The Future of Coal

——Host Country Study of Coal Fired Power Plants Along the Belt and Road Initiative

Global Environmental Institute (GEI)

- **Background**

In 2015, The Paris Agreement demonstrated a global consensus on the need to take joint action to reduce greenhouse gas (GHG) emissions. Energy sector GHG emissions, and especially those from coal fired power plants (CFPPs), have become a global issue.

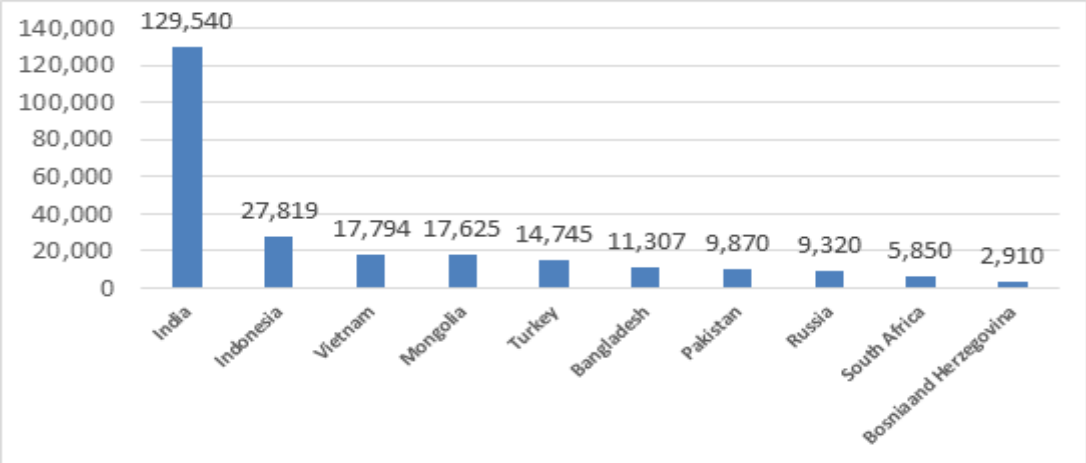
In 2017，GEI conducted a preliminary study on China's involvement in CFPP development and investment along the Belt and Road Initiative[1](BRI). The study showed that growing demand from host countries is a driving force behind China's involvement in CFPP development along the BRI.

To further understand the trends in CFPP development along the BRI, and to better understand possibilities for coal replacements, GEI conducted host country case studies in 2018.

- **The Choice of the Host Countries**

Figure 1 shows the top-ten countries in terms of installed CFPP capacity with Chinese involvement form 2001 to June 2018.

Fig. 1： Top 10 top-ten countries in terms of installed CFPP capacity with Chinese involvement from 2001 to Jun 2018 (by MW)

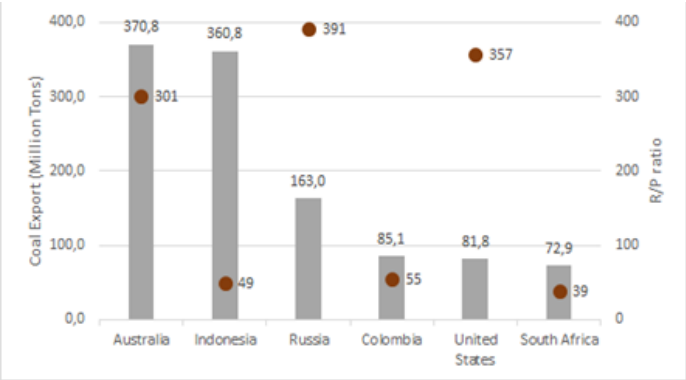


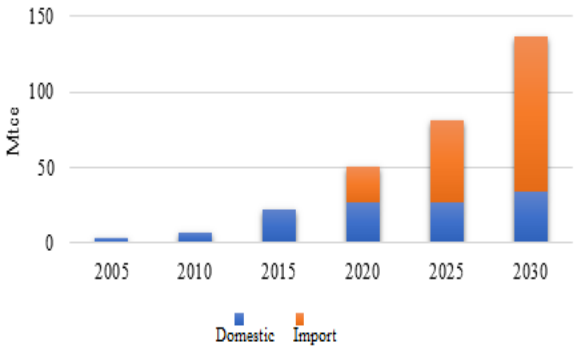
India ranks number one in total CFPP capacity with Chinese involvement over that time period. However, India's adoption of protectionist policies in 2009, combined with the increase of import duties on power equipment since 2012, have significantly reduced China's participation in India. As a result, GEI chose Indonesia (the 2nd biggest coal exporter) and Vietnam (a coal importer since 2016) to engage in CFPP studies.

