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China's Belt and Road Initiative: from perceptions to realities in Indonesia's coal power sector

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ABSTRACT

This paper contributes to the debate on the sustainability of the Belt and Road Initiative (BRI) by analyzing Chinese investments in Indonesia's coal power sector. Insofar, scholarship on the BRI examined the role of Chinese companies "going out," neglecting host countries' agency in shaping this initiative. This study analyses this important yet often overlooked dimension through the lens of local stakeholders. Fifteen in-depth interviews provide key insights into themes that are explored using a novel database. Results show a sharp increase in the Chinese-led financing, construction, and investments in Indonesia's coal power plants. While large State-owned enterprises spearheaded this increase, the BRI is also generating an impetus of private investments in new "instrumental" coal power plants that serve industrial parks, owned by non-energy companies. After the Paris Agreement, only Chinese, Japanese, and Malaysian institutions continued to finance coal power plants in Indonesia. However, unlike other foreign investors, Chinese companies are bringing mostly subcritical (low-end) technology, and their operations have been associated with the use of illegal labour. Overall, results show how China's export of industrial capacity and financing through the BRI is met by Indonesia's developmental attitude towards using coal and foreign investments to prioritize its economy growth over environmental and social sustainability.

1. Introduction

Since its launch in 2013, the narratives on China's Belt and Road Initiative (BRI) have considerably evolved. In its initial stage of euphoria, many observers described the initiative as "China's most ambitious foreign and economic policy" [1] or "China's $1 trillion-dollar project to shake up the economic order" [2]. Gradually, narratives of "debt traps" emerged [3,4], which were met by defensive counterarguments by official and pro-China responses [5–7]. The debate on the BRI's sustainability has been equally polarized. On the one hand, the *Guidelines on Promoting Green Belt and Road* and *The Belt and Road Ecological Cooperation Plan* show an official commitment by the Chinese government to drive investments towards sustainable outcomes. The document affirmed the need for "enterprises and institutions involved in the One Belt and One Road initiative to practice environmental protection in foreign countries to ensure an eco-friendly and green Belt and Road" [8]. Similarly, the BRI's leading vehicles – the Asian Infrastructure Investment Bank, China Development Bank, and China EXIM Bank set up guidelines and cooperation agreements with international counterparts to promote green finance and Corporate Social Responsibility (i.e., [9]). Commentaries from NGO leaders and academic sources inside China also touted how the BRI "can pave the way to global sustainability," [10] making somewhat propagandistic claims that "BRI has a positive impact on the sustainable development of all countries" [11], without however providing strong empirical evidence. On the other hand, recent reports and commentaries on the impacts of Chinese outward investments outlined the potential threats and challenges that such a large-scale endeavour can bring at global (see Refs. [12,13]) and local level [14,15]. In-between the two, other studies have focused on the role of investors, policy banks, and host governments in delivering the promised outcomes [16–18] and have analysed the evident gap between China's domestic and overseas policies aimed at stirring green investments by Chinese companies [14,19–21].

Energy research is, likewise, contradictory. China was dubbed the next "world's renewable energy superpower" and a "global clean energy champion" by studies that showed the country as the largest producer, exporter, and installer of solar panels, wind turbines, batteries and electric vehicles [22,23]. However, studies also show China as a leading player in the financing and development of coal power plants, therefore contravening its own sustainability commitments for the BRI as well as

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other multilateral ones such as the Paris Agreement [19,24–27]. These studies often employ datasets of financial data that, despite being comprehensive and consistent, are often not released and verifiable. They often look at the role of Chinese investments globally or in a specific region; hence, they seldom captured the role of host governments in attracting these investments, nor examine the impact and politicization of Chinese investments. Most importantly, by focusing solely on Chinese investments, they miss a comparative angle with other foreign investments that may reveal significant differences.

