemed to be based on a desire to feign sympathy and awareness of the severe difficulties faced by nations vulnerable to the climate crisis while forging on with business-as-usual. The other leg appears to be constructed on realpolitik positioning that would ostensibly provide rich countries leverage to advance their preferred outcomes after COP26. Unreliable as the chair feels, Australia seems determined to behave like a neanderthal by burning the flimsy façade further into the ground as it committed with a sense of impunity – without any condemnation from North America and Europe – to sell coal “decades into the future.”

The words of so-called global leaders are flimsy and weak. Of the two elements identified by vulnerable countries as prerequisites to trust and shared goals, developed countries have delivered largely rhetorical flourishes while coming up short, again, in terms of actual delivery. This also forms the crux of reasons why much of the expectations of vulnerable country governments are anchored on finance – because they face the urgency of ensuring their citizens enjoy a life of prosperity and safety despite the climate-constrained world we are currently in. Finance delivered at the right scale, timing, and modality is the bedrock on which cooperation on a global level will stand, and right now a common global objective stands on shaky ground, not just because rich countries have again come up short in their promises, but because they continue to refuse to face the urgency of designing and realizing long-term adaptation plans

and coping strategies long required by vulnerable countries. There was little sense of a delivery plan regarding climate finance promised. Identified months for the climate talks, there would be no delivery plan, much less cash on the table. This has understandably effectively undermined the climate negotiations, poisoning whatever trust was remaining across differently situated developing countries.

It has taken over a decade of moving goalposts, and many vulnerable country governments have understandably tired of dealing with pledges that promise to try and make an effort to potentially do better in delivering new promises. The fabric of trust is frayed, and it certainly will not be mended when historically responsible rich countries refuse to deliver more than the absolute bare minimum of what the hurting public expects of them worldwide. The UN Secretary-General issued a Code Red for humanity because warming is worsening and accelerating, with chances of breaching the 1.5 degrees Celsius average warming threshold relative to pre-industrial levels having advanced by a decade. The impacts mean vulnerable countries, such as those featured in this issue, will face far more intense trade-offs and dilemmas. They will have less space to transform their economies and aim at rapid, climate-friendly modernization as they attempt to protect the livelihoods and lives of their citizens.

There is much potential in conversations that have yet to take place between China and vulnerable countries. The importance of structured exchanges, where experience can be shared in a structured way in terms of devastation and existential threats can only enable stronger ties away from a client-master relationship on which much of the West continues to depend on, and on the basis of mutual respect and understanding.



Governments from Bangladesh and the Philippines for instance will recognize the pain Shanxi and Henan have gone through recently, with rainfall in a few days or even hours surpassing the average historical monthly records. Is China also a climate vulnerable country? For many, it is. And there lies the basis of working together more closely with others not from the rich Western nations.

It is a two-way street, where efforts of cooperation are extended by China to other countries facing the great and growing rise of impacts threatening the long-term viability of their economies, and where China can learn from countries potentially more vulnerable to climate change, countries that may have more experience when it comes to building and deepening public awareness of the climate crisis, developing responsive alert systems, effective coordination among government agencies, and the ability to harness goodwill, support, and active solidarity with communities and non-government organizations well-versed in public mobilization for social development and voluntarism. Together, the population is 1.4 billion, almost the same as China's, and their landscape and natural diversity also provide references to China. Ethiopia is dealing with desertification, insect infestation, and increasingly erratic rainfall that are imposing ever-higher levels of food insecurity, conflicts over natural resources, and massive strains on agriculture, livestock, water, and human health. Ghana is one of Africa's fastest-growing economies which is making significant strides in reducing poverty, but like China, Ghana's march to development is threatened by rising sea levels, flooding, water-borne diseases, and higher temperatures affecting agricultural exports and hydro-reliant power, including worsening soil

erosion and threats to biodiversity, broad swath of the country's coastal populations, infrastructure, and hydropower production. More intense and more frequent rainfall are impacting Rwanda's industries, in particular its The Philippines, with a population of 110 million, is facing not just a projected increase in episodic weather extremes but also worsening slow-onset effects. Sea levels in the Philippines are rising at twice the global rate, indicating further salinization of freshwater meant for irrigation and drinking.

It should not come as a surprise, therefore, to read the 55-government strong Climate Vulnerable Forum's (CVF) offer of sincere sympathy and concern to China as it faced the aftermath of floods in Henan. As Bangladesh Prime Minister and current CVF President, Sheikh Hasina wrote to China with an offer of support, "As a country which itself regularly experiences the adverse effects of such floods, Bangladesh stands in heartfelt solidarity with all those affected by the devastating impacts of these extreme weather events, far more frequent and severe due to the global climate crisis unfolding across our planet." Hasina writes with concern how "the extreme flooding ... is yet another painful reminder of the pressing reality of climate change and its impact on people, communities, fundamental human rights, Mother Earth, and ecosystems worldwide. This and other, similar recent tragic climatic events underline the extent to which all countries are vulnerable. With the Climate Vulnerable Forum, Bangladesh is therefore strongly committed to collaboration, cooperation, and collective action... There is a necessity for all nations to join forces and work with urgency and ambition for addressing this global crisis."

Technological cooperation, capacity, finance, sharing of insights and experience with a vast and still rapidly growing array in business models and development pathways, sharing of vast resilience expertise – there is much potential for efforts to advance new diplomatic long-term development alliances based on mutual respect and shared prosperity.

A lot of press attention has been devoted to the announcement of Pres. Xi Jinping that China will no longer build new coal-fired power projects abroad. While this pronouncement has been welcomed by countries from all continents and regions, recognition of China's resolve to stop the harm should actually highlight the words preceding Pres. Xi's statement against coal—because they indicate that “China will step up support for other developing countries in developing green and low-carbon energy.”

It is a good backdrop for bold steps toward international cooperation, anchored on the resolve of vulnerable

countries to pursue a future similar to the one China is chasing instead of the past China is leaving behind. The Climate Prosperity Plans led climate vulnerable countries under close cooperation with China will enable them to avoid the old development model by the West of heavy carbon pollution and dependence. New alliances are to be built based on fertile grounds of common experience and shared development objectives between climate vulnerable countries and China.

There is much room for them to together explore collective approaches to common challenges imposed by climate change – as nations on equal footing who have an eye on a future that is based on reaching shared goals through the practice of shared leadership on a global scale.

(The author is Deputy Chair of the Expert Advisors Group of the Climate Vulnerable Forum, member of the board of the People's Survival Fund (PSF), Executive Director of the Institute for Climate and Sustainable Cities.



▲ A woman walks by wreckage left by Typhoon Ompong that hit the Philippines from Sept 15th to 18th in 2018. Photo by AC Dimatatac/ICSC



▲ A wind power plant in Kutubdia Island of Cox's Bazar, Bangladesh. Photo by KM Asad

Bangladesh, Tough but Determined Energy Transition

■ By Wang Lin

"As we say in Bangla: 'Bhabia korio kaj, koria bhabio na' (think before you act, not after you're done), we should not do anything that cannot be reversed," Prime Minister Sheikh Hasina of Bangladesh wrote in the Financial Times recently. "The inconvenient truth of our times is that while action on climate change has never been more urgent and achievable, governments are not cutting emissions fast enough to keep nations such as mine safe." Terming the climate change, pandemic, and destruction of nature as the common threats, Prime Minister Sheikh Hasina has urged global leaders, businesses, and G20 to work unitedly to get a common solution—a cleaner, greener, safer world.

This is the latest public response to climate and energy issues from South

Asian country Bangladesh, known as the "land of jute". Climate change is doing the country a profound harm. In recent years, extreme weather events have frequently hit Bangladesh, such as heatwaves, hotter summers than ever before, irregular dry and monsoon seasons, which have led to an increase in the size of the country's "climate refugees". Rising sea levels, floods, and other problems have forced people to leave their homes, triggering other social problems in the country, as well as neighboring countries.

Bangladesh has limited mineral resources, such as coal, natural gas, and some unexplored oil reserves.

It has a single energy structure, relying heavily on coal and natural gas. Against the backdrop of a rapidly worsening climate crisis, Bangladesh is ready to restructure the country's energy mix, planning to phase out coal in favor of expanding natural gas use and expanding its clean energy business, such as wind and solar power. But the fragile economy has made Bangladesh's energy transition quite a challenge.

Climate Crisis Worsened Fragile Economies

Bangladesh's geographical conditions make it extremely vulnerable to climate change. On the one hand, the country's humid, hot and rainy climate, frequency of tropical hurricanes, coupled with extensive rivers, resulting in frequent floods during the rainy season; on the other hand, one quarter of the country's land is almost as low as the sea level, and land erosion due to rising sea levels is widespread.

Abul Kalam Azad, Bangladesh Special Envoy of the Climate Vulnerable Forum (CVF), told CEN that Bangladesh's high vulnerability to climate change can be attributed to a number of topographic, hydro-geological, and socio-economic factors. They include its geographical position in South Asia, its flat deltaic topography with low elevation, its extreme exposure to climate variability, its high population density and incidence of chronic/abject poverty, and its greater dependency on an agrarian economy for incomes and employment, which in turn is severely affected by a capricious climate.

Bangladesh's geographical characteristics are intricately linked to local and regional hydrological characteristics that rely on climatic processes, including seasonality. Bangladesh is at risk of natural disasters such as riverine and flash floods, tropical cyclones, storm surges, droughts,


salinity intrusions, sea-level rise, and riverbank and coastal erosion. Flooding of various types, cyclones, and droughts is common. Many parts of Bangladesh's economy and society are severely affected by climate change including water resources, agriculture and forestry, food security, human health, and infrastructure.