Fig. 2(left): World's top coal exporters (Enerdata, 2018) and Reserve/Production ratio (BP, 2018)

[1]http://www.geichina.org/_upload/file/report/China's_Involvement_in_Coal-fired_Power_Projects_OBOR_EN.pdf

Fig. 3(right): Coal supply and demand in Vietnam[2]





- **Main Findings**

Three main findings have emerged from the study:

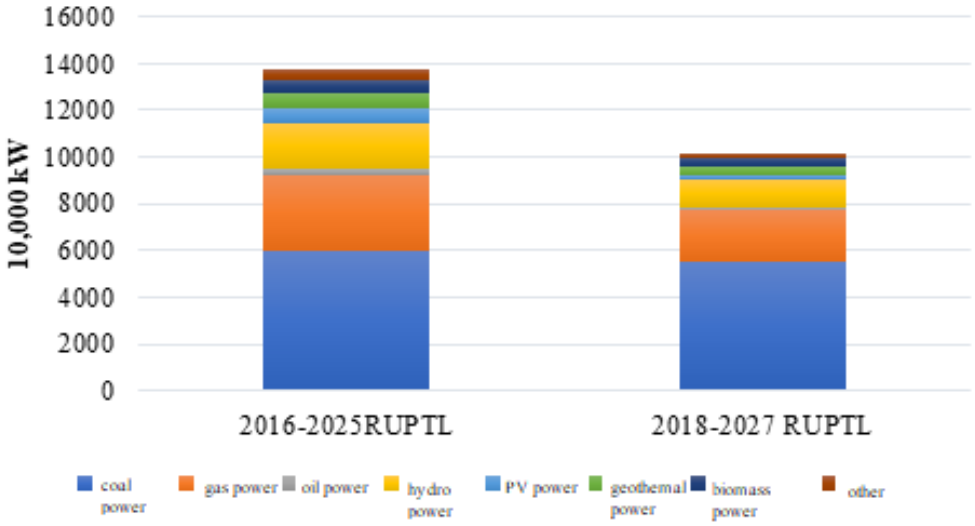
1. In the short run, coal will still be the main resource for power generation in both Indonesia and Vietnam

Both Indonesia and Vietnam have made Nationally Determined Contributions (NDC) Under Paris Agreement. Both countries have also set GHG reduction goals for the energy sector. Yet, as a result growing power demand, and due to their current economic status and cost-sensitive policy approaches to development, CFPP will likely remain both countries' principle choice for electricity generation.

Indonesia had installed 24 GW in CFPP capacity by 2017, accounting for 39.47% of total installed power capacity. By 2025, Indonesia plans to add an additional 56 GW of total capacity, with 26.8 GW, or 47.8%, being provided by CFPPs. That plan will result in Indonesia doubling their CFPP fleet when compared with 2017.[3]

Fig.4 Installed power generation capacity in 2025 in different plans of Indonesia[4]

[2] Source: Professor Yuan Jiahai from North China Electric Power University (NCEPU)
[3] Data collected from General Planning on National Energy (RUEN) of Indonesia.
[4] Source: Professor Yuan Jiahai from NCEPU.



A comparison between two different ten-year RUPTL[5] plans developed by Indonesia's state owned electricity company PT PLN (Persero), shows a nearly 30% decrease in general installed capacity under the 2018-2027 plan due to its slowing economic growth. Yet total CFPP capacity only decreased marginally, and took an even higher share in general capacity than under the 2016-2025 plan.

