

CLEAN ENERGY EMPOWERING AFRICA: A SUMMARY OF VIEWS ON THE ROLE OF CHINA AID

Institute of International Development Cooperation
of Chinese Academy of International Trade and Economic Cooperation

May, 2022

Acknowledgments

This series of seminars aims to enhance the understanding of the convergence and growth points in the energy and climate issues between China and Africa by all parties. Experts from various fields such as energy and power, technological innovation, climate change and finance (see Appendix for full list of speakers) have contributed their valuable insights to the seminars. The above views will also be used to inspire subsequent research activities and knowledge products.

We would like to express our sincere gratitude to all the experts who took time to attend the seminars and share their knowledge and ideas!

Authors

Sun Tianshu, research associate, Institute of International Development Cooperation of CAITEC
Song Jing, research associate, World Resources Institute (WRI) Sustainable Investment Program

(Intern Li Siyuan has also contributed to this report)

Disclaimers

This summary note solely reflects the views of the experts at the seminar, and should not be viewed as the expression of views by any government or organization.

CAITEC and WRI do not guarantee the accuracy of the data included in this work, nor assume liability with respect to the use of the information set forth. The mention in this work of specific enterprises and products does not mean that they are more supported or recommended by the conference organizers than those not mentioned. The geographical areas and “countries” referred in this work do not imply any judgment on the the legal status of or sovereignty over any country, territory, city or area, or the endorsement or acceptance of such boundaries.

For any suggestion or question, please contact suntianshu@caitec.org.cn or jsong@wri.org.

CONTENTS

Contents	1	III. China's Energy Aid and Africa's Green Recovery	10
I. China's Energy Aid and Energy Accessibility in Africa	3	1. Development needs	10
1. Discussion background	3	2. Severe challenges still facing energy transition	11
2. Needs for better energy access in developing countries	3	3. How to demonstrate the economic viability of international cooperation projects on renewable energy	11
3. Design of off-grid and mini-grid renewable energy projects that meet users' needs and affordability	3	IV. Conclusions and Consensus	14
4. Inclusive energy equipment and innovative financial products	4	1. Less developed countries and underserved population are challenged with multifaceted vulnerability	14
5. Development and utilization of the African energy accessibility database	4	2. Development assistance/aid remains an important pillar and China's role carries more expectation	15
6. Suggestions	5	3. Getting a clear understanding of the difficulties and challenges to the application and transition of renewable energies	16
II. China's Energy Aid and Pandemic Prevention and Control in Africa	6	4. Innovation and popularization of renewable energy products, programs and financial instruments will empower development	16
1. Discussion background	6	5. Improving development effectiveness of energy aid and formulate demand side-oriented aid planning	17
2. Coupling health care with renewable energy development cooperation ---- China's experience in anti-epidemic aid	6	6. Establishing a forward-looking environmental and social impact assessment system in line with international discourse	17
3. Energy access still plaguing vaccine distribution in low-income countries	6	Appendix: Full List of Speakers (in chronological order)	18
4. Analyzing renewable energy's compatibility with African healthcare system's demand	8		
5. Coupling China's energy and power aid with health aid in Africa for better impact	9		

After years of development, China has accumulated rich experience and formed a mature model in foreign aid in energy. Frustrated by the dual challenges of climate change and COVID-19, there emerges a new issue in China's aid to Africa that how to make better use of the existing experience and model in the field of renewable energy, so as to explore more effective public investment roadmaps to meet the diversified specific needs in the continent. According to the FOCAC Dakar Action Plan (2022-2024) issued on the 2021 Forum on China-Africa Cooperation, China will work with Africa to enhance practical cooperation in the areas of energy accessibility, clean energy, resource planning and green development under the framework of the China-African Union Energy Partnership. Although such a blueprint for China-Africa cooperation on energy and climate has been laid out, there are still pressing questions to be answered about how to build a dynamic partnership, how to work together to amplify the voice of developing countries in the global arena of energy and climate, and how to share innovation outcomes of clean energy technologies and products.

In order to further discuss the fundamental, critical and immediate issues in China-Africa energy development cooperation, at the end of 2021, Institute of International Development Cooperation of Chinese Academy of International Trade and Economic Cooperation (CAITEC) and World Resources Institute (WRI) jointly held a series of seminars on “China-Africa Renewable Energy Development Cooperation” in Beijing, where experts from different fields and disciplines were invited to conduct pragmatic and in-depth discussions. The seminars aim to explore the multiple pathways of China's foreign aid in energy to empower African partners, so as to enhance the consensus of all parties on China's energy aid and form forward-looking and practical suggestions and roadmaps.

I. CHINA'S ENERGY AID AND ENERGY ACCESSIBILITY IN AFRICA

1. Discussion background

Tracking SDG 7: The Energy Progress Report (2021) released by the International Energy Agency (IEA), the United Nations and other agencies points out that while the current global energy access rate has grown up to 90%, 760 million people are still living without electricity, 75% of whom reside in sub-Saharan Africa and 84% in rural areas. At the UN High Level Dialogue on Energy in September 2021, the Chinese representative called for that the same priority should be given to addressing energy accessibility as to climate change and energy transition, and feasible plans should be in place as soon as possible.

China has achieved the goal of 100% electricity access rate in 2015 and innovatively combined energy services inclusion with poverty alleviation to promote common prosperity. As a global leader in energy access, China can contribute and share its solutions and wisdom to global energy access efforts. On the eve of the upcoming Forum on China-Africa Cooperation this month (November 2021), it is essential to explore how to integrate development aid, commercial cooperation and multilateral platforms, collaborate by means of policy dialogue, infrastructure building, and low-carbon projects and work with African partners to advance the agenda of “ensuring access to reliable, affordable, sustainable and modern energy for all”.

2. Needs for better energy access in developing countries

At present, energy poverty still exists in developing countries, especially in Africa. 75% of the 760 million people without electricity in the world live in sub-Saharan Africa, 80% of whom are rural dwellers.

Since areas without electricity are often remote, inaccessible and scattered, electrification through grid expansion is a huge investment with little return, so there are more and more solutions focusing on off-grid technologies or mini-grids to provide renewable energy generation. Assessment of Distributed Solar PV Potential in BRI Countries conducted by WRI calculated the number, household size and average household electricity consumption of people without electricity in urban and rural areas of Belt and Road countries, assessed the electricity demand in combination with grid expansion rate and other factors, and concluded that the installation potential of distributed PV in areas without electricity in Belt and Road countries is about 3.5-7.7 GW. This potential, if realized, will have a profound impact on the social and economic development of low-income countries, including some African countries.