The greatest impact of climate change is on human settlement, causing mass displacement of inhabitants and loss of livelihood. Some 22–30% of the country is usually inundated by heavy rainfall during the monsoon season, while a major flood may inundate two-thirds of the country. Climate change will deplete capital stock in the construction sector by 0.05% annually until 2100.

A rise in sea levels and coastal erosion could lead to a loss of 17% of land surface and 30% of food production by 2050. One-third of Bangladesh's population is estimated to be at risk of displacement because of rising sea levels. A study of sea-level rise scenarios by the Bangladesh Ministry of Finance projects the annual cost from loss of capital and reduced economic activity could range between 1.49% and 3.02% of GDP by 2031, with significant job losses.

According to National Geographic, a total population of nearly 700,000 people have had to relocate each year, with about 400,000 "climate refugees" rushing into the capital city of Dhaka. However, Dhaka's total population is only 9 million, which means that "climate refugees" add nearly 5% to the city's immigrant population each year.

Most of these people live in slums, which pose a number of public health and safety problems, such as watercourses, inadequate electricity supply, fires, infectious diseases, etc. The infrastructure construction has a hard time catching up with the influx of refugees.



Climate change has been a threat multiplier in Bangladesh as the country continues to experience unprecedented impacts and losses from the phenomenon. Climate change is now a growing humanitarian crisis for the country.

Power Modernization: Key to Transformation

Bangladesh has placed building adaptive capacities and adaptation at the very core of climate policies and plans. Power and energy security are the main driving forces for Bangladesh's future. The Government will continue taking major steps to ensure uninterrupted power supply through increased installed generation capacity, an expanded transmission and distribution network, reduced system loss, increased electricity coverage, a greater share of renewable energy, and a cost-effective cross-border energy trade.

At the second Belt and Road Energy Ministers' Meeting in October, Nasrul Hamid, Minister of State for Electricity, Energy and Mineral Resources of Bangladesh, said Bangladesh was committed to the transition to cleaner energy, fulfilling its responsibilities as a signatory to the Paris Agreement and achieving the United Nations Sustainable Development Goals.

"We have reviewed the overall plan for the power system, increased the share of renewable energy in the energy mix, and gradually reduced the use of fossil fuels, particularly coal, which shows that we are focusing on increasing the share of clean energy," said Nasrul Hamid at the meeting. "We are committed to achieving carbon neutrality. Our power sector will always prioritize the use of clean energy to generate electricity." He added that Bangladesh has completed wind mapping in nine regions and will

soon be investigating the future of offshore power generation with a view to increasing the share of renewable energy to 40% by 2041.

Electricity modernization is key. In June 2021, Bangladesh developed the world's first "climate prosperity plan", a vision under which Bangladesh plans to enhance climate resilience, grow the economy, create jobs, and expand opportunities for the citizens, using action on climate change as the catalyst.

For Bangladesh, the Climate Prosperity Plan illustrates the way forward, in the face of increasing climate-fueled disasters, for safeguarded energy security, and enhanced climate resilience. It is a clear indication of movement away from old, outdated and expensive imported fossil fuel technology, towards a green transformative economic vision. According to the Bangladesh Ministry of Energy, the country aims to achieve a 30% share of renewable energy by the end of 2030, to increase the share further to 40% by 2041, and to strengthen cross-border electricity trade by importing clean electricity such as hydropower and solar energy from neighboring countries.

By the end of 2020, Bangladesh generated about 53.86% electricity from gas, 6.33% from diesel, 5.62% from coal, and the rest from furnace oil, imported power, with only 0.19% from renewable energy sources.

For the next steps, Bangladesh will develop wind farms along the coast, which is believed to have the ability to revitalize the mangrove forests and help stabilize shores and protect against storms and flooding.

Imperative to Phase Out Coal

In advancing its “Climate Prosperity Plan”, Bangladesh plans to increase its use of natural gas while gradually abandoning coal. Earlier this year, the government of Bangladesh announced to cancel plans for 10 coal-fired power plants, with a total installed capacity of 8451 MW. Nazrul Hamid said the decision to stop building coal-fired power stations was made based on newly evolved energy technology and a global trend that more and more countries have stopped coal-fired projects for environmental reasons.


In August 2020, Bangladesh re-examined 26 coal-fired power stations under construction and found that only three of them met development standards and could be retained. Nazrul Hamid added that coal power accounts for only 5 gigawatts of the planned new

40-41 GW of installed capacity, and that the government is currently studying the prospect of getting rid of coal power altogether.

For Bangladesh, coal-fired power is no longer a cheap system. Power Cell, a research institute under Bangladesh’s Ministry of Energy, points out that coal power is no longer a cheap option while importing coal is becoming more expensive. Until now, the Bangladesh Electricity Development Commission has been required to pay compensation for underutilized coal-fired power stations in the form of “installed payments”. In the fiscal year 2018-2019, Bangladesh’s coal-fired power generation utilization rate was only 43%, but it paid up to \$1.1 billion in subsidies to coal-fired power plant operators. In the Fiscal Year 2020-2021, about a third of the national budget went to idle loss-making power stations.

▼ Upgrading Unit 4 of Ghorashal Power Plant in Narsingdi District, Bangladesh. Photo by KM Asad





In addition, most of Bangladesh's coal-fired power stations are built in coastal areas, which are densely populated and environmentally important. Quitting coal is a necessary option. To date, Bangladesh has a total installed power generation of 19,000 megawatts, with natural gas accounting for over half of the total, followed by oil and hydropower, biomass, and then renewables such as solar and wind. For this developing country, electricity demand will keep rising, and natural gas has been given some more hope.

Nazrul Hamid said in a written interview with CEN, "In order to achieve our national economic growth, gas has been identified as a primary energy source." However, he added that Bangladesh's natural gas reserves are rapidly declining, with 20 gas fields in the country currently producing 2,525 million cubic feet per day, plus imports of 1 billion cubic feet, all of which have been integrated into the national gas grid. "In order to meet the growing demand for natural gas, we have developed short-, medium- and long-term projects to find more reserves of natural gas. We have taken various measures to increase natural gas delivery capacity and LNG imports."

It is reported that LNG usage is expected to double as Bangladesh begins construction of LNG import ports. In response, industry analysts have warned that LNG is an unsustainable long-term solution for Bangladesh's energy sector, with volatile gas prices, posing way too high risks for the country's fragile economy.

This winter, gas prices in Europe and Asia have hit record high, and sent strong blows to Bangladesh, whose heavy reliance on LNG makes it even more vulnerable to price volatility than the rest

of Asia. Despite Bangladesh's planned shift from oil to natural gas, the country has had to reconsider renewing leases on five oil-fired power plants that are due to expire because of a shortage of natural gas and high prices.

The Institute for Energy Economics and Financial Analysis (IEEFA) pointed out earlier that as a net importer of fossil fuels, Bangladesh is under heavy financial and environmental burden from the importation and burning of fossil fuels. This is the strongest incentive for Bangladesh to embrace sustainable renewable energy.

Slow Progress of Wind and Solar

Clearly, the "gas instead of coal" approach is not a long-lasting strategy; Bangladesh needs to speed up the development of wind and solar power. In fact, climate vulnerable countries such as Bangladesh are heavily burdened with high capital costs, which further undermines their ability to develop low-carbon and climate-resilient projects. While the climate finance gap and climate actions from developed countries are lagging, Bangladesh is at greater risks and has higher financing costs, drastically slowing down the country's deployment of low-carbon and climate-resilient infrastructure, modern technologies and projects.

Many climate-resilient and low-carbon projects have higher capital intensity than traditional infrastructure. A renewable energy project may have a higher upfront cost, but lower operating costs than a coal plant of equal output. As small changes in interest rates have compounding effects on project costs over time, lowering financing costs can therefore have significant price benefits for project end-beneficiaries (electricity customers, farmers using resilient

irrigation infrastructure and so on). The success of climate prosperity outcomes in Bangladesh hinges on providing a lower cost of capital or a high level of concessionality.

Nazrul Hamid says Bangladesh has the world's largest solar system, powering 20 million people who are not connected to the grid in remote areas. "But at the same time, we have many challenges and the development of renewable energy in Bangladesh is quite slow. One of the reasons is the shortage of land. Bangladesh is a very populated country without much land to use. We are therefore working to advance land use for renewable energy and intend to establish a renewable energy database, which requires both talents and technology, as well as a great deal of time for in-depth research."

For Bangladesh, a recent study showed that modernization through renewable energy and energy efficiency could lead to 6 times more jobs than fossil fuel generation, which is up to 55,000 new jobs between 2016 and 2030. To complement this trajectory, Bangladesh will reduce, displace,

and potentially replace outdated and expensive technology to improve the balance of trade, reduce inflationary pressures and exposure to volatility, and improve the sector's cost competitiveness.


Bright Future for China-Bangladesh Energy Cooperation

The above challenges are also opportunities for the future of energy cooperation between China and Bangladesh. Nazrul Hamid stressed China and Bangladesh enjoy good and healthy bilateral relations, which is one most important favorable conditions for long-term trade and investment. The two countries can cooperate in areas including oil, gas, and clean energy. China can provide training on drilling, contract negotiation etc. for workers from Bangladesh.

"I believe that under the Belt and Road Initiative, our two countries will be able to propose viable solutions to the energy problems we face today or in the future for a greener, more inclusive energy future," said Nazrul Hamid. "The

▼ A solar farm in Manpura Upazila in Bangladesh. Photo by KM Asad





two countries can work together in key areas such as personnel development and technology transfer. In addition, waste-to-electricity, offshore wind power, distributed solar power, biomass, and tidal energy are all clean energy which we should explore. These efforts require a lot of investment, and we hope to expand our collaboration into these areas.”