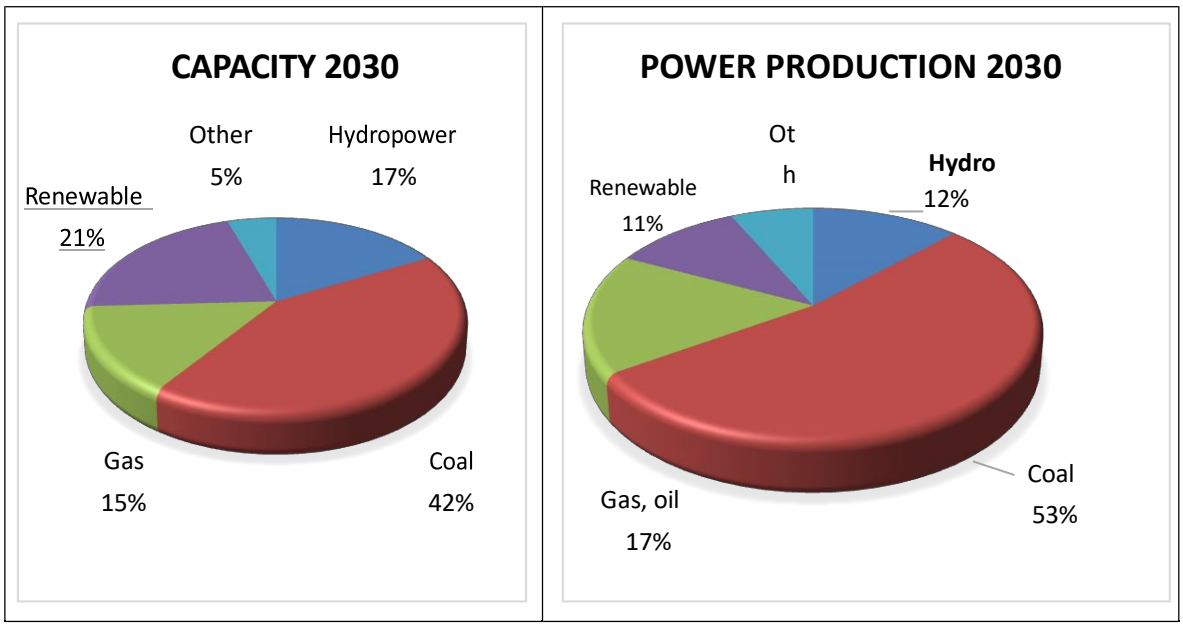
This means that the Indonesian government has positioned coal-fired power as its primary power source going forward.

As for Vietnam, according to Electricity of Vietnam (EVN), hydropower served as the primary source of power by 2016. Hydropower accounts 37% of total installed capacity, followed by gas-fired power and coal-fired power, which account for 32% and 30% of total installed capacity respectively.

Fig. 5： Vietnam energy resource structure[6]

[5] RUPTL is a ten-year Electricity Supply Business Plan developed by PT PLN (Persero).

[6] According to the Vietnamese Electrical Master Plan VII (PDP VII), adjusted in 2016. Source: CEWAREC.



According to the revised PDP VII (2016),[7] it is expected that by 2030, the number of CFPPs will rise to 52; this will result in an installed capacity of 55.25 GW, accounting for 42.6% of Vietnam's total capacity. The CFPPs are expected to generate 304,478 KWh of electricity, accounting for 54% of overall power production.

2. **In the short run, a developmental approach for CFPP could be to improve environmental standards and energy efficiency**

The environmental standards for CFPP in both Indonesia and Vietnam are relatively weak and need to be updated. In recent years, there is growing demand for improving environmental policies and raising emission standards. Both governments have embarked on revising relevant laws and regulations.[8] A potential developmental approach for CFPP here could be to improve emission standards and energy efficiency

Tabel1：Indonesian air emissions standards for CFPP, 2008[9]

parameter	unit	Old plants	New plants
SO_2	mg/m^3	750	750
NO_x	mg/m^3	850	750
PM	mg/m^3	150	100
Opacity	per cent	20	20

The current Indonesian legal framework for environmental protection, the *Environmental*

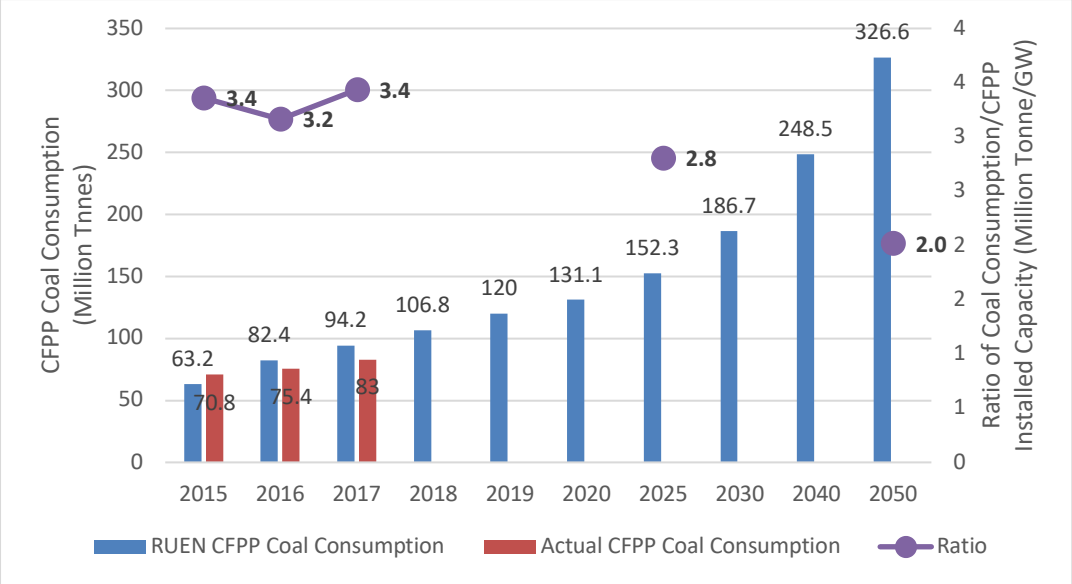
[7] Vietnamese Electrical Master Plan VII (PDP VII), adjusted in 2016.