3. Design of off-grid and mini-grid renewable energy projects that meet users' needs and affordability

Electrification through off-grid renewable energy solutions is relatively mature at the technical level but yet to be demonstrated in terms of economic models. Compared with extending the electricity grid to remoter areas, the total investment of off-grid renewables-based solutions is smaller, but the user-side share of electricity costs is higher. In view of the affordability of the users in areas not covered by the grid, the key to sustainable operation of such a solution is to ensure its economic viability. The electricity prices and the subsidies scope and ways should be determined reasonably so as to ensure that the life cycle cost of the project is properly shared between the government and the users.

The cost of off-grid renewable energy projects includes capital costs (including return on investment) and operation service costs of developers. Off-grid projects can be divided into three categories based on electricity price's recovery of the costs. First, the “profitable” model, i.e., the electricity price can fully cover the capital costs and operation service costs; second, the “partially subsidized” model, i.e., the electricity price should in principle cover the operation service costs, and the capital costs depend wholly or mostly on external subsidies; third, the “fully subsidized” model, i.e., the

electricity price cannot recover the operation service costs, and the sustainable operation of such projects needs to rely on long-term external subsidies.

Therefore, project selection should be conducted first before the off-grid development and aid actually occurs. The projects, of which the electricity charges can cover the operation cost, should be preferred, so that the projects can support the operation on its own in a sustainable way. It is suggested to construct off-grid solar systems in areas with good conditions of renewable energy resources, long distance from the main grid (10km+), relatively concentrated population, stable and huge energy demand, and large proportion of medium- and high-income population. In addition, the contractor should send experts to work with local technicians during the construction phase, so as to help improve local operation and maintenance (O&M) service capacity and rely on the local to realize follow-up O&M services, thus reducing later O&M costs and boosting employment.

4. Inclusive energy equipment and innovative financial products



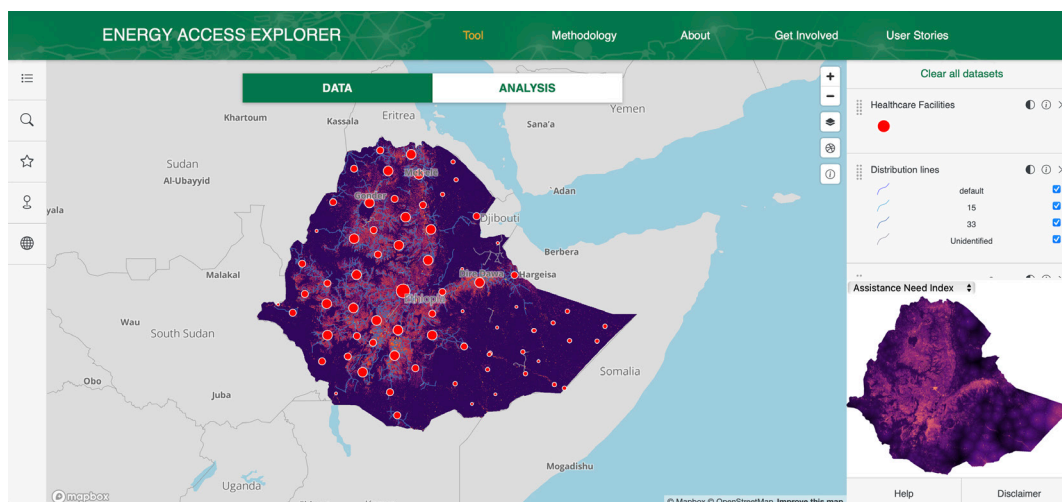
Each year 5.3 million people worldwide die from respiratory diseases, of which the use of kerosene lamps by people in areas without electricity is a major cause. Meanwhile, people without electricity spend \$27 billion annually on kerosene, candles and batteries. In order to address the above issues of electricity shortage, health and environmental pollution and improve the quality of life of people at the bottom of the pyramid while balancing commercial sustainability, many innovative enterprises are committed to developing and promoting inclusive household renewable energy facilities. For example, Shenzhen-based Power Solution has developed the “Candles Killer”, a portable solar light that costs as much as three months’ kerosene for a household without electricity, but can be used for three years while reducing

carbon emissions by one ton, making it both economically and environmentally valuable.

Innovative financial payment models currently spreading in Africa also help to increase the affordability of such products. By measuring the mini-grid systems using Pay As You GO to invest in small solar products, Kenyan distributors have reported that they can help a household save an estimate of \$750 in energy costs within four years. The popularity of mobile phones and mobile payment platforms has made it possible for more and more people to buy or rent such products in installment. (In terms of mobile phones, Chinese brands have a high market share in Africa, with the shipments of Transsion alone accounting for 40% of the African market.) Therefore in addressing energy poverty, the focus is not necessarily on the energy and power sector, but also on empowering low-income people through telecommunications and digital platforms, which can also contribute to the spread of off-grid power products.

5. Development and utilization of the African energy accessibility database

The implementation of the above solutions and products relies on accurate data on energy accessibility to identify the needs of users and deduce the feasibility and sustainability of products. WRI has developed the online interactive data platform-- Energy Access Explorer (EAE), which is designed to visualize energy supply and demand in developing countries and now covers four African countries ---- Tanzania, Uganda, Kenya and Zambia ---- at one square kilometer resolution. EAE compiles data on both the demand and supply sides of energy: demographic and social data on the demand side and renewable energy and infrastructure data on the supply side. The database can be customized to serve different types of users as follows: first, to provide technical support for local government energy authorities in comprehensive energy planning; second, to help clean energy enterprises and technology providers identify market demand and affordability; third, to support financial institutions in assessing the impact of projects; fourth, to support bottom-up energy demand evaluation.

Figure 1 | Online interactive data platform of Energy Access Explorer (EAE)

6. Suggestions

Africa still has a long way to go to achieve full energy accessibility. Taking into account the electrification costs and the financial and governance situation in some least developed countries (LDCs), international development aid remains an important source of finance and technology to support areas without electricity to have access to electricity.

In 2015, China completed the historic task of ensuring access to electricity for 2.73 million people in most remote areas, of which about 56% were powered through grid expansion and 44% through stand-alone PV systems, in combination with urban infrastructure construction, rural grid renovation, poverty alleviation and other national programs. Summing up the experience in this process, China has a lot to share and contribute.

It should also be realized that institutional characteristics and political setup have been indispensable for China in achieving 100% energy accessibility. Therefore in carrying out aid and south-south cooperation, it is still necessary to start from the demand of the host country and comprehensively evaluate its resource endowment, economic development and infrastructure, end-user affordability, etc., to examine the possibility and sustainability of the products and programs. From international practice and the experience of Chinese enterprises going abroad, cooperation projects, in order to benefit both poverty alleviation and economic development, should always combine policy aid and commercial development and operation and even flexibly adjust the ratio of the two components based on the assessment of local conditions.