There is already South-South cooperation between Bangladesh and China to install 450 MW of solar capacity and a 50 MW wind farm in Bangladesh, under a deal signed in 2019.

With the Mujib Climate Prosperity Plan, there is a further opportunity for cooperation between Bangladesh and China. The Plan effectively triangulates climate action, resilience building and competitive positioning, which include the maximization of domestic renewable energy resources through leveraged international support, foreign direct investment and domestic private sector participation. The move will double Bangladesh’s existing clean energy capacity to 601 megawatts, of which nearly 368 megawatts will come from solar energy.

Abul Kalam Azad told CEN: “To achieve Bangladesh’s green energy transition, we need grid modernization and storage capacity which China has both the financial and technology to support.” For Bangladesh, Chinese investors and lenders can consider investing in large scale renewable energy-based power generation, storage and grid modernization projects. Technology transfer and skills transfer is very important to ensure the sustainability of projects and the workforce moving forward. To minimize risk, Bangladesh has launched the Accelerated Financing Mechanism to make available guarantees for projects, as an important way

forward. “We will also empower banks to offer favorable terms to fossil fuel-free infrastructure projects,” Abul Kalam Azad added.

For Chinese energy investors, according to industry analysts, Bangladesh provides strong opportunities and advantages, including prioritization of the government, favorable policies, rapid economic growth, market potential, abundant labor resources, and low prices, etc. These are all important for energy and infrastructure building and development.

Chinese companies in fact have already been playing an active role in Bangladesh’s energy sector since the launch of the Belt and Road Initiative. China Electric Power Construction Group Co., Ltd. (hereinafter referred to as “Power China”) has set up a representative office in Bangladesh, an important step by the company to strengthen construction and production capacity, and to increase capital in the host country. The representative office, comprising 17 member enterprises of Power China, is responsible for jointly developing and operating the local market in Bangladesh, and helping to introduce standards, advanced technologies and equipment to Bangladesh. It is also responsible for creating new investment and financing models, upholding the concept of green innovation and development as a core part of BRI, and actively fulfilling corporate social responsibilities. This joint marketing model has proven to maximize the advantages of Power China’s entire industrial chain from upstream to downstream, but also greatly stimulates the new development vitality of the local energy market in Bangladesh.



▲ A 50 MW solar farm in Palo in the Philippines. Photo by AC Dimatatac/ICSC

Philippines, New Chapter for Renewable Energy

■ by Dong Zitong

The Philippines is an archipelagic nation with more than 7,000 islands, some large, mostly small. The country has a mountainous terrain, with more than three-quarters of the country's total land area, and a few islands have broad inland plains; most of which have only sporadic narrow plains along the coast.

The Philippines has long been heavily dependent on imported energy, but with the successful implementation of local energy programs, the share of imported energy in energy consumption has fallen from about 90 percent in the 1970s to about 40 percent nowadays. At the same time, the advantages of rich natural renewable energy resources have

put the Philippines at the forefront of the transition to clean energy in Southeast Asian countries.

The Philippines, as a very climate vulnerable country, is exploring new pathways, combining mitigation and adaptation, to transit from high polluting and energy intensive economy to green development with encouragement for renewable energy projects such as solar and wind energy. The Philippines has achieved quite encouraging results in a number of areas, and sustainable development is taking up momentum in the country.

Energy Self-sufficiency Rates Increasing

The energy sector has been a priority for the Philippines' economic plans. However, constrained by factors such as topography, the country's energy self-sufficiency was low over the last century. In 1976, the Philippines launched an indigenous energy development program, including five major measures: first, to explore and develop oil fields with relatively small reserves but commercially viable; second, to develop geothermal energy with the aim to become one of the most successful countries in the world in geothermal energy utilization; third, to develop Malampaya deepwater gas fields; fourth, to increase coal production; and fifth, to increase renewable energy development efforts to achieve rapid growth. As a result, the Philippines' dependence on imported energy dropped from 92 percent in 1976 to about 40 percent in 2016.

In 2020, due to the COVID-19 pandemic, the Philippines economy slowed down, with energy demands in transportation, industry, and agriculture all dropping while household energy use rose slightly. In 2020, total final energy consumption (TFEC) was at 32.4 MTOE, a decrease of 10.7 percent from the 2019 level of 36.3 MTOE. Power generation meanwhile declined by 4.0 percent in 2020, recording only 101,756 GWh.

The self-sufficiency rate, representing the share of indigenous energy sources, remained well in 2022 at 53%, thanks to renewable energy. In 2020's total primary energy supply, renewable energy accounted for 34% share, followed by coal at 30.9%, oil at 29% and gas at 5.8%. The Philippines remains to have the highest RE share in TPES among all the Association

of Southeast Asian Nations (ASEAN) countries. This puts the country at the forefront of the sustainability game in the region.

However, when it comes to newly installed capacity in 2020, renewable energy lagged behind coal. In 2020, the Philippines' installed 755 MW of generating capacity, a year-on-year rise of 3.0%. The additional capacities that augmented existing supply were from new coal at 42% share, followed by RE at 29%, oil at 16%, and natural gas at 13%.

Prioritize Renewable Energy Sources

The Philippines was the first ASEAN country to publicly state that it would no longer consider new coal-fired power projects. In June 2020, the Philippines' Congress Committee on Climate Change approved House Resolution 761 to stop further permitting of new coal plants. Since then, the Department of Energy (DOE) director Alfonso G. Cusi, and Chairperson of the National Renewable Energy Board (NREB) Monalisa C. Dimalanta have both expressed publicly that the Philippines will prioritize renewable energy projects and lift foreign investment restrictions in the field.

Energy plans for the Philippines are set to achieve a 35% renewable energy share in the country's total power generation by 2030, and to aim for a total transition to a clean energy future by 2040.

At the moment, the Philippines government has issued policies on energy efficiency such as the Government Energy Management Program (GEMP), Philippine Energy Labeling Program (PELP), and Minimum Energy Performance for Products (MEPP)

Standards, etc. to improve energy efficiency. However, the development of renewable energy is the top priority for the Philippines Department of Energy's low-emission development strategy. Rules and guidelines have been formulated to facilitate the implementation of all RE policy mechanisms, such as the publication of feed-in tariffs for renewable energy, additional incentives to support financing, the introduction of relevant administrative licensing mechanisms and technical standards, and the acceleration of grid interconnection to promote clean energy consumption.

Specifically, the Guidelines Governing the conduct of Green Energy Auction Program (GEAP) was issued on 14 July 2020 to provide additional market options by auctioning RE capacities from qualified RE suppliers and promoting a competitive setting of RE supply in the country.

The Philippines is the only ASEAN country to have a mechanism for end-users to choose renewable energy

sources via the Green Energy Option Program (GEOP), with more rules and procedures following to support the implementation of GEOP, such as the Operating Permits of RE suppliers.

Furthermore, the Net-Metering Program (NMP) was launched in the Philippines to allow end-users to install up to 100-kW RE systems to reduce their electricity bills and sell the surplus to the grid. The amended net-metering rules issued on 22 October 2020 reduce soft installation costs for prosumers (consumers and producers) and simplify the processing timeline.

"Apart from implementing policies, the Department of Energy formed partnerships with other government agencies and private institutions, both domestic and international in mainstreaming RE development," said Atty. Felix William Buquid Fuentebella, Undersecretary for Planning, Renewable Energy, Power, Investment, Media Affairs and Spokesperson of the Department of Energy in an interview with CEN.

▼ ICSC installs solar panels on Jan 22, 2020, at a primary school after Typhoon Phanfone. Photo by AC Dimatatac/ICSC



Development of Geothermal Energy with Foreign Capital

Among the many renewable energy sources, geothermal energy stands out in the Philippines, leading the world in terms of exploration and utilization. The potential is huge, and the advantages obvious. The Philippines, located on the edges of the Eurasian Plate and the Pacific Plate, close to the Indo-Australian Plate, sits right on the Ring of Fire. Active crustal movements and plate collisions lead to frequent volcanic and seismic activities, but also rich geothermal resources, with an estimated reserve of about 6 million kilowatts, equivalent to 2.09 billion barrels of crude oil.

The Philippine government is keen to regain its global standing as one of the top countries in geothermal development, Fuentebella added. "Exhausting the full potential of our geothermal resources for both power and non-power applications are continuously being pursued."

Geothermal energy is in fact a key pillar for the Philippines' power sector. Currently, a total of 1,928 MW generating capacities have already been installed in the Philippine Power System. As of May 2021, 34 Geothermal Renewable Energy Service Contracts (GRES-Cs) have already been awarded with potential capacity of 814.2 MW.

One of the key reasons for the success of the geothermal industry in the Philippines is the introduction of foreign investment. The Philippines attaches particular importance to international cooperation in this field. As early as 2009, the Philippine government launched 19 geothermal resource development cooperation projects to encourage companies to develop and utilize geothermal resources with a total capacity of more than 600,000 kilowatts. In 2020, the DOE issued a

policy guideline to allow 100% foreign participation in large-scale geothermal projects through Financial and Technical Assistance Agreements (FTAAs). Foreign companies were allowed to participate in geothermal exploration, development, and utilization activities projects with an initial investment cost of about USD 50 million capitalization.

Alberto Dalusung III, an energy transition expert from the Institute for Climate and Sustainable Cities, told CEN that, unlike fossil fuel-based power generation, geothermal power companies have to take exploration risks in finding commercial geothermal resources suitable for power generation. However, local power companies do not have the resource competencies and risk tolerance required. Thus, it is important for the DOE to open up geothermal development to investors outside the Philippines.