[8] https://icel.or.id/en/govt-takes-more-time-over-stricter-emissions-rule/

[9] Emission standards remain considerably weak, especially for NO_x and SO_2. Reference conditions for testing are 25°C at an atmospheric pressure of 1 atm (or 101 kPa) on a dry flue gas basis with 7 per cent O2 in the flue gas (except for opacity). （Source: Ministry of Environment and Forestry, Indonesia）

Protection and Management Regulation, was enacted in 2009. Air pollution standards for CFPPs, however, are still tied to regulations issued in December 2008,[10] which lag behind international standards.

Figure 6：CFPP Coal Consumption and Ratio to CFPP Installed Capacity, Indonesia[11]



It is also expected that CFPP efficiency in Indonesia will improve. For new CFPP, Indonesia's General Plan on National Energy (RUEN) looks to raise power generation efficiency standards and increase deployment of Clean Coal Technology (CCT).

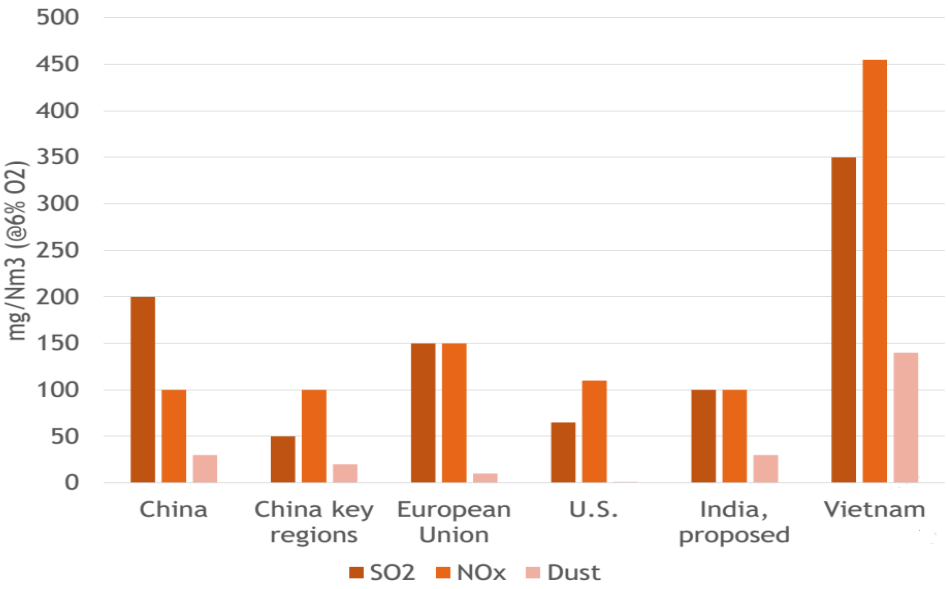
In Vietnam, while the new *Environmental Protection Law* was enacted in 2014, regulations regarding air pollution and emission standards are still tied to the to 2009 Environmental Protection Law.[12]

Fig.7：Comparison of CFPP emission standards (Myllyvirta 2015)

[10] https://icel.or.id/wp-content/uploads/Policy-Paper.-ICEL-CSE-REEI-2017-Indonesias-Coal-Power-Emission-Norms-Lessons-from-India-China.pdf

[11] Source: IESR

[12] "National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts QCVN 19:2009/BTNMT " 2009, and" National Technical Regulation on Emission of Thermal Power industry QCVN 22:2009/BTNMT"



Compared with other countries, Vietnam has poor energy efficiency standards and high emissions.