This puts forward high requirements for the flexibility of China's international development cooperation. Considering its deep participation in global governance, as well as its aim to launch and implement the Global Development Initiative, China needs to respond to major global issues. Eliminating energy poverty, for example, is not only a sustainable development issue of global concern, but also an area where China has rich experience and solutions worth sharing. In this regard, we should form a systematic idea of international development cooperation as soon as possible and combine development needs and supply advantages to adapt to the “dual circulation” development pattern. We should also clarify the key directions of development cooperation, effectively allocate foreign aid resources and combine infrastructure, materials, technical training and capacity building in aid with the development of business projects and industrial parks and import/export trade so as to strengthen integration, develop multiple tracks and form synergy. At the same time, China needs to think beyond foreign assistance and consider how to forge a public finance system that supports China's international cooperation as a rising major country in the era of globalization.

II. CHINA'S ENERGY AID AND PANDEMIC PREVENTION AND CONTROL IN AFRICA

1. Discussion background

On September 21, 2021, China's President Xi Jinping delivered a speech at the general debate of the 76th session of the United Nations General Assembly, affirming that we must pursue more robust, greener and more balanced global development, and proposed the Global Development Initiative. It is clearly stated that China will vigorously support other developing countries in green and low-carbon energy development and help them in responding to COVID-19.

China has already provided various forms of aid in the fields of renewable energy and health care to other countries. Against the backdrop of the widening development gap brought by COVID-19 and the urgent need for developing countries to enhance their ability to respond to the pandemic, it is assumed to be a feasible initiative to couple green and low carbon development with policies and measures to fight against COVID-19. Therefore, the synergistic effect of China's renewable energy aid in public health and COVID-19 prevention can be improved, thus helping other developing countries upgrade their social infrastructure needed to respond to the pandemic and other public health crises, and strengthening key junctures in pandemic prevention and control and diagnosis and treatment.

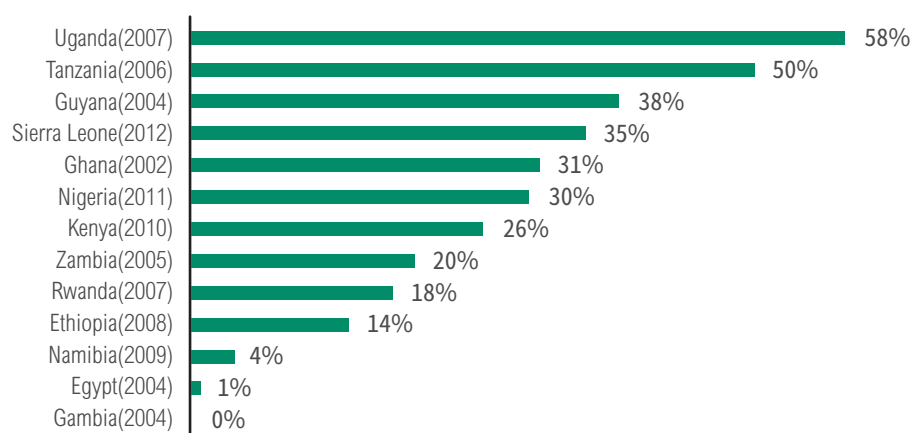
2. Coupling health care with renewable energy development cooperation ---- China's experience in anti-epidemic aid

Since the outbreak of the pandemic, China has expanded new practices and presented many shining points in its anti-pandemic aid to other developing countries. For example, Chinese and African medical experts have communicated through remote consultation on imaging diagnosis of COVID-19 and shared initial diagnostic criteria. Another example is the Mirwais Hospital built by China in Kandahar province, Afghanistan in the 1970s. Although war-torn for decades, it has now become an important local medical center with the material and technical support from China and international organizations and has also played an important role in the prevention and control of COVID-19.

All of these medical and health care aid requires the support of energy and electricity in order to serve the wellness for a wider range of people; innovative aid forms, including remote diagnosis and treatment and remote training, are also inseparable from electricity supply ---- in terms of the increment of future projects, if energy and power aid is linked with medical and health aid, there will be an opportunity to release greater development benefit; in terms of the current projects, if the medical and health aid provided by China lacks energy and electricity support, there may be a risk of decrease in its effectiveness.

3. Energy access still plaguing vaccine distribution in low-income countries

Is there a need to upgrade energy and power supply for health care systems in developing countries? Since long before the pandemic of COVID-19, lack of electricity has been one of the elements affecting the quality of healthcare in less developed countries. One billion more people worldwide are currently served by unelectrified health facilities, and nearly 60% of the health facilities in 46 low- and middle-income countries have no access to reliable electricity; as of 2014, in 11 sub-Saharan African countries, about 25% of the health facilities has no access at all. The health of women and children is first and foremost threatened by the lack of primary healthcare services ---- more than 289,000 women worldwide die each year from complications related to pregnancy and childbirth, many of which can be avoided if better lighting and other electricity-dependent services were provided.

Figure 2 | Health facilities without electricity supply

Source: Compiled from (Adair-Rohani et al., 2013) for sub-Saharan Africa; data for Guyana and Egypt is from the Service Provision Assessment (SPA) of USAID's Measure Health initiative (United States Agency for International Development, 2013).

Since the outbreak of the COVID-19, the global focus on public health crisis response has further highlighted the vulnerability of medical and health care infrastructure in developing countries. According to WHO statistics, 42 of 54 countries in Africa are unable to meet their vaccination targets, and only 3% of the African population was fully vaccinated ---- compared with 52% in the United States and 57% in the European Union.

A vaccine never works before it is injected. The distribution of vaccines, especially how to distribute them to people outside of central cities, is a much more difficult problem than the supply of them. To date, 26 countries have used only less than half of the vaccines they have received. While vaccine distribution and vaccination effectiveness depend on a variety of variables, infrastructure including power supply to the health care system and cold chain facilities are undoubtedly the weak links. Vaccines are biological products, which are temperature sensitive and must be stored within a reasonable temperature range. Some specific types of vaccines need to be refrigerated at ultra-low temperature (e.g., -70°C), which has higher requirements for the cold chain. Currently, most medical cold chain systems in low-income countries are developed for routine childhood immunization schedules without the equipment and delivery capacity of ultra-low temperature cold chains to meet the needs of large scale COVID-19 vaccination.