Electric Vehicles (EV) Next Steps

At present, the global transportation sector is also at a high level of carbon emissions, and it is regarded as the focus of the world's emission reduction. The Philippines also wants to gradually increase the penetration of electric vehicles and has set targets for this purpose. "Electric vehicles (EVs) are an instrument or strategy to veer away from oil," Fuentebella said.

In order to encourage consumers to purchase more energy-efficient vehicles voluntarily, the Philippines DOE has set emission standards for automobiles. At the same time, the Philippine government has developed guidelines for the establishment, operation and development of the electric vehicle industry, and regulations over the manufacture, importation, distribution and sales to ensure safe and stable growth and a fair, just and open business environment.

Senate Bill (SB) 1382, referred to as the “Electric Vehicles and Charging Stations Act” was passed and approved by the Senate on 31 May 2021, in order to support the commercialization and local adoption of EVs, including the infrastructure requirements particularly the establishment of EVCS.

The DOE also entered into a partnership with national government agencies (NGAs), state universities, and private entities to conduct studies and demonstration of energy technologies related to EVs, such as research and development about the actual road performance data gathering of the Electric Vehicles (EVs) and Hybrid Electric Vehicles (HEVs).

Based on the 2018 data from the Department of Trade and Industry, the Philippines now has 28 firms engaged in the manufacturing of various EVs, 11 companies for parts and component manufacturers, and 7 importers. They provide employment to 14,840 individuals.

New Stage for China-Philippines Energy Cooperation

“Global trends have shown a growing interest in shifting from fossil fuels to cleaner forms of energy,” said Fuentebella. The DOE has refocused its strategies by strengthening collaboration with international organizations and development partners for the necessary assistance involving energy security, access to electricity, increasing share of clean energy, development of new and emerging clean energy technology, and on energy transition program.

As a major renewable energy developer country, China is providing the necessary technical and financial support for the Philippines to achieve its climate goals. In May 2017, the Philippine government signed a memorandum of

understanding (MOU) with China to establish a China-Philippines energy expert team with the aim to find practical cooperation opportunities and turn intentions into operations.

In recent years, China and the Philippines have cooperated in the field of energy, covering waste power plants, wind and solar integration projects and so on. According to Chinese photovoltaic company Jingko Solar, under the Belt and Road Initiative, the company’s product supply to the Philippine market has been increasing. According to BMI Research’s Singapore office, China has invested \$32.8 billion in 21 projects in the Philippines.

Fuentebella said that recognizing China’s current position as the world’s largest operator of installed offshore wind capacity, advancing this clean technology domestically is only one of the several avenues for cooperation between the Philippines and China, including transfer of technology, wind resource assessment, and capital investments.

Alberto Dalusung III added that there are already several offshore wind developers with service contracts. “China is the world’s leading supplier of Variable Renewable Energy (VRE) equipment and the State Grid Corporation of China (SGC) owns 40% of the National Grid Corporation of the Philippines (NGCP), the franchise holder on the power transmission system. This situation provides a natural market opportunity for Chinese technology and finance,” he said.

The Philippines is also open for other mature and variable RE technologies, as accelerating development in the RE sector is part of our clean energy initiative for a greener and sustainable future, Fuentebella added.

Ghana, Rich in Resources but Access is Challenge

■ By Wang Lin

Ghana, located in West Africa, is an important commercial center in West Africa and a “model student” for Africa’s economic development. Although Ghana is only a low- and middle-income country, it is attracting more and more international investors with its rich mineral and natural resources as well as its strong agriculture and fishery industry.

To date, Ghana has 23 large mines and more than 30 small-scale mines. It also has rich reserves of oil and gas resources in the western basin of Ghana, with oil fields such as Jubilee and Tweneboa Enyera Ntomme, accounting for about 20% of the country’s total exploitable reserve. Ghana is politically stable, with a sound democratic system.

How has Ghana’s energy sector developed to support Africa’s fastest-growing economy? What is the role of clean energy? In the context of the rapidly worsening climate change crisis, has the country put in place a responsive plan to address the crisis and prepare itself for a global energy transition? The answer may be more optimistic than one would think.

Vision: Energy Self-sufficiency

The vision of the Ghana Energy sector is to make the country self-sufficient in energy, and its overall goal is to make competitively priced energy universally and readily accessible in an environmentally sustainable manner for the local market and for export. The goal of the oil & gas subsector is to

sustainably manage Ghana’s oil & gas value chain for the benefit of present and future generations, with transparent and sustainable exploitation and management for local consumption and for export.

The total primary energy supply in Ghana comprising oil, biomass, and natural gas constituted 38.3%, 37.8%, and 18.2% respectively of the country’s total primary energy supplied in 2019. Between the years 2000 and 2011, biomass constituted the more than 50% of the share of primary energy supply in the country. Oil became the dominant primary energy supplied into the economy from 2012 to 2019 accounting for about 40%. The annual average growth rate of total primary energy supplied between 2000 and 2019 was 3.1%.

For final energy consumption, the share of biomass decreased from 61.7% in 2000 to 48.5% in 2008 representing an annual average reduction of 3.1%. Oil and gas had become the dominant fuel in the final energy mix from 2009 to 2019 with its share in the final energy consumption mix increasing from 2,597.7 KTOE (45.5%) in 2009 to 3,794 KTOE (47.6%) in 2019.

The fastest-growing energy-demanding sector is the transport sector. It grew at an annual rate of 5%, from 1,169 KTOE in 2000, representing 21.0% of the total energy consumed, to 2,952 KTOE in 2019, or 37% of the total energy consumed.

Renewable energy is also an important energy supply option for Ghana. In recent years, the country has been seeking to diversify its energy mix to minimize the adverse environmental, ecological and climatic effects of energy production. Ghana's renewable energy options are mainly hydropower, solar, wind, biofuels, etc. Ghana has launched the Renewable Energy Master Plan, targeting at reaching a 10% share of renewables in its energy mix by 2030, to support sustainable economic growth and reduce climate change impact on the economy.

So far, besides the above-mentioned Renewable Energy Master Plan, Ghana has also passed other relevant policies and acts, including the Bio-Energy Policy, the National Liquefied Petroleum Gas (LPG) Policy, the National Gas Master Plan, and the National Transportation Policy. Ghana plans to keep revising its policies in the future to better support

the transformation of the country's energy structure.

Climate Crisis: Major Threat to Economy

Ghana has been severely affected by the growing climate change crisis. Over the past 40 years, local temperature has increased by an average of 1.2°C and is projected to increase from 1°C to 4°C by 2080, particularly in the northern part of Ghana. The mean annual rainfall shows a decreasing trend in both the northern and south of the country, with a frequency of occurrence of extreme events such as wind/rain storms, long dry spells are highly likely to occur. The major threat in the energy sector includes drought, endangering hydroelectricity power, which has currently reduced hydroelectricity power between 60 -70%.

Data from Ghana's Ministry of Food and Agriculture shows that over



▲ Electricity pylons in Accra, Ghana. Photo by Nipah Dennis

80% of the country's farmers have been affected by the drought this year alone. In addition, Ghana's arable land has shrunk by 7% in the past 10 years, as a result of extreme weather, leading to an annual loss of millions of dollars. Ghana's revenue in the first seven months this year fell to USD \$5.66 billion, with a struggling outlook. Economists are forecasting annual expansion to stay well below the target of 5% in 2021.

Ghana, although one of the fastest-growing economies in Africa, is currently a lower-middle-income economy globally. It aims at achieving an upper-middle-income status by 2030 and becoming a high-income country by 2057. Achieving and sustaining an upper middle-income status would require the current average GDP per capita of about \$2,000 to expand to at least \$10,000 by 2030, when the country's prevailing population of about 30 million is projected to reach about 37 million, with an estimated 61% living in urban areas.

Accordingly, Ghana's per capita electricity and energy consumption is projected to grow. By 2030, the average electricity consumption per capita is projected to increase from the current average of about 420 kWh to the average upper middle-income status of about 5000 kWh. The corresponding energy consumption per capita is expected to increase ten-fold from the current average of about 0.5 TOE to about 5 TOE by 2030.

The expected population, economic and energy growth would spur increases in total greenhouse gas (GHG) emissions from the prevailing average of about 42 million tonnes of carbon dioxide equivalent (MtCO₂e) (i.e. 1.4 tonnes per capita) to about 74-80 MtCO₂e (i.e. 2-3 tonnes per capita) by 2030.

Seven areas to promote climate action

In response to the climate change crisis, the Ghanaian authorities have taken a positive approach, committing themselves to advance emission reduction and climate adaptation actions through seven priority areas: energy, transport, agriculture and forestry, water, gender, industry, disaster management and climate services.

The country has set a 2030 target to decrease its greenhouse gas emissions by 15%, relative to a BAU growth scenario, which means a drop from the target of 2 to 1.7 tonnes per capita. A further 30% emission reduction to 1.4 tonnes per capita is attainable, provided the country receives the said external support encompassing not only finance but technology transfer and capacity building to cover the full cost of implementing its proposed mitigation actions.