This study contributes to the current debate on China's BRI sustainability by providing an in-depth analysis of investments in coal power plants from a host country perspective. Being the largest mobilization of Chinese capital to date, understanding the dynamics of BRI-led investments is of paramount importance for the sustainability debate in energy research. This study selected Indonesia as a focus of research. The country is the quintessential case of resource-rich emerging economy with a considerable gap in electrification rates and a "developmental" attitude [28] that seeks to attract foreign capital to alleviate its infrastructural gap. The study explores the role of Chinese firms and financial institutions vis-à-vis other foreign investors in the development of coal power plants and adds nuances to the perceptions, host government agency, and impacts at local level by proposing an novel mixed-method research design. This design provides on the one hand, insights on how local elites, civil servants, and civil society leaders perceive Chinese investments, and on the other hand, confronts these views with data. The database was created by merging and cross-checking five databases as well as other government-related sources. This process could be replicated for other emerging economies to create more comprehensive databases of coal power plants that not only show the financing, but also comprise data related to ownership, construction, technology, social mobilizations, and environmental concerns. This new method seeks to address the gap in creativity in the energy research methods and add a "social" dimension to energy research that scholars recently identified as under-examined [29,30]. In particular, analysing the case of Indonesia through different actors' viewpoints – the government, the business elites, the foreign investors, and the civil society can provide useful insights into the complex dynamics that other emerging economies are facing. As recent studies have pointed out, "It is critical to understand current performance and establish a baseline understanding of the environmental impacts of Chinas overseas projects thus far" [31]:1. A single country perspective allows an in-depth analysis of the internal dynamics affecting Chinese investments, financing, and contracting of coal power plants and how these investments are perceived by different stakeholders at national and local level. This focus on a single case also allows to understand how the Belt and Road Initiative has changed the presence of Chinese companies and financial institutions , and how this can in turn shape a country's energy future and its sustainable development.

2. Dark paths: Indonesia's developmental attitudes meet China's BRI

Indonesia is the largest economy in Southeast Asia, and in 2020, it accounted for roughly one-third of ASEAN's GDP. In 2017, the country had, however, yet to achieve homogeneous electrification rates to accomplish its growth potential. Fig. 1 shows how provinces like Papua and East Nusa Tenggara that had electrification rates below or slightly above 50% were in stark contrast with highly electrified areas and provinces in Java and Sumatra.

This gap set Indonesia behind most of the other countries in ASEAN such as Singapore, Brunei, Malaysia, Thailand, and Vietnam, which all had higher installed capacity and electrification rate [32]. The frequency of power outages and the goal of achieving upper middle-income country status by 2025 are the main reasons behind the ambitious 35,000 MW plan that President Widodo launched in 2015. This program perfectly fits into the narratives of Indonesia's developmentalism [28,33,34] whereby large-scale projects are "justified by appeals to grand narratives," in which infrastructure development becomes vital to the nation's progress. Of this 35,000 MW of power, 10,681 were to be added by state electricity company PLN through the construction of 35 new power units, while the rest will be offered to Independent Power Producers (IPPs; [32]). These IPPs include local power companies as well as foreign investors.

Under the 35,000 MW plan, PLN issues a yearly Power Supply Business Plan to set the specifics of the installed capacity and the energy mix of each region. The 2018–2027 plan [35]projected an increase of electricity capacity of 56,024 MW over the next decade, mostly provided through coal, which will account for 54.4% of Indonesia's energy mix by 2025 (Fig. 2), followed by renewable energy (23%), natural gas (22.2%), and gasoline (0.4%). In 2019, Papua and East Nusa Tenggara had already reached a respective 94% and 85% electrification rate [36].

While the Government of Indonesia showed strong support for moving towards the United Nations Sustainable Development Goals both with its domestic policies and by signing and ratifying the Paris Agreement in October 2016, the reality is that the heavy reliance on coal will not change in the future. As pointed out by Cornot-Gandolphe [37]; this is because, from the government's point of view, Indonesia's abundant coal is the quickest, easiest, and cheapest way to provide