A number of multilateral initiatives have been developed in recent years to address the energy and power gap in health care systems in developing countries. In 2019, the Health and Energy Platform of Action (HEPA) was established by a number of organizations including the World Health Organization (WHO). HEPA focuses on clean cooking and health care facility electrification and promotes policy agendas by building consensus at a high level among major participants including WHO, UNDP, UN Department of Economic and Social Affairs, World Bank, International Renewable Energy Agency (IRENA) and other key stakeholders. In addition, HEPA focuses on coordination between countries on a global scale. In 2020, Sustainable Energy for All (SE for ALL) initiative under the United Nations led the Multilateral Energy Compact for Health Facility Electrification (HEF Compact), which aims to elevate concerted action on the electrification of health care facilities in developing countries. This initiative is more action-oriented than HEPA, with two specific goals, namely, to power 25,000 health care facilities with clean and reliable electricity between 2020 and 2025 and to provide data and solutions of electrification for 20 national health care systems. The initiative is expected to improve health care services for 100-200 million people, including refugees and displaced people.

4. Analyzing renewable energy's compatibility with African healthcare system's demand

One important role of energy is to provide electricity to end users. Health care systems can be electrified mainly in the following two ways: first, in relatively densely populated areas such as towns and cities with large- and medium-sized hospitals and health centers, electricity are often supplied through main grid extension.

Second, due to the large population in remote African rural areas, electricity could be supplied through off-grid or mini-grid systems. Renewable energy is considered as the energy that fits in with the resource endowment, development agenda, affordability and health care needs of developing countries. Among all types, PV is the most widely applied in international aid and the most suitable for off-grid diagnosis and treatment. Diesel and other fossil fuels are also used for back-up energy (e.g., diesel generators in hospitals.), but surveys demonstrated that available diesel can only be found for less than 30% of health care equipment in African countries on the survey day. In addition, the influence of diesel and coal combustion on health also goes against the purpose of the health care system.

So far, an off-grid solar project has been established in Ghana to supply power to remote hospitals, and it can save nearly 60% of electricity bills according to relevant files and reduce medical costs to a certain extent. Also, it wins valuable time for patients' treatment as hospitals are built in a remote area always. With the growing maturity of off-grid technologies and the reducing construction costs, it'll become a future trend to electrify hospitals in remote areas through off-grid renewable energy systems.

5. Coupling China's energy and power aid with health aid in Africa for better impact

The need to upgrade energy and power services in the health care system is widely recognized. Currently, development cooperation agencies address such need mainly through aid projects on three levels: a) on individual household or community level; b) on power production and retail department level and c) on international policy coordination level. Based on the prospect of two-way promotion, projects such as "health care × clean energy" and micro&smart aid projects can be taken into consideration.

From the current foreign aid system, suggestions are made for China's foreign aid in the energy sector as follows:

- (1). Focus on the people at the bottom of the pyramid, areas with less or no access to electricity and off-grid power products.** Innovative products for areas and vulnerable people with low capacity to pay need to be identified and promoted. Efforts should be made based on the needs of the recipient to better define the power demand of equipment to help drive appropriate design and fine management of energy supply-side solutions. Suggested projects to be explored include providing back-up solar power to large hospitals, equipping small clinics with renewable energy equipment such as a solar vaccine refrigerator or power supply equipment, and conducting interdisciplinary human resource development cooperation projects.
- (2). Incorporate Chinese products into international product certification system.** For example, the quality verification by "Lighting Global" of World Bank ensures the quality of power equipment purchased by developing countries and the certified enterprises can also receive World Bank subsidies. Chinese enterprises should also try to incorporate themselves in such an international system. The creativity and initiative of enterprises, especially private enterprises, needs to be better mobilized and utilized, and outstanding private enterprises should be encouraged to participate in contracting, subcontracting, implementation and development of foreign aid projects, as well as in the bidding or shortlisting of projects of international development organizations such as the World Bank and the United Nations. They are also encouraged to apply available resources to go out and improve international competitiveness.

(3). Leverage innovative and inclusive financial instruments. Inclusive finance including mobile payment (Pay as You go), is providing conditions for opening up more markets of developing countries and enhancing the feasibility of distributed renewable energy power generation products. At the same time, China's policy-oriented financial institutions should also consider providing practical support for such products and solutions that give full play to people's livelihood, enhance the image of Chinese products, and conform to China's positioning in international development cooperation.

In addition, the most difficult part of energy and power support for health care services is inter-sectoral coordination and collaboration. It consists of the coordination of the energy, health, and development assistance sectors, the coordination between government departments and the commercial sector (providers of generation, transmission, sales and off-grid power solutions), and the coordination between the aid providers and coordinators. Therefore, the discussion on international development cooperation needs to step out into other sectors to achieve more options worth trying. At the same time, it is suggested that non-official international development agencies carry out pilot projects to investigate the needs, accumulate experience, and summarize models, so as to provide useful references for the development and design of official foreign aid projects.

III. CHINA'S ENERGY AID AND AFRICA'S GREEN RECOVERY

On November 29, 2021, the 8th Ministerial Conference of the Forum on China-Africa Cooperation (FOCAC) was held in Senegal. The Conference adopted FOCAC Dakar Action Plan (2022-2024) and Declaration on China-Africa Cooperation on Combating Climate Change. International development cooperation on renewable energy will be the focus and highlight of China-Africa cooperation. According to the Action Plan, China will work with Africa to enhance practical cooperation in the areas of energy accessibility, clean energy, resource planning and green development under the framework of the China-African Union Energy Partnership.

To achieve long-term stability of China-Africa renewable energy cooperation, we need to transform the model from “blood transfusion” to “blood production” and from “giving people fish” to “teaching people how to fish”, so as to empower the sustainable development of the host countries. Cooperation should not only promote development and people’s livelihood, but also generate financial and economic benefits, so as to stimulate the enthusiasm of various parties to participate in development cooperation and achieve mutual benefit and win-win situation between China and Africa. Therefore, it is necessary to innovate renewable energy development and cooperation models and provide policy, institutional and financial support for high-quality products and solutions to “go global”.

At present, the “renewable energy+” model has been explored both at home and abroad, combining renewable energy with economic development and the improvement of people’s livelihood. Which projects or models are worthy of reference for China-Africa renewable energy development cooperation? It’s often hard for renewable energy cooperation in less developed countries to promote local development while yielding economic benefits, which is also indispensable for the longevity of the project itself. To enable the projects to transform from “blood transfusion” for the people at the bottom of the pyramid to “blood production” with independent operation, how should we innovate the forms of cooperation and develop policies and systems to support the operation? How can development financial institutions assess the risks and benefits of such projects and how do they provide financial support? Many key questions remain yet to be answered. under the blueprint of China Africa energy and climate cooperation.