Ghana signed and ratified the Paris Agreement in 2015 and 2016 respectively. The country's Nationally Determined Contributions (NDCs) include 10 main energy actions: 1) Increase small-medium hydro installed capacity up to 150-300MW; 2) Attain utility scale wind power capacity up to 50 – 150MW; 3) Attain utility scale solar electricity installed capacity up to 150 – 250MW; 4) Establish solar 55 mini-grids with an average capacity of 100kW which translates to 10MW; 5) Scale up the 200,000 solar home systems for lighting in urban and selected non-electrified rural households; 6) Increase solar lantern replacement in rural non-electrified households to 2 million; 7) Scale up adoption of LPG use from 5.5% to 50% per urban and rural households up to 2030; 8) Scale up access and adoption of 2 million efficient cook stoves up to 2030; 9) Scale up 120 MSCF



▲ Gridco electricity plant in Accra, Ghana. Photo by Nipah Dennis

natural gas replacement of light crude oil for electricity generations in thermal plants; and 10) Expansion of inter and intra city mass transportation modes (rail and bus transit systems) in 4 cities.

These ten major energy actions and 21 other climate actions proposed would require \$22.6 billion investments of which US\$ 6.4 billion is being mobilized from domestic sources, whilst 16.2 billion are being sought from international support.

In addition to financial challenges, technical and equipment aspects also require iterative upgrades. At the end of 2020, Ghana began to promote the installation of solar panels and smart meters, but the spread was extremely slow. Against the background of the rapid growth of power demand and accelerated aging of power infrastructure, power outages brownouts have become the norm in the country.

New Challenge: Integration of Clean Energy

For Ghana, the systematic integration of renewable energy into the country's energy mix is a major challenge. At present, the key issues in development, deployment, and promotion include insufficient data on some renewable energy resources and their utilization, inadequate local participation and investment in the renewable energy industry, high upfront cost of most renewable energy technologies, challenges in accessing long-term low-cost financing facilities for residential installations, difficulty in accessing land for renewable energy projects due to land ownership structure, and the intermittent nature of the major renewable energy sources such as solar and wind.

In view of these challenges, the Government of Ghana has developed incentives aimed at the systematic

integration of renewable energy into the national energy mix, while promoting the development and use of mature and affordable renewable energy technologies. Other policy objectives also include to achieving a sustainable and competitively priced renewable energy deployment, deploying renewables for electricity supply in remote and island communities, increasing the penetration of non-electricity applications of renewables such as solar water heaters and crop dryers, and supporting the sustainable production and supply of wood fuel, biogas and liquid biofuel for local consumption and for export.

Ghana still has many problems to overcome in developing renewable energy sources, including weak infrastructure, underfunding, labor shortages, and a gap in skilled personnel. This is not only the case for Ghana but a constraint to the energy transition of most African countries.

Opportunities in Ghana for Chinese Companies

To sum up, Ghana's energy mix bottleneck and the pain of economic transformation have charted a clear path for the next phase of cooperation between China and Ghana. Ghana hopes to gain with the immense capacity of China in the development and deployment of renewable energy technologies to unlock the country's vast clean energy potential. China is willing to contribute to Ghana's energy economic development, thereby further consolidating the friendship between the two countries.

Dr. Emmanuel Tachie-Obeng, Principal Programme Officer of Ghana Environmental Protection Agency (EPA), described clear proposals for Chinese energy companies in Ghana to CEN. They include rural electrification through renewable energy off-grid solutions such



▲ Solar panel installation at a car park in Accra, Ghana. Photo by Nipah Dennis

as standalone solar home systems and mini-grids, electric cars and charging stations, the production of hydrogen gas from hydro-electric power dams, rural electrification through grid extension, and even solar powered irrigation systems.

Chinese influence in Ghana, as with much of the continent, has been keenly felt in infrastructure investment. From transport projects to utilities and power, Chinese public and private capital has been brought to bear. This is evident in the power-generation sector. Chinese capital and expertise have been involved in providing just over 80% of independently or privately produced power in the country and 21% of the overall generation capacity.

Ghana's links with China date back to the 1960s and over the period, Ghana has made efforts to strengthen its south-south cooperation with China and diversify both its trade and investment. By 2012 the volume of Ghana-China trade had touched \$5.4 billion. In 2013, 53 Chinese investment projects were registered with the Ghana Investment Promotion Council, with a net value at \$165 million.

A China-Ghana showpiece project is the 400-MW Bui Hydro-electric Power project situated in northern Ghana, bordering Côte d'Ivoire. The project was financed by the Exim Bank of China, built in 2007 by SINOHYDRO Corporation Limited under an EPC contract, and was handed over to the Bui Power Authority on schedule in 2013. The hydropower station plays an important role in Ghana's socio-economic development to balance the big gap between the north and south, with functions such as irrigation, agricultural cultivation, fisheries development and tourism.

At the inauguration of the Bui Hydro-electric Power Plant, the then Chinese ambassador to Ghana, Gong Jianzhong, told local press that the project would not only alleviate the electricity shortage in the country, but also that it was an important demonstration of the "hardworking and fraternal friendship between China and Ghana". The Bui Power Authority (BPA) secured another financing from China to construct a 50MW Solar power plant on the Bui hydropower dam, the first floating solar plant. Financed and constructed with Chinese support and equipment, the floating solar farm on Bui was connected to the Bui grid in late 2020.

China and Ghana have also piloted on renewable energy technology transfer, from 2015 to 2018, intending to facilitate the exchange of expertise and technology on renewable energy, with focus on building the institutional framework and capacity required to facilitate the local absorption of the technologies. One of the major outcomes was an enabling environment in place for the transfer, production and regulation of the use of renewable energy technologies in Ghana.

Ghana's relatively stable political environment and a flexible business environment can attract more Chinese companies and institutions to invest and develop here, which would undoubtedly have a beneficial impact on the future growth of the country's economy.

Ethiopia: Energy Transition is Both Business Opportunity and Climate Action

■ By Li Limin

"Humanity is on the edge of extinction due to the anthropogenic climatic disaster." Mensur Dessie Nuri, Director of Ethiopia Environmental, Forest and Climate Change Commission, and the negotiator and coordinator of National Climate Change, told CEN, "The least developed countries in Africa are the ones who get the sharpest edge of the knife, and Ethiopia is among them."

Ethiopia, the second most populated country in Africa with a long splendid history, is one of the least developed countries. On the one hand, the good part about Ethiopia's energy is that it mostly depends on clean energy. On the other hand, Ethiopia is still in short of power supply, with only 45% electric access.

Climate crisis is a global problem that requires global efforts. African countries suffer disproportionately from climate-related risks. They also need to see fast energy transformation. Ethiopia is endowed with abundant clean energy resources such as solar, hydropower, and wind resources. They have all opened up investment opportunities for renewable energy investors and companies in China. Perfect cases are the ongoing Adama wind farm and hydropower plant Gilgel Gibe III, two key projects of China-Ethiopia cooperation.

Disproportionate Climate Risks

The consensus was reached in recent years that global warming is mainly caused by the historical and disorderly emissions by the developed countries during their industrialization and urbanization periods. No place on earth is spared from climate change impacts. African countries' annual emissions are estimated to only account for less than 4% of global emissions, but the temperature in Africa is rising at a much faster rate than other regions, at almost twice the global mean. Africa bears the heaviest climate change impacts in the world.

Desertification, infestation, and severe weather fluctuations are only a few of the impacts that are clearly apparent in Ethiopia. In Nuri's view, Ethiopia is suffering from a disproportionate number of climate risk trigger points, compared with the developed countries with higher historical emissions and stronger adaptation capabilities.

According to a report released by Coalition for Urban Transitions, Ethiopia needs \$42 billion to tackle climate change by 2050. The report says that Africa is the fastest urbanized region in the world, but is also seriously affected by climate change. In recent years, Africa has been plagued by cyclones on the southeast coast, and drought, floods, and landslides in the south.



▲ Street lights at Meskel square in Addis Ababa, Ethiopia. Photo by Maheder Haileselassie Tadesse

From government data, in 2021, approximately 90% of the installed generation capacity was from hydropower, while the remaining 8% and 2% are from wind and thermal sources respectively. Nuri thinks that the hydro-dominated systems have been subject and are vulnerable to changing climate impact. The government of Ethiopia is now diversifying the generation mix with other sources such as solar, wind, and geothermal that will result in a more climate-resilient power system.

Despite the numerous problems that Ethiopia has faced, it has persevered and is leading the way toward growth, Nuri added. Various development techniques have aided in the country's ability to compete with the rest of the globe using sustainable and environmentally friendly methods.

Ethiopia has been taking bold national sustainable and climate actions

to grow its economy while strengthening its resilience. To deal with the problem and grow efficiently, the government has taken the initiative of developing one of the most ambitious Nationally Determined Contributions (NDC) in the international arena, as well as a Climate Resilient Green Economy (CRGE) plan at home.

Furthermore, Ethiopia's government has been implementing and accounting for a large number of sustainability-related initiatives. The green legacy movement of planting the most trees in the shortest time has recently received a lot of attention across the world, as Ethiopia sets new records for planting 353 million trees in 12 hours. The government is also attempting to transition its energy industry to a more robust and sustainable system, as this is the country's most feasible form of energy generation.

The Great Potential of Green Power

Ethiopia has considerable hydropower, solar, wind, and geothermal energy, wood, natural gas, coal, shale oil, and gas resource potentials. Except for wood, most other energy sources are yet to be developed.