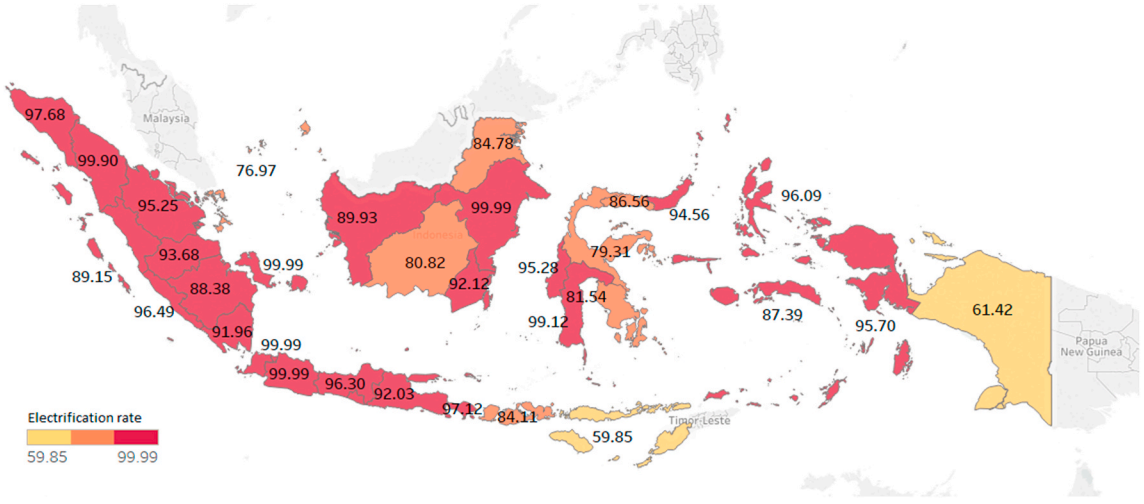

Fig. 1. 2017 Electrification rates in Indonesian provinces. Sources: Ministry of Energy and Mineral Resources, 2017 - https://www.esdm.go.id/assets/media/content/content-rasio-elektrifikasi.pdf.

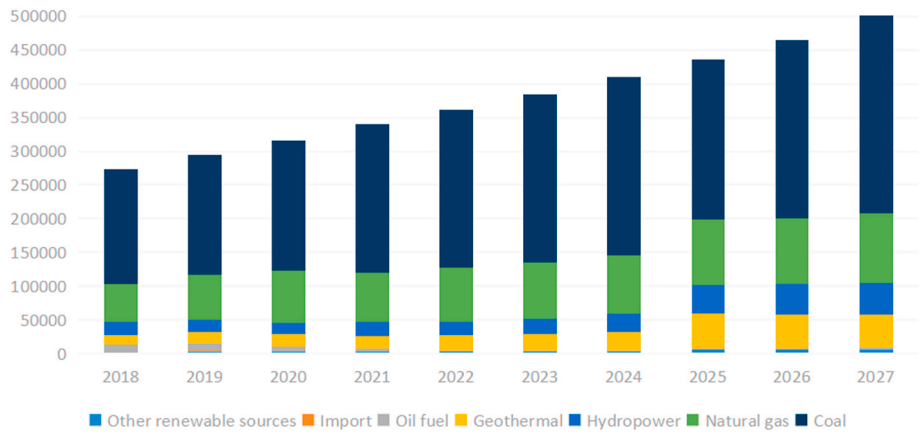

Fig. 2. Indonesia Energy mix 2018 - 2027 (Gwh). Source: PLN, 2018: V-64.

electricity. This study's interviews with local private and public sector stakeholders reflect this perspective (Interview1; Interview6; Interview10). The cost advantage for coal relates to its availability and extraction method, its lower capital costs, but also the absence of emission fees, and the lack of consideration of environmental externalities [38]. The analysis made by the Climate Action Tracker group revealed that "Indonesian energy policy is not only going against the global trend where renewable capacity additions have overtaken coal," but it seems set towards an insufficient commitment towards emission reduction. Overall, "forest fires, fast increasing energy demand, and expansion of its dependency on coal will lead to an unsustainable scenario of 3–4 °C temperature increase by 2030" [39]. While the Ministry of Energy and Mineral Resources issued several strategies to phase out plants that use subcritical pulverized technology, improve the refurbishment of existing power plants, and prioritize the use of so-called "green coal technologies" such as supercritical, ultra-supercritical (USC) and Combined-Cycle Technology [40], these are in sharp contrast to the growth imperative set by PLN.

As previously mentioned, foreign investors play a crucial role in this growth by building, financing, and operating new coal power plants. Indonesia's infrastructure development plan shows a considerable financing gap of almost USD110 out of 157 billion that could be filled by private investors, among which Chinese companies seem to be the most eager to contribute [41]. According to Shearer et al. [42]; "Chinese financial institutions are the world's largest funder of overseas coal plants, investing US$15 billion in coal projects from 2013 to 2016 through international development funds, with another US$13 billion in proposed funding" – the latter concurs with a report by the Natural Resources Defense Council [43].

Recent research [20,42,44–47] well documented the overcapacity issue in China's coal sector, which has also been addressed by the CCP's 13th Five Year Plan. The plan outlined the setting up of a fund to reward structural adjustments in industrial enterprises, especially in the coal and steel sector. Hence, capacity exporting, a commonly cited motive underpinning the ambitious Belt and Road Initiative [48,49] along with the excess of national savings and foreign reserves that China seeks to diversify [50] seem particularly appropriate when looking at the coal power sector in Indonesia [51]. Djankov and Miner [48] noted that even though the total investments and construction contracts generated by the BRI would still be much lower than the USD5 trillion per year that China invested in fixed assets domestically, "going out" will provide leeway for Chinese companies to re-think of their future growth strategy and engage in much-needed organizational restructuring. While this could be a perfect match between a country with a significant infrastructure deficit seeking investors and a country with sizeable industrial overcapacity and available financial resources, the environmental and social sustainability of this path would go against both countries' international commitments towards a green energy transition and carbon reduction. The following sections show how the BRI has changed the presence of Chinese companies and banks in the financing, construction, and ownership of coal power plants in Indonesia.