1. Development needs

Energy transition is one of the three main targets of the SDG7. In July 2021, the African Union Commission launched a new 5-year continental Green Recovery Action Plan 2021-2027, which emboldens actions on five priority areas including on climate finance and supporting renewable energy development. The Action Plan aims to help Africa explore a green development path that does not come at the expense of the environment, with promoting investment, development and technology transfer of renewable energy in African countries as a key breakthrough. Countries in Africa continent with highest overall emission, including South Africa, Egypt, Algeria, Morocco, Tunisia and Kenya, are also the fastest growing countries with relatively stable business environments. Scaling up support for these countries to accelerate their emission reduction and transition to clean energy will help the African continent to significantly reduce greenhouse gas emission and is expected to promote coordinated development of countries in the region.

Many development financial institutions have begun to mobilize private sector capital to finance the green transition in Africa. At COP26 in Glasgow, more than 40 countries including China, launched the Breakthrough Agenda at the World Leaders Summit. The Agenda enables countries and businesses to work together to accelerate the development and deployment of the clean energy technologies and sustainable solutions needed to achieve the Paris Agreement goals over the next decade and help more countries in the just and inclusive transition to clean energy. At the conference, U.S., U.K., France, Germany and EU also announced a Clean Energy Transition Partnership with South Africa and the decision to provide about \$8.5 billion in grants and concessional loans in the next 3-5 years to help realize its green transition potential. In addition, UNECA led the launch of the green and blue bonds, and South Africa recently issued a 3 billion rand (\$196 million) green bond to refinance its energy sector.

2. Severe challenges still facing energy transition

Although all parties have expressed their political will to support the green energy transition, the transition to renewable energy will not happen overnight. Renewable energy always has such characteristics or weaknesses as low density, intermittency, and time-sensitive distribution, and its large-scale application needs to meet the requirements of safety, reliability, and economy. In addition to the characteristics of renewable energy itself, there are many other challenges facing the energy transition in Africa, for example, underdevelopment, poor credit records, weak affordability of power users and difficulties in collecting payments for power projects in most countries. This results in a high rate of bad debt in renewable energy projects and makes it even more difficult for the financing of power service projects in remote areas: first, there's a lack of finance; second, the financing process takes a long period of time; third, the interest rate is too high.

On the other hand, even if public funds or concessional loan support can be obtained from bilateral creditors, development financial institutions and creditors, it may bring new debt burden and fiscal deficit to developing countries, and also lead to a certain degree of debtor nations ceding their voice and planning power to creditor nations, which will widen the equality gap between the South and the North.

3. How to demonstrate the economic viability of international cooperation projects on renewable energy

From an economic perspective, if a renewable energy project is to gain a firm footing, profitability (potential of commercial operation) and risk management are the first to be considered, both of which are more important for inclusive energy projects for low-income areas and its people.

(1) Profitability

In terms of profitability, a sustainable business model needs to be built to ensure the integration of energy services with industries and the participation of commercial institutions in project operation. For example, PV technologies can be integrated into local agriculture to develop solar pumps, solar pest control lamps, solar threshers, PV cold storage system, etc. They can be integrated into downstream industries, too. For example, the PV cold storage system can be integrated into cross-border e-commerce to provide African agricultural products to global consumers so as to form a complete industry chain from production to sales.

Case 1

The Zambia Solar Mill Project is supported by loans from Chinese policy bank. The project has established a total of 1,583 solar-powered mills in villages and towns in Zambia, providing villagers with a place near their homes to process grain. As a result of greatly reduced processing costs, food supply has been significantly enhanced, national staple food prices have dropped by nearly one-third, and many local processing workers have received technical assistance, driving employment in Zambia's agricultural sector. The project is featured by strong sustainability, fast project construction, daily cash flow for each mill built, short payback period, and the capacity of self-restoration and autonomous operation. China Development Bank, the project lender, is adhering to the idea of green finance in this project, focusing on sustainable development goals and combining economic benefits with social and environmental benefits. The current pandemic has severely shrunk national budgets, making it difficult to realize large-scale projects; this kind of distributed project, combined with productive use, can better achieve a balance between self-development value and commercial value, and has strong implications.

Case 2

The photovoltaic agriculture project in Jimo, Shandong Province, uses PV modules with different light transmittance to meet the needs of different crops for light to realize the model of double income from power generation on the shed and planting under the shed. The business model of the project organizes the four direct stakeholders well and mobilizes local farmers while strengthening the local government's guiding responsibility. On the other hand, a multi-channel financing model was adopted, pooling the enterprise's own funds, bank loans, Qingdao PV industry fund, government industry guidance fund, equity financing developed using the project financing lease model, and relevant government subsidies. The photovoltaic pastoral research was initiated in Xinjiang when the Chinese government vigorously promoted photovoltaic poverty alleviation, and remarkable achievements have been made in poverty reduction there. 220 poor households could directly benefit from the project to get out of poverty and achieve a per capita household income exceeding three times the poverty standard at that time, while driving the whole livestock industry chain and the indirect income of the surrounding herders through the creation of jobs.

Case 3

PV water pumping is an innovative solution to the water problem in rural areas using solar energy, i.e. using solar photovoltaic power to directly start the pump to bring water to areas with high terrain and few water sources. This model has many advantages. Firstly, later maintenance will be easy because there are no batteries, hence no need for replacement; secondly, it is a small investment with good return. For example, in 2013, the planned investment in the water pumping project in Xundian County, Kunming City was originally 1.2 million yuan, but the initial investment of PV pumps was only 600,000 yuan, which eventually solved the problem of water for production and living in the whole village, with an annual direct economic benefit of 10 million yuan. PV pumps are of great significance for the future realization of "renewable energy +" projects in Africa. Water pumping through PV power generation solves the problem of drinking water and irrigation water in remote areas and also protects the environment, and in particular, people can get rid of poverty after the access to water.

China has developed a relatively mature model in the sector of renewable energy. For example, it has developed solar water pumping to meet the needs of local residents for water supply and agricultural irrigation. It has also accumulated rich experience in solar-agriculture projects, where PV technologies are utilized in growing and processing, and solar-fishery projects, and has formed many demonstration cases. More sustainable application of this model to Africa will help to improve the quality and effectiveness of aid to Africa and realize the transformation from "blood transfusion" to "blood production" .

These projects are good demonstration with benefits on both people's livelihood and economic development, so it is appropriate to support them with policy funds in foreign aid and in particular, to apply them in China's aid projects in

people's livelihood. For example, such technologies as fishery-solar hybrid project and PV water pumping are suggested to be grafted with China's agricultural demonstration centers for aid to Africa.