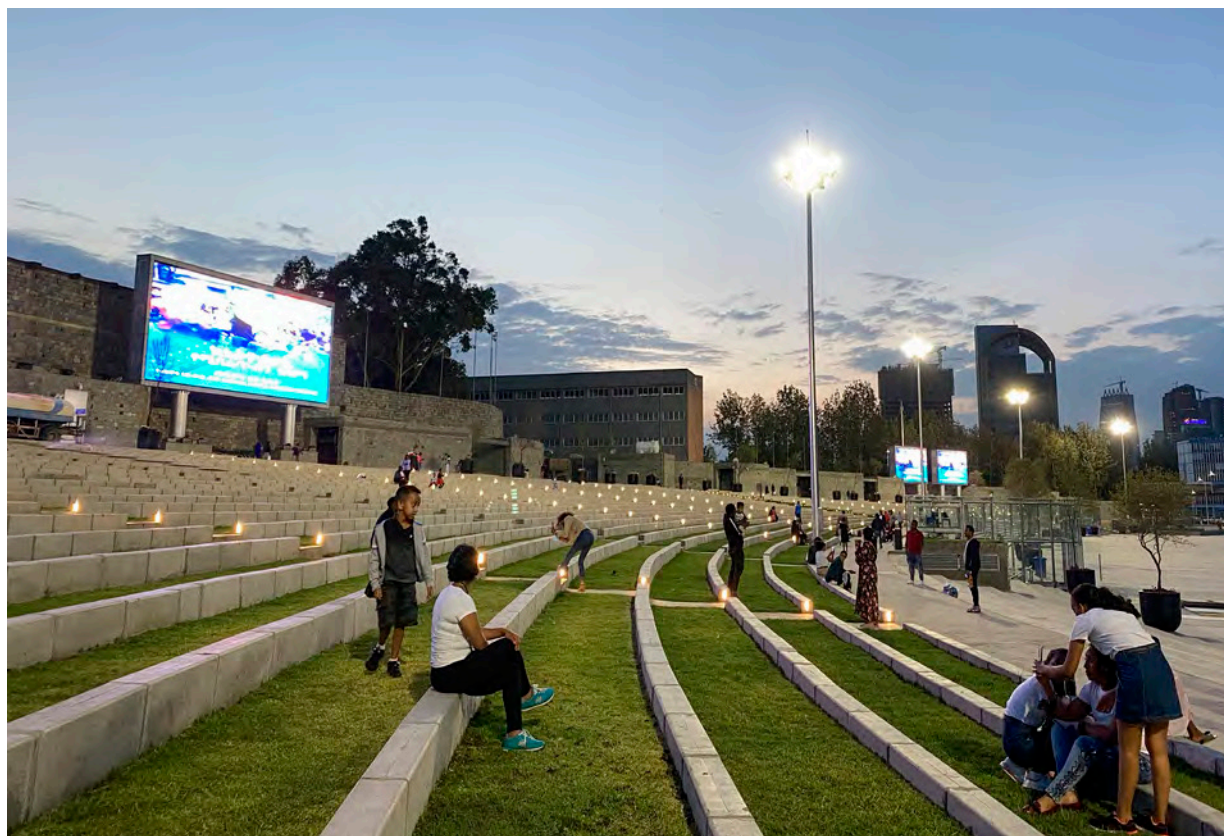
Ethiopia's hydropower potential is estimated at up to 45,000 MW, the 2nd highest in Africa, second only to that of the Democratic Republic of the Congo. Approximately 30,000 MW is estimated to be economically feasible, which is equivalent to an electricity generation of 162 TWh. The current production of 3.98 TWh thus equals to an exploitation of only 2.5%. In general, Ethiopia's terrain is advantageous for hydropower projects.

Besides rivers, Ethiopia's solar and wind power potentials are abundant.

Ethiopia receives a solar radiation of 5000 – 7000 Wh/m² according to region and season and thus has great potential for the use of solar energy. With an installed capacity of approximately 5 MW and an estimated PV market potential of 52 MW, with a majority in the solar home system (SHS) market and a further expansion of the telecommunication sector, not even 10% of the potential is exploited, said Nuri.

Ethiopia has good wind resources with velocities ranging from 7 to 9 m/s. Its wind energy potential is estimated to be 10,000 MW. The Ethiopian National Meteorological Services Agency (NMSA) began work on wind data collection in 1971 using some 39 recording stations located in selected locations.

▼ The recently renovated and inaugurated Meskel square park in Addis Ababa, Ethiopia. Photo by Maheder Haileselassie Tadesse



With the support of the Danish government, a new wind farm will be built, supplying power to 400,000 homes. Siemens Gamesa, the European wind power giant, is building the country's first wind farm. The Assela wind farm will be located 150 kilometers south of Addis Ababa and will have a capacity of 100 MW. The site is expected to be handed over to Ethiopian Electric Power (EEP), the country's state-owned energy company, by spring 2023. Siemens Gamesa estimated it would reduce at least 260,000 tons of carbon dioxide emissions every year.

In fact, as a large landlocked country in Africa, Ethiopia has developed less than 1% of its wind power resources, leaving high space for investment and exploration.

Ethiopia's biomass energy resource potential is considerable. According to estimates by Woody Biomass Inventory and Strategic Planning Project (WBISPP), national woody biomass stock was 1,149 million tons with annual yield of 50 million tons in the year 2000. These figures exclude biomass fuels such as branches/leaves/twigs (BLT), dead wood and homestead tree yields. Biomass may become a major energy development in Ethiopia.

A Long Way to 100% Electric Access

Despite its rich natural resources, Ethiopia is faced with big electricity access challenges. With only 45% of electric access, Ethiopia still has a long way to go in terms of energy transition and access to energy. Nuri

said, "expanding electricity generation from renewable sources of energy for domestic and regional markets," and "leapfrogging to modern and energy-efficient technologies in transportation, industry, and buildings," are two of the four main pillars of the Climate Resilient Green Economy Strategy (CRGE).

The Growth and Transition Plan II (GTP II (2015-2020)) was released in 2015, targeting to achieve low-and middle-income countries (LMICs) in 2025. Meanwhile, the government promoted the economy transformation by improving the efficiency and quality of agriculture and manufacture and by stimulating domestic competition to boost the economy and sustainable growth.

The government planned to increase the installed generation capacity by an additional 5,000 MW by 2022. Based on updated planning projections from Ethiopian Electric Power (EEP), the forecasted total installed generation capacity will be 10,358 MW by 2022. EEP is charged with maintaining more than 14 hydropower and 3 wind power plants throughout the country.

The Grand Ethiopia Renaissance Dam (GERD), with a projected installed capacity of 5,600 MW, is under construction by the Ethiopian Government and was 77% completed as of mid-2020. It will be Africa's largest hydropower station once completed. The GERD is intended to serve as an engine for industrialization, economic development, and hard currency earnings through the export of electricity, Nuri added.

Besides the newly installed generation, repair and update of existing power facilities are also one of the main energy strategies of the Ethiopian government. Nuri added, currently energy-producing facilities are well below capacity. An assessment has been conducted to propose renovations and optimization of their output.

Solar energy will be a key driver for Ethiopia's economy in the coming years. Nuri said, "Costs for SHS are relatively high, and unlike costs for micro-hydropower plants (MHP) systems, cannot be reduced by connecting more customers. In the near future, larger and particularly grid-connected solar energy systems will thus compete with small-scale hydropower systems. Next, to the Photovoltaics solar home systems (PV SHSs), there is also a market for solar water heating (SWH) systems that use solar irradiation to heat up water, which can significantly reduce fuel wood and electricity consumption."

Chinese Companies and Investors in Ethiopia

Most of Ethiopia's energy source is renewable energy, mainly hydropower, thus the main challenge is ensuring energy access, Nuri said. There are two challenges to this goal.

Firstly, the issues of access to energy are highly affected by the fact that electricity tariffs are significantly lower than cost-reflective levels. If such loss-making tariffs are maintained, much-needed distribution network reinforcement investments will be delayed. Secondly, until recently, the sector was completely controlled by the government, and private companies were not facilitated to work in it.

Nuri said to CEN: "We now have new legislation that encourages private sector participation, but in practice, we still face challenges involving the private sector due to the low tariff the sector is not seen as profitable and others. The government of Ethiopia took note of the challenge and set out private sector engagement as one of the five strategic priorities under the government's homegrown economic reform to transform the country's economic development."

The main role that foreign investors can play is in assisting with the introduction of new technologies, particularly in solar and wind energy. Not only to bring technologies but also to build capacity to help with project ownership, which has been a challenge in the past.

For a long time, China has been Ethiopia's strategic partner in the energy sector. The signing of Gilgel Gibe III, as well as a series of new major contracts for financing hydro plants and substations, demonstrated the extent of Chinese cooperation in the Ethiopian market. Gilgel Gibe III recently came close to financial closure with an agreement between Ethiopia and China. The project is about to start construction and will bring a new MW 1870 capacity in the future.

Major Chinese renewable energy companies have been active in Ethiopia.

China Electric Power Equipment and Technology Co., Ltd. (CET), a subsidiary of State Grid Corporation of China, built four small-scale off-grid solar farms in remote areas in Ethiopia. The one recently completed in October 2020, in Somali region, Ethiopia, is already providing electricity to nearly 6,000 people from more than 2,000

families in Qorile village near the project. Another Chinese leading wind equipment manufacturer, Goldwind, has also been active in Ethiopia for long, as the supplier of wind farm equipment, including 34 wind turbines and a five-year warranty, for the first China-Ethiopia wind cooperation Adama Wind Farm in 2011.

Ethiopia has great potential for renewable energy, and this can be realized given the right support in technology and finance. Much more can be done not only for the country but also for east Africa as a whole. Muri told CEN: "Currently, we are exporting electricity to South Sudan and Djibouti and there are projects planned in Kenya as well."

▼ A neighborhood in Addis Ababa, Ethiopia. Photo by Maheder Haileselassie Tadese





▲ I & M bank building, the only one commercial house that uses renewable energy in the city center, November 7, 2021; Kigali Rwanda.
Photo by Jean Biziman

Rwanda's Ambition in Energy Transition

■ By Zhong Rui

Rwanda is a landlocked, hilly country with fertile ground located in sub-Saharan Africa, hence the nickname, "the land of a thousand hills".