Up until 2016, most CFPPs in Vietnam were running with subcritical technology and without restrictions on emissions.[13]

3. **Renewable energy: rich in both potentials and challenges**

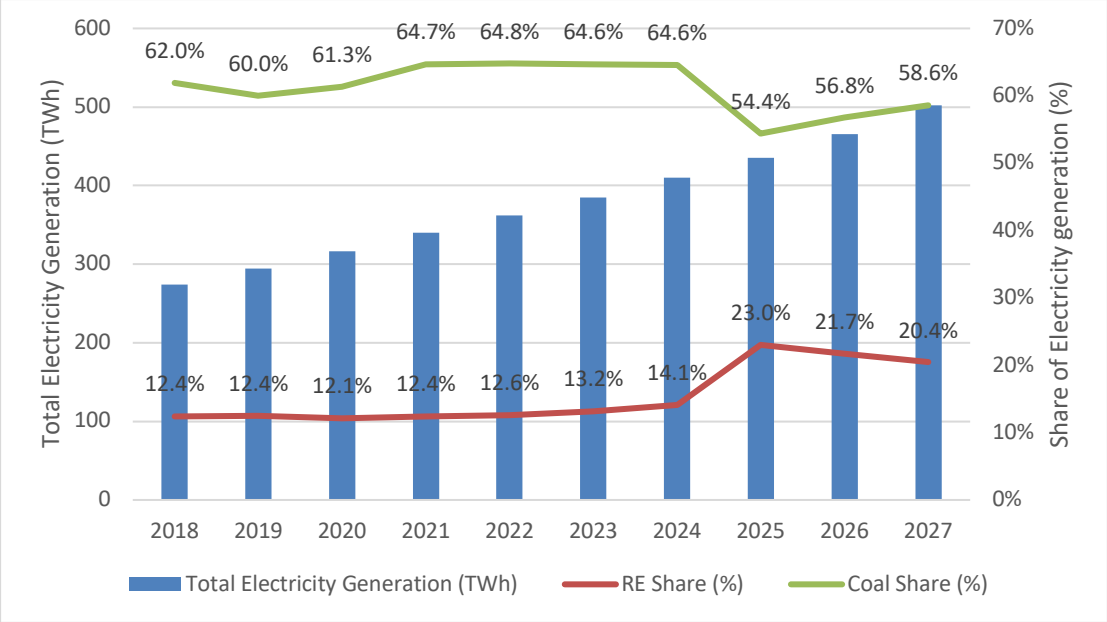
According to 2018 GEI's assessment on renewable energy development along the BRI, Indonesia and Vietnam ranked No.9 and No.11 on renewable energy potential (apart from major hydro power stations). Both countries have fertile renewable energy resources and great potential to replace fossil fuels; still, both are restrained by economic policies and limited access to technology. The development of renewable energy has faced various challenges and difficulties.

Indonesia has a vast amount of renewable energy sources. It has 40% of global proven geothermal energy. Indonesia also ranks fifth in the world in terms of potential hydropower resources, though 95% of its hydropower resources have yet to be deployed. Located close to the equator, Indonesia also enjoys average solar radiation resources of 4.8 kWh/m^2/day.

Figure 8：Percentage Share of RE and coal in electricity generation (Source: RUPTL 2018-2027)[14]

[13] Minh Ha-Duong, An Ha Truong, Hong Nam Nguyen, Hoang Anh Nguyen Trinh. Synthesis Report on Socio-environmental Impacts of Coal and Coal-fired Power Plants in Vietnam. [Technical Report] Vietnam Sustainable Energy Alliance. 2016. <hal-01441680>