(2) Risk Management

In terms of risk management, investors are concerned about the return after risk hedging, so they are often reluctant to carry out projects in less developed countries with immature markets. Consequently, the risk assessment of projects will affect the financing capability.

Risk management in energy projects often needs favorable policies from governments. This means both the government of the investors' country and the government of the target country should play a supportive role in matching demand and establishing policy-based financial structures. For instance, banks should provide low-interest loans to sectors in line with national development plans, and producing and selling renewable energy can be granted tax incentives, allowing costs to gradually decline. Renewable energy feed-in price should be preferential, investor returns should be treated fairly and reasonably, and enterprises should be able to recover capital to further enhance renewable energy development.

Chinese international engineering enterprises initially participated in power project cooperation with African countries in the mode of EPC (engineering, procurement, and construction) contracts. Later, the financing part was incorporated (EPC+F), and in recent years the enterprises gradually participated in the projects as independent power producers (IPP). As a result of the strong national policy incentives for encouraging international cooperation in clean energy, the traditional engineering contracting sector also follows the policy guidance with power energy enterprises transitioning to carrying out independent investment and renewable energy projects. IPP projects pay more attention to the above-mentioned profitability and risk management factors. The main considerations are whether the host country has sufficient financial resources to support the subsequent operation of the projects and whether the terminal electricity price can cover the initial power investment. On this basis, we will also consider combining other business models, focusing on projects with notable stimulus on local economic growth and with high influence and tangible results, such as renewable energy projects in forests and fishery complementary PV power plants. However, considering that some African countries have low sovereign credit ratings, immature business environments, and frequent regime changes, different business models will be adopted for each country to implement projects.

In this process, international development agencies (including bilateral aid agencies, bilateral development financial institutions, multilateral development banks, international organizations, etc.) usually conduct studies on project development and feasibility, and provide technical assistance to the host country's energy and power sector to improve the profitability of projects and improve electricity price certainty (ie. with feed-in tariff). For countries with immature markets, aid agencies often work to strengthen capacity building in host countries, improve financing and laws and regulations, create better conditions for various business models, and attract enterprises to develop and operate on projects.

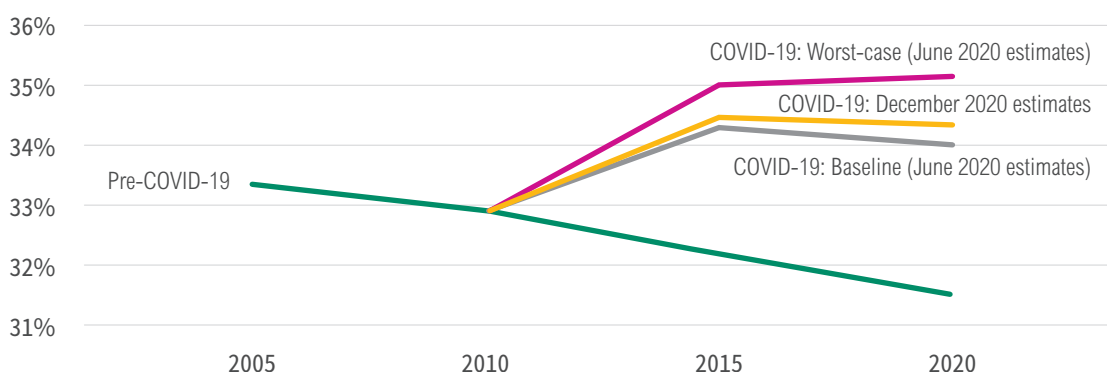
IV. CONCLUSIONS AND CONSENSUS

This series of seminars explored the convergence of China's international development and cooperation in the energy sector and the development needs of developing countries and regions, a major one of which being Africa. The seminars include efforts to solve chronic problem of electricity shortage, responses to the Covid-19 pandemic, and an outlook for promoting a green and just energy transition in the future. Through discussions, experts attending the meetings have achieved consensus on how to identify the needs of host countries in international development and cooperation and how to mobilize resources to make cooperation more effective, which is of great importance in guiding future policy research and cooperation. The summary is as follows:

1. Less developed countries and underserved population are challenged with multifaceted vulnerability

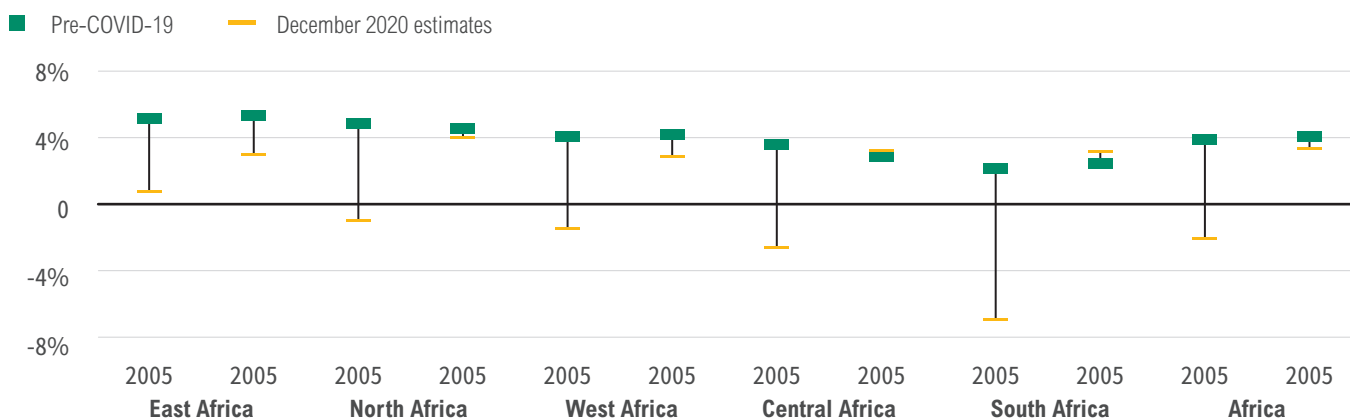
Africa has the largest number of LDCs and developing countries in the world. For African countries, poverty reduction has long been a common goal. In 2020, the extreme poverty rate of Africa was 34.5% (see Figure 3), which means that one-third of its people were living below the poverty line. The hard-won gains in poverty reduction will be reversed by Covid-19 effects: with the implications of Covid-19, the economy of Africa contracted by 2.1% in 2020 (see Figure 4). This is a decline