In the past two decades, Rwanda has made great progress in alleviating poverty, improving livelihood and governance system. With the support of the International Monetary Fund (IMF) and World Bank (IBRD), Rwanda undertook an important reform of its economy and structure, maintaining high economic growth, especially in the most recent 10 years. Rwanda hopes to achieve sustainable development in the future

through dual transformations of the economy and its energy structure.

In recent years, Rwanda has developed methane, nuclear energy and renewable energy to diversify its energy mix with less dependence on hydro power, and to provide stable power services. Meanwhile, the country has been expanding its grid systems to improve national electricity access. Rwanda has created an enabling investment environment and is seeking opportunities in the energy sector for Chinese investors and companies.

Solid Economic Growth

Munyazikwiye Faustin, Deputy Director General (DDG) of Rwanda Environment Management Authority (REMA), told CEN that the government of Rwanda developed its seven-year National Strategy for Transformation I (NST I 2017-2024) in 2017 that lays out targets under three pillars of economic transformation, social transformation, and transformational governance, and several cross-cutting areas. Rwanda aims to achieve universal access to electricity by 2024 under NST1, trying to stimulate the economy, drive growth by the private sector, and finally achieve self-sufficiency.

With Covid-19 pandemic impacts on its economy, the government of Rwanda has taken active measures for economic recovery. The Regional Economic Outlook for Sub-Saharan Africa (April 2021) released by IMF was optimistic about Sub-Saharan Africa's economy and expected a 3.7 percent growth in 2021 and 3.8 percent growth in 2022.

According to the Outlook, Rwanda government's active measures boost the economy during the Covid-19 pandemic have been effective, and its GDP rebound from a negative growth of 3.4% in 2020 to a growth of 5.1% in 2021.

Abebe Aemro Selassie, Director of IMF Africa Department, said to CEN, a return to normal for sub-Saharan African countries who are still navigating through a persistent pandemic with repeated waves of infection, will be far from easy, and therefore, "international cooperation on vaccination is critical to address the threat of repeated waves."

"Looking further ahead, the region's vast potential remains undiminished. But the threat of climate change—and the global process of energy transition—

suggest that sub-Saharan Africa may need to adopt a more innovative and greener growth model. This presents both challenges and opportunities, and it underscores the need for bold transformative reforms and continued external funding," Abebe Aemro Selassie added.

Smooth Electrification Progress

According to Faustin, the electricity supply of Rwanda is composed of domestic generation and the imported electricity from neighboring countries and regional shared power plants. The source of energy used is from the following sources: hydropower plants, thermal power plants (Diesel and Heavy fuel generators), methane gas and solar energy.

Data from REMA shows that as of today, a total of 27,217 kilometers of distribution lines have been constructed across the country, in a bid to extend electricity producers to the end-user. Of these, 9,883 km are Medium Voltage lines while 17,334 km are low voltage distribution lines. The national electricity grid has continued to expand with 671.48 km of MV and 1,214.3 km of LV distribution lines constructed across the country against the planned 603.92 km MV and 1835.18 km of LV. The high voltage transmission lines are still under construction with some TL planned to be completed in the FY 2021/22.

The increase in electricity access and expansion of the electricity grid is guided by programs and projects under the Energy Sector Strategic Plan (2018-2024) and 2016 Rural Electrification Plan, and Universal Energy Access Program. Access to electricity has reached 66.7% as of September 2021 and during the period from July 2020 to May 2021, 146,079 new connections were added to

the grid against the planned 118,657 new connections bringing the total households connected to the grid to 1,278,601 from the 1,132,522 connected as of end June 2020. The total number of households connected through both off-grid and grid connection increased from 1,560,699 connections registered in the previous year to 1,752,345, indicating an 11.5% increase in connections.

According to the data of Rwanda Energy Group, most public facilities in Rwanda are connected to the power grid. By March of 2019, 100% of hospitals and 93% of medical centers nationwide were connected to the grid. Rwanda's electricity access growth from 2010 to 2016 ranked 3rd in Africa and 11th in the world.

Firm Version of Development of Clean Energy

Reducing carbon emissions and accelerating energy transmission as some of the most urgent ways to address the global climate crisis have reached global consensus. In May 2020, Rwanda pledged to reduce 38% greenhouse gas emissions by 2030. Clean energy will play a central role for Rwanda to achieve its climate ambitions.

Climate change and its impacts are major consideration in the government of Rwanda's energy policy and strategies, Faustin said. The Rwanda Energy Sector Strategic Plan of 2018-2024 has prioritized renewables with up to 52% of the electricity shares by 2024. Rwanda also intends to reduce biomass dependency especially in rural areas up to 50% in 2024; halving the number of households using traditional cooking technologies by 2024 through supporting Improved Cook Stove (ICS) market development and expanding supply chains of alternative fuels for cooking.

Besides hydropower, Rwanda has solar power potential, with solar radiation of more than 2400 Wh/m². And the large rural population may contribute to the markets to the solar power plants.

The increase in installed capacity over the past few years was realized from newly upgraded micro hydropower plants including Rukarara V phase 1, Mukungwa II, Gisenyi among others, said Faustin. Considering the challenges associated with grid-connected electricity, the Government of Rwanda considers access to off-grid electricity as the primary means through which electricity access could be expanded through the country. The current on-grid installed solar energy is 12.08 MW main plants include Mount Jali in Kigali, (250KWp, Rwamagana Solar Power Plant (8.3 MW), and Nasho Solar (3.3 MW). It is planned that 48% of households will be connected through the off grid; a significant share of this will be covered by solar power solutions.

Rwanda is committed to becoming a green and low-carbon country. Developing renewable energy is one of the effective ways. "We will work together in resource mobilization efforts to implement our Nationally Determined Contribution especially for renewable energy targets. We look forward to scaling up in our cooperation in renewable energy transitioning for a greener future of Rwanda," Emmanuel Hategeka, Rwanda Ambassador to the UAE said.

According to the local Rwandan media "New Era", Rwanda, viewing nuclear power as clean and safe, is also seeking nuclear technology to promote economic growth and transformation. In 2018, a nuclear energy agreement was signed between the Ministry of Infrastructure of Rwanda and the Russian state-owned nuclear company Rosatom Global.

The government of Rwanda hopes to use nuclear science and technologies to boost national development, especially the power needs in the industries of energy, health, agriculture, and mining.

100% Electricity Access in Four Years

Rwanda has been traditionally heavily dependent on hydropower due to its abundant hydro resources. But since the 1990s, precipitation began to fall and the water level of lakes began to drop. In 2004, the water level of Lake Burera and Lake Ruhondo had decreased 50%, which led to hydropower production decrease during dry spells. Together with the power demand increase as a result of economic growth, large areas of Rwanda started to experience serious power shortages. The government took to diesel generators as an emergency power supply, which provided 56% of electricity in Rwanda by 2006. However, due to its high cost, electricity access in Rwanda staggered and remained low at 13% as recently as 2013.

Power demand increased with the growth in the economy. To improve power supply and reduce hydropower dependence, the Rwanda government actively developed thermal, methane, renewable energy, and other power generation to diversify the energy mix. In the Rwanda Energy Sector Strategic Plan (2018-2024), the government plans to improve the quality, reliability and capacity of power supply, and to expand electricity access to 100% by 2024 with 52% of the national population connected through grid extension while 48% will be connected through off-grid systems.

Electricity generation installed capacity has increased from 228.102MW in June 2020 to 238.052 MW in May 2021, said Tom Rwahama, Director of Power Generation, Operations and

Maintenance at Rwanda Energy Group in an interview with CEN. The energy mix has varied over the years with a significant increase in methane gas. An estimated 120 to 250 million cubic meters of methane is generated annually in the Lake and has the potential to generate 90 to 130 MW per year.

Faustin said fossil fuel generation in Rwanda's power mix dropped from about 45% in 2013 to less than 20% in 2018, replaced by hydropower, methane gas, and a small part of solar and peat. By the end of 2019 financial year, renewable energy contributed more than 53% (from 51% in 2016) of the total electricity generated followed by methane with a contribution of about 25% (from 14% in 2016). Thermal power, solar and peat have also increased but are still low at 18.6%, 2.1%, and 3.7% respectively in 2019.

Opportunities for Chinese Enterprises in Rwanda

Rwahama said that the role of Chinese companies and financiers will be to support in development and financing of more sustainable energy projects such as hydro, solar, and so on.

The Government of Rwanda in collaboration with multi-development partners (MDPs) is designing the Rwanda Universal Energy Access Program (RUEAP), which intends to improve access to energy and increase the efficiency of energy service delivery to Rwandans. Chinese companies can therefore, work closely with the Ministry of Infrastructure through Rwanda Energy Group – EDCL to develop projects in upgrade of low-level voltage lines, large scale peat and hydropower plants, etc.

There are overarching challenges to the energy sector in Rwanda, Faustin added, such as urgent need for a robust legal and regulatory framework,

inadequate infrastructure that requires huge investment, high cost of fuel for electricity generation, and vulnerability to climate change. "Internally, there are many other challenges such as inadequate coordination and information sharing between the various projects, government bodies, the private sector and civil society organizations; inadequate energy planning information system; inadequate financial resources to plan for and monitor the energy sector and carry out appropriate research and development (R&D); lack for appropriate curricula in energy studies at many institutions of higher learning; and inadequate human resource and institutional capacity."