[14] Source: IESR

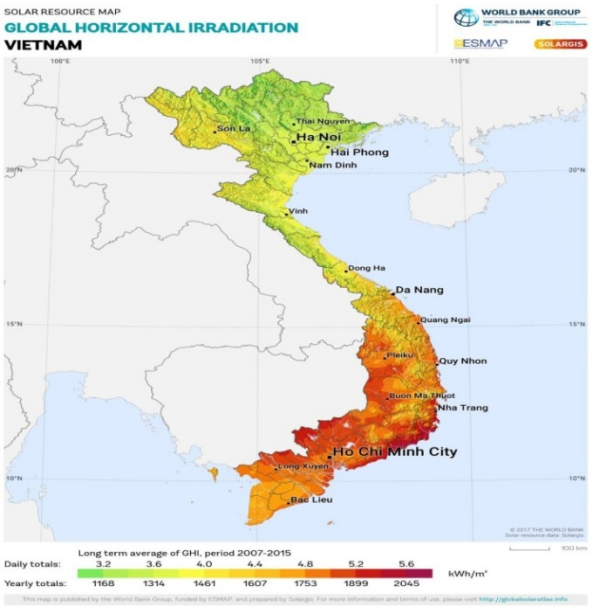


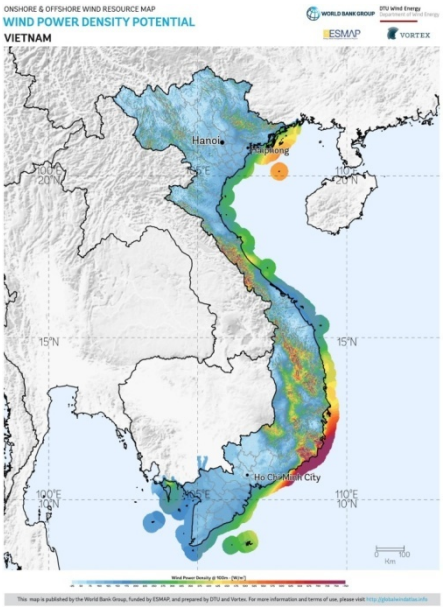
RUEN projected that by 2025, renewable energy will account for 23% of overall installed capacity in Indonesia. Installation of renewable capacity, however, has progressed slowly. The main challenges facing renewable energy development are:

1. A high cost of renewable energy due to the lack of the support from a mature industry sector, and a lack of reliable equipment and technology;
2. Due to slowing economic growth, energy sector development strategies have opted for energy resources with a "low cost and high stability." Currently, the government lacks the ability and will to subsidize the renewable energy sector.

Similarly, Vietnam has a huge potential for renewable energy, especially in solar and wind power.

Figure 9(left): Map of solar radiation in Vietnam
Figure10 (right): Wind Power Potential in Vietnam





In the context of Solar power, the average radiation intensity in Vietnam is roughly 4.6 kWh/m2/ day. The World Bank's study shows Vietnam's wind potential at 65 m is the largest in the Mekong River Region, with theoretical wind potential of up to 513,360 MW.

However, the renewable industry sector in Vietnam is still in the initial stages. In the future, Vietnam will give priority to the development renewable energy and raise the share of non-hydro renewable resources from 3.5% in 2010, to 4.5% in 2020, and then 6.0% in 2030.

- **Suggestions**

Energy sector strategies in both Indonesia and Vietnam are heavily linked to economic development and energy security. In the short run, fossil fuels, especially coal, will not be replaced.

However, the environmental and social side effects of the CFPPs are growing. Indonesia and Vietnam have already experienced protests and an increase in groups opposing CFPP. Both countries are also under pressure to achieve their NDCs; both are likely to adjust their CFPP and electricity plans, limit installed capacity of coal, and set stricter environmental standards. These are the investment/finance risks that China ought to consider.

The long-term goal of “decarbonization” should aim to improve energy efficiency, raise environmental standards, and develop renewable energy.

Detailed suggestions are as follow：

A. **In each host country: institutionalize host country case studies**

Each country has unique resource endowment. Moreover, their political, economic, legal, and social conditions vary greatly. To understand how these contexts vary across host nations, case studies on individual countries should be conducted regularly.

There should be a regular updates on the policies, regulations, and standards development of host countries and their industry. A risk identification and mitigation mechanism should be established.

B. **In the context of CFPPs: help host countries to improve their environmental standards and energy efficiency**

China's energy transition policy experience (such as the coal cap, and coal-electricity upgrades) can provide a reference for the host countries.

Chinese financial institutions should set up an environmental factor credit rating system or credit enhancement mechanism. For example, for projects with poor environmental standards and performance, Chinese financial institutions could reduce the credit score or give those projects a lower rank in the rating system. Conversely, for projects utilizing advanced technology and higher environmental standards than the local requirement, financial institutions can increase the score or give a higher rank. This could push host countries to improve their standards.

Chinese enterprises should adopt better technology and environmental standards than those of the host country, promote clean coal technology (CCT), and improve the energy efficiency of coal power. This could help those enterprises avoid potential investment risk (e.g. policy changes brought about by social pressure for improved environmental regulation).

C. In the context of renewable energy: promote exchange in experience and technology

China is the largest and fastest-growing country in terms of wind power generation; it is also the world's leading PV manufacturer.

The developmental experience and technology of China's renewable energy sector could help host countries promote and utilize renewable energy resources, and foster the development of the industry.

- **Acknowledgement**

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