Figure 3 | Africa's extreme poverty rates, 2018-21

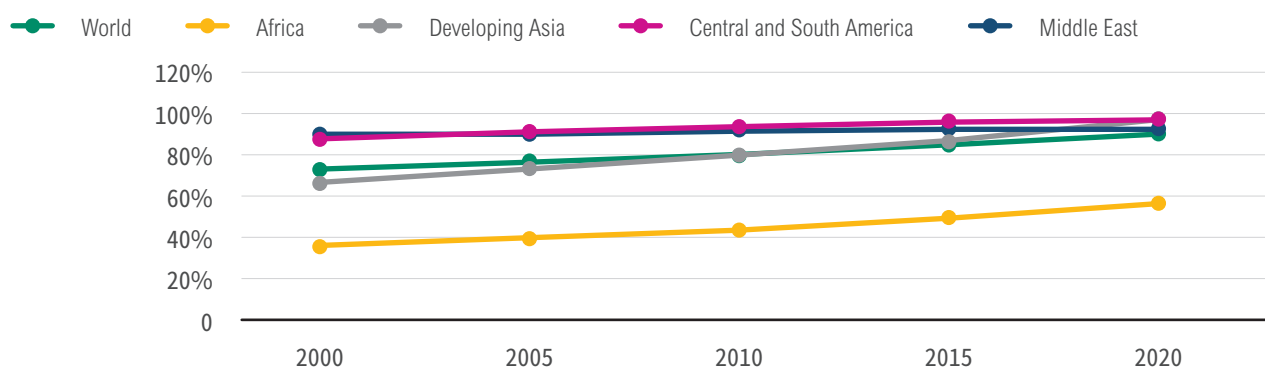
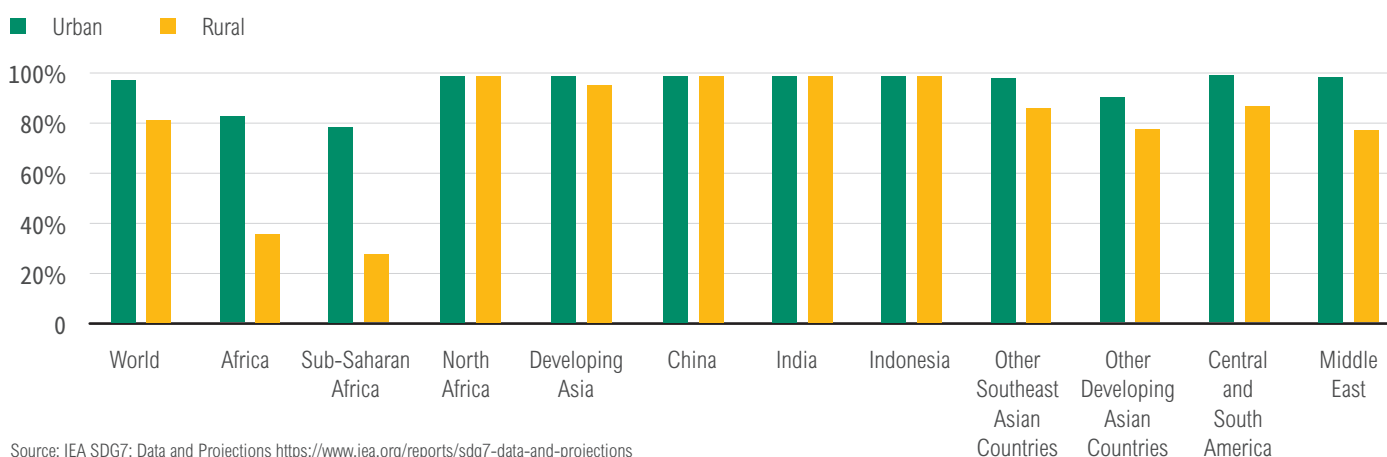


Source: African Economic Outlook 2021

Figure 4 | Analysis of overall and regional GDP of Africa



Source: African Economic Outlook 2021

Figure 5 | Proportion of the population with access to electricity**Figure 6** | Proportion of the population with access to electricity at urban and rural level in different regions

Source: IEA SDG7: Data and Projections <https://www.iea.org/reports/sdg7-data-and-projections>

of between 5.6 and 7.3 percentage points compared to pre-pandemic growth forecasts, making it the worst recession of the past half-century. African countries deficits have soared and debt servicing capacity has declined.

In the energy and power sector, at the macro level, vulnerability lies in the difficulty of financing infrastructure while at the micro level, challenges emerge from providing basic services to remote and poor areas. To be more specific, vulnerabilities are shown in the current high debt servicing pressure in African countries, the difficulty in financing large infrastructure projects such as energy and power facilities, and the inadequate supply of electricity to primary health care systems and cold-chain facilities as emerged during the Covid-19 pandemic. These vulnerabilities are compounded into a vicious cycle. Sub-Saharan Africa is expected to have 560 million people without access to electricity by 2030.

2. Development assistance/aid remains an important pillar and China's role carries more expectation

Considering the electrification costs in areas without electricity and the financial and governance situation of some LDCs, international development assistance remains an important source of funding and technical support. Substantial financial and aid funding support are essential in helping African regions to enhance resilience, eliminate energy poverty

and achieve green transition. However, the commitment made by developed countries at the Copenhagen Climate Conference in 2009 to provide \$100 billion a year in climate assistance to developing countries by 2020 has been delayed. According to the latest OECD statistics, in 2019, the total amount of climate finance mobilized by developed countries was only \$79.6 billion. The vulnerability of developing countries and the lack of aid reflect global public crisis and deficit of governance .

In this context, China's energy and climate cooperation with other developing countries under the framework of South-South cooperation carries the expectation of the international community and is a proper way for China to participate in global governance sufficiently and contribute to the solution of global public problems. China's foreign aid in the energy sector can serve as a bridge between China's industrial advantages, the needs of developing countries and the global agenda of "SE for All" . On one hand, China can share its products, technologies and experience to help developing countries break through the bottleneck of energy accessibility; on the other hand, it is expected to set up examples of best practice for commercial cooperation, and clarify China's position and objectives in getting involved in development and global climate governance, thus leveraging more production factors, both development oriented and commercial, to flow into the energy sector of developing countries.

3. Getting a clear understanding of the difficulties and challenges to the application and transition of renewable energies

Although both international multi-bilateral cooperation and China's goals of carbon peaking and carbon neutrality have outlined bright prospects for the development of renewable energy and the transformation of energy structure within China, the development and utilization of renewable energy will always need to break through the bottleneck brought by its characteristics and to meet the requirements of overseas project development both in terms of profitability and sustainability. External conditions such as enabling environment for business and end-users ability/ willingness to pay, especially in underdeveloped regions adds another layer of challenge and calls for careful feasibility study. At the same time, it should be clearly recognized that "China's experience" cannot be simply replicated, although China has accumulated "know-hows" in the development of product, technologies and solutions in its process of achieving universal access to electricity and has made the "30·60" commitment. Therefore, in international development cooperation, there is still a need for a demand-side oriented and step-by-step approach. The implementation of China-Africa energy cooperation blueprint still face constraints and needs patience.