All the above areas are investment opportunities in the energy sector that Chinese companies can take and help Rwanda to overcome those gaps and challenges, said Faustin. Rwanda has created an enabling investment environment including business-friendly regulations, multiple incentives for exporters and priority sectors, efficient and supported processes, as well as a commitment to foreign ownership, he added. In the Where to Invest in Africa 2021 by Rand Merchant Bank (RMB), Rwanda ranked 4th among the top 10 African countries with investment

attractiveness, a big jump from the previous year's position at 9. Daniel Kavishe, RMB Africa economist, said, "We created a new set of rankings that incorporated some of the unavoidable COVID-19-induced challenges, of which the operating environment score was one." Based on operating environment scores, fiscal scores, and developmental aspirations, Rwanda performed very well. "As part of the National Strategy for Transformation (NST), various investments should support the construction and energy sectors over the next few years," the RMB report mentioned about Rwanda's performance.

As of the end of 2020, Rwanda had registered 172 investment projects, valued at \$1.2 billion despite the slowdowns wrought by COVID-19, Rwanda Development Board statistics show. The Government established Rwanda Finance Limited to lead the development and promotion of Kigali International Financial Centre (KIFC), an ecosystem that supports significant inward investment into Africa and positions the country as a highly credible financial center. Rwanda also initiated 24 new double taxation treaties, 13 of them on the African continent, six with Europe, and the others in countries like China, South Korea, Israel, and the US.

▼ *Rwamagana Solar Power Plant with a 8.5 MW capacity. It is the largest solar power plant in the great lakes region, November 7, 2021; Rwandagana South-East of Rwanda. Photo by Jean Biziman*



Chinese Energy Companies Go Abroad for Green Belt and Road

■ by Dong Zitong

In recent years, in the context of combating climate change and adhering to sustainable development, it has become a global consensus that renewable energy will play a major role in the energy transition. With the accelerated pace of global energy transformation, China and other countries are building closer and stronger cooperation connections in the field of renewable energy, and overseas markets have become an important part of China's renewable energy market. Overseas investment by Chinese enterprises, project construction, and exports of renewable energy equipment have become more common, effectively supporting the steady growth of renewable energy installed capacity worldwide.

Industry watchers think, under the carbon-neutral target, the world is looking at green investment as an important part of helping their economic recovery and growth, some countries with a broad market, great potential for development, and some others with a packaged plan of innovation incentive policies to boost the development of renewable energy industry. This background has injected more impetus for Chinese enterprises to "sail out to sea" and build a truly green Belt and Road, and new opportunities are being ushered in in the field of renewable energy cooperation around the world.

Great Space for International Cooperation

According to the 2020 China Renewable Energy International Cooperation Report released in July 2021 by the China Renewable Energy Engineering Institute (CREEI), the global installed capacity of renewable energy generation reached 2,799.1 GW by the end of 2020, a big jump of 260.7 GW alone from 2019. Hydropower remained the largest renewable energy source, with a total installed capacity (excluding pumped storage) of 1,210.6 GW, an increase of 20.1 GW from 2019.

At the same time, solar and wind are rapidly catching up with hydropower, with the total installed capacity of solar photovoltaic power generation reaching 707.5 GW, an increase of 126.7 GW over 2019, and the total installed capacity of wind power amounting to 733.3 GW, a growth of 111 GW new capacity in the year.

In addition, solar thermal power generation, biomass power generation, renewable hydrogen production, marine energy and other renewable energy sources are also attracting investment and development globally.

“Speeding up the global energy transition and promoting green and low-carbon development has become the consensus of all countries,” Zhou Shichun, a CREEI spokesman said at the launch of the report. “In 2020, the COVID-19 pandemic plunged the global economy into a deep recession. However, global renewable energy saw unprecedented growth.

Speeding up the development of renewable energy has become an important means for countries to respond to the pandemic crisis and achieve green recovery.”

The China Photovoltaic Industry Association (CPIA) noted in its Overseas Photovoltaic Market Development Report (2020-2021) that the COVID-19 pandemic has led to a global slowdown in economic growth and a significant decline in energy demand in 2020. Total global electricity generation declined by 0.9% year-on-year in 2020, the second decline in global electricity demand since 1985, but at the same time, the growth rate of wind and solar power generation installations reached a record high.

The Renewable Energy Report 2020, jointly published by the International Energy Agency, the National Development and Reform Commission's Energy Research Institute and the Danish Energy Agency, stated that by 2025, renewable energy will be the world's largest source of electricity, providing one-third of the world's electricity, and will end coal's 50-year-long dominance

Qian Jing, vice president of China's Jingko Solar, said at the second Belt and Road Energy Ministers' Meeting in mid-October that global carbon neutrality targets will require tighter international cooperation on renewable energy. “Traditional energy markets are generally just a trade, which is very

different from renewable energies. For renewable energy projects, development and construction can be carried out as long as resources are abundant and land can be coordinated, which also provides the basis for international cooperation on renewable energy.”

More Chinese Companies Participating

The above background also provides a new opportunity for China's renewable energy companies to “go abroad”.

“China's rapid development of green energy is an important contribution to international green energy cooperation, with its own transformation success and the newly established energy cooperation platform on the Shanghai Cooperation Organisation (SCO) Demonstration Zone. We look forward to strengthening cooperation with China in the field of green energy and hydrogen energy through this platform,” Alisher Sultanov, the Minister of Energy of Uzbekistan said at the second Belt and Road Energy Ministers' Meeting.

Indeed, China's renewable energy industry has been at the forefront of the world. In the case of photovoltaics, for example, all aspects of the global photovoltaic industry are being concentrated in China, with Polysilicon, silicon wafer, battery cells, components accounting for 69%, 93%, 77%, and 69%, respectively, of the global production capacity. In 2020, China's total exports of photovoltaic products (silicon wafers, battery cells, components) were valued at approximately USD \$19.75 billion, of which component exports alone reached USD \$16.99 billion, or approximately 78.8 GW, a record-breaking increase of 18% Year-on-Year.

At the same time, with the cost of renewable power generation

dropping, photovoltaics have become a competitive form of energy in more and more countries. According to IRENA's Renewable Energy Generation Costs 2020 report, the total cost of new photovoltaic power generation dropped from USD \$4,731 per kW in 2010 to USD \$883 per kW in 2020, and the global weighted average leveling power cost decreased from USD \$0.381 per kWh to USD \$0.057 per kWh, a decrease of 85% in those ten years. Photovoltaic power generation used to cost twice as much as fossil fuels, but now it is the same or even lower than coal power in some countries and regions. In recent years, the global PV power bid prices reached new lows. On the other hand, the participation of Chinese photovoltaic enterprises in overseas photovoltaic power plant construction has been increasing, with diversified characteristics in terms of destination country, project type, development model and implementation model. In 2020, the China Chamber of Commerce for Import and Export of Machinery and Electronic Products registered 93 overseas (mostly in BRI countries) solar engineering projects, compared with only 17 from 2019. The overseas development of photovoltaic power stations is diversified from a single land power station to new types such as distributed rooftops, microgrid, floating solar farms, etc., and the business model has been continuously developed from the package contracting to new models such as equity participation, formation of consortiums, direct investment, mergers and acquisitions.

In addition to products, Chinese companies are also taking renewable energy technologies overseas to serve countries along the Belt and Road. Zuo Lei, Chairman of CETC Electronics Equipment Group Co., Ltd. (CETC), said that in 2020, the first 2.7-meter-

long crystal rod in Turkey's history was successfully produced, which was an important part of the 500 MW Photovoltaic Industrial Park project, co-developed by the Kalyon Group in Turkey and CETC. In the course of the project construction, CETC provided support from the manufacturing of solar equipment to installation and personnel training.

China's energy enterprises have exported not only products but other aspects of the industrial chain covering equipment, technology, standards, production capacity, industry, services, etc., as an important support for the development of the photovoltaic industry in more countries, helping them to achieve global climate goals.

Opportunities and Challenges

Qian Jing pointed out, however, that although the Belt and Road Initiative and carbon cut goals have brought new opportunities for international energy cooperation, Chinese renewable energy enterprises still face some difficulties and challenges in "going global".

If Chinese enterprises want to participate in the development of renewable energy markets around the world, they must strengthen the accumulation of experience in localization of overseas business, reduce the problems caused by differences in culture, customs and management business model. To this end, when developing overseas projects, Chinese enterprises should conduct thorough market research, understand local society and cultures, employment policies, infrastructure, etc., and formulate smart market development programs and investment strategies.



At the same time, it is important to find reliable partners to conduct business through technology transfer or co-operation, which will not only facilitate the rapid entry of Chinese enterprises into the market, promote the localization of business, but also facilitate participation in local policy support and encourage project construction.

In order to deal with the risk of development rights, Chinese investors must strengthen their research on the local laws and regulations, industry practices, etc., comprehensively review the development rights documents, and conduct in-depth investigations into the project's renewable energy service contracts, feasibility studies, environmental permits, and indigenous community FPIC, etc., said Power China and SDIC in a joint research paper. In many cases, it is necessary to ask for official verification documents from relevant authorities. They also recommend working with local lawyers for legal due diligence to avoid carrying significant legal risks.

With carbon neutrality as a global goal, the global renewable energy market is expanding. "Overseas markets such as Southeast Asia have always been a focus for Jingko," says Mr Qian. "In the future, Jingko will contribute more to the greening of Belt and Road Initiative to further expand the world map of the renewable energy industry."

Zuo Lei said that CETC will further strengthen the national and regional policies and markets in the BRI partner countries, and consider opening branch offices to take deeper participation in "Belt and Road" renewable projects. At the same time, CETC will focus on SMART manufacturing, and further maximize the company's core technical advantages in the field of photovoltaic equipment, and join hands with all parties "to systematically lead Chinese equipment, Chinese technology, Chinese standards and China's production capacity to go abroad."

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