4. Innovation and popularization of renewable energy products, programs and financial instruments will empower development

In SDG 7 Progress Report released recently, both IEA and IRENA highlighted the potential of distributed renewable energy systems (including mini-grids and stand-alone systems) to address electricity supply in areas without electricity, and the importance of providing financial and policy support for enterprises and users. Experts at this series of seminars also emphasized the potential of distributed (off-grid and mini-grid) renewable energy in eliminating power poverty, improving life quality and reducing health and environmental hazards. Be it the "PV+" model that combines PV with different industries or "Candles Killer" and solar powered radios for the people at the bottom of the pyramid, it's clear that solutions and capacity is already on the table. The promotion and sustainability of such products and solutions could benefit from the integration into international certification systems including "Lighting Global", so as to gain support from development financial institutions and increased international competitiveness.

Experts at the meetings generally mentioned that the inclusive financial innovation, represented by the mobile payment service of Pay as you Go, has played a significant role in boosting the purchasing power of end users for power equipment and utility. The mobile phone industry that Chinese companies have been deeply rooted in in turn expands the use of Pay-

Go. With the increasing affordability of more end users, the costs of distributed renewable energy is expected to decrease and the financing ability to increase, which will greatly empower the elimination of energy poverty.

5. Improving development effectiveness of energy aid and formulate demand side-oriented aid planning

It is important to recognize that different development needs under the SDG7 framework of “SE for ALL” require different modes of cooperation. For example, the following scenarios require very different dimensions, scales and modes of international cooperation in energy and power: the provision of basic energy services for people without access to electricity to live a dignified life; the provision of electricity for major public health crisis prevention systems at all levels of health care facilities; and the provision of clean energy supplies for various economic sectors and laying the foundation for future energy transition.

For this reason, it is necessary to design cooperation planning according to the needs of recipient countries, development agenda and market conditions, carefully screen and select projects, match the appropriate type of funding according to the profitability, development benefits and risk expectations of projects, or adjust the ratio of policy funding and commercial funding. Take the optimization of energy development cooperation as a breakthrough point to form an interconnected aid system of “goods and materials supply/technical cooperation - complete set of projects - capacity building - industrial park - comprehensive planning”. By doing so, scattered sets of projects and material aid can be integrated through low-carbon planning programs, fully leveraging and developing existing projects as well as facilitating the transition of assistance subjects from “turnkey” projects to “menu-style” cooperation.

6. Establishing a forward-looking environmental and social impact assessment system in line with international discourse

There are often multiple factors of development, economy, health and environment affecting renewable energy development cooperation projects. In the process of gradually establishing carbon emission trading system and ecosystem service pricing system, the value of these projects is more possible to be transformed into monetary value, thus enhancing their financing and sustainability. The basis of this possibility is to monitor and assess the environmental, social and climate impacts of the projects, and to establish a testing and evaluation system oriented to sustainable development benefits. The indicators should reflect not only the driving force for the national economic and social development of recipient countries, but also the project’s impact on residents’ life, climate change, environment and health, and they should also meet the SGDs and other standards universally recognized by the international community.

APPENDIX: FULL LIST OF SPEAKERS (IN CHRONOLOGICAL ORDER)

Miao Hong	Director, WRI Sustainable Investment Program	Zhang Rui	Research fellow, GEIDCO Economic and Technology Research Institute
Wang Luo	Director, CAITEC Institute of International Development Cooperation	Peng Peng	Secretary-general, China New Energy Investment and Financing Alliance
Sun Tianshu	Research Associate, CAITEC Institute of International Development Cooperation	He Jijiang	Executive Deputy Director, Research Center for the Energy Transition and Social Development of Tsinghua University
Teng Aihua	Former Chairman, Poly New Energy Technology (Beijing).	Zhao Liya	Investment Manager, Photovoltaic Business Department of Tongwei Group
Shen Dichai	Founder and CEO, Bridge Beijing; Consultant, Coalition for Epidemic Preparedness Innovations (CEPI)	Liu Zuming	Professor/ Doctoral Supervisor, Yunnan Normal University; General Manager, Yunnan Zhuoye Energy Co. Ltd.
Jiang Hao	Secretary General, China-Africa Renewable Energy Cooperation and Innovation Alliance (CARECIA)	Yang Fuqiang	Specially Appointed Researcher, Institute of Energy at Peking University
Li Bolun	Founder, Diinsider	Hao Rui	General manager, Research and Development Department of China-Africa Development Fund (CADFund); Senior economist
Li Dan	Executive Secretary General, Renewable Energy Special Committee of China Association of Circular Economy		
Chen Zhang	Deputy Director, Africa Division of International Business Department of China Renewable Energy Engineering Institute		
Shen Yiyang	Director, Inclusive Development Research Center		
Yuan Min	Research Analyst, WRI Sustainable Investment Program		
Li Xia	Deputy Secretary-general, ShenZhen Solar Energy Society; Founder of Power-Solution		
Hu Gen	Senior Manager, International Cooperation Division of CSCEC International Operations		

World Resources Institute (WRI)

Founded in 1982 and headquartered in Washington, D.C., the World Resources Institute (WRI) is an independent global think tank and do-tank. In the past 40 years, we have been providing solutions and support for scientific decision-making through pioneering research methodologies and tools, building resourceful and diverse data platforms, and providing incisive, objective analysis with a tangible impact.

Around the globe, we have more than 1,400 experts and employees located in 12 international offices, who work with partners in over 50 countries. In 2008, WRI opened its first overseas office in Beijing, China.

Green BRI Project, Sustainable Investment Program

Based in China, the WRI Sustainable Investment Program works with a global network of Chinese and International leading thinktanks and research institutes in renewable energy and green finance. The program aims to track China's outbound financial flows and facilitate Chinese outward investment's shift away from traditional energy, especially coal, towards renewable energy, helping facilitate China's decarbonization transition with a vision to contribute to the global goal of sustainable growth and carbon neutrality.

WRI CHINA

Address: Room K-M, 7/F, Block A, Donghuan Plaza, No. 9, Dongzhong Street, Dongcheng District, Beijing
Postcode: 100027
Tel: 86 10 6416 5697
Fax : 86 10 6416 7567

WRI.ORG.CN



商务部国际贸易经济合作研究院
Chinese Academy of International Trade and Economic Cooperation

CAITEC Institute of International Development Cooperation

Address: No. 28, Donghou Alley, Andingmenwai Street, Dongcheng District, Beijing, China
Postcode: 100710