3. Research methods

This study adopts a mixed method design that, according to Molina-Azorin's classification [52]:42), is a sequential type that assigns priority to qualitative data and uses quantitative data to help validate and expand on the gained insights. Using this design allows the validation of interviewers' perceptions with the realities of energy investments in Indonesia.

3.1. Qualitative research methods

The interviews, which depict key perceptions of Chinese investments by Indonesian stakeholders in the energy sector, are used to form hypotheses and provide additional content used in the results section. Twenty-one in-depth interviews were collected using a snowball sampling until saturation level was reached during three field research trips to Indonesia in December 2017, August 2018, and July 2019 for a total of six weeks. Interviewees include members of international organizations (3), international and local think tanks (3), NGO leaders (3), executives of energy companies (4), leaders of business organizations (2) as well as legal, financing, and academic experts (4). Two interviews were conducted in the Hong Kong SAR with a senior executive of a utility company and an Indonesian diplomatic official. The questions ranged from ones' perception of the BRI and Chinese investments in Indonesia to details of specific coal power plants projects. A content analysis of the results led to the formulation of four hypotheses, which were explored by analysing quantitative data and other documentation. The hypotheses are summarized below:

H1: The Belt and Road Initiative is bringing larger, first tier-type of companies to invest in Indonesia (Interview1; Interview2; Interview3; Interview8; Interview15). The quote by an executive of a leading Indonesian firm engaged in coal mining and power plants exemplifies this hypothesis:

"In 2014, my company visited Shenhua. The BRI brought more first-tier companies like this that have huge capacity - imagine that Shenhua and Huadian combined produce 180 GW of power, and Indonesia's total capacity is 50 GW" (Interview8). This hypothesis entails that the BRI is bringing companies that are leaders in the industry. Hence, they can provide higher standards as opposed to what happened in the past, which will be discussed in the next section.

H2: After the Paris Agreement, multilateral banks such as the World Bank and funding institutions from the EU and OECD countries are not

financing any more coal power plants. This commitment does not constrict Chinese-led financial institutions and Chinese State-Owned Enterprises (SOEs); hence, they can provide an indispensable channel of financing for new coal power plants (Interview10; Interview11).

NDRC data and Ren et al.'s [25] "Stage Three of rapid growth" of Chinese financing during the 2013–2015 period clearly illustrate this claim. While financing from the World Bank and the European Investment Bank stopped, Chinese financing of coal power plants boomed. While investments decreased from 2016 onwards because of the commitment from the Paris Agreement, it is yet too early to establish if this trend will continue. This study validates Ren et al.'s phases through a detailed analysis based on a single country examining also the type of financed technology (see H3).

H3: Chinese companies bring lower-end types of technology to minimize investment costs and win construction contracts because the Indonesian tendering system in favours bidders mostly based on budget. However, this generates a much higher cost on the environment and the surrounding communities (Interview1; Interview9; Interview10; Interview11).

H4: Chinese investments bring illegal labour to the country (Interview1; Interview2; Interview3; Interview9; Interview10; Interview11). Indonesia has strict laws regarding foreign labour, but Chinese workers often bypass these laws with stratagems, such as using visitor visas or sharing temporary work permits among workers (Interview3).

Yao et al. [51]'s policy brief partially supports hypotheses 3 and 4 despite, however, supporting it with data. This study does so by examining the type of technologies employed by coal power plants and by coding the data on the Global Energy Monitor GEM.wiki (formerly SourceWatch), which provides a background of main events and news articles on each coal power plant. This data shows if these projects have triggered any environmental or social impacts, have caused any work accidents, legal lawsuits, or raised concerns over foreign labour issues.

Some of the above hypotheses reflect a negative sentiment towards Chinese investments, which is not surprising when looking at the problematic history of the two country's foreign relations [53]. This paper aims to scrutinize these perceived dynamics by looking at data as well as existing research on the coal power sector in Indonesia and explain if and how the BRI is changing the institutions, the financing, and the technology brought by Chinese investments.

3.2. Quantitative research methods

This study employs a dataset that combined and crosschecked information from three databases of coal power plants. These are: the Global Energy Monitor (GEM, formerly Coalswarm), an open-access source on coal power plants; an open-access database on emissions of coal power plants in Indonesia published by the American Chemical Society containing data from the proprietary database Platts [54], which was the primary source of emission data; and with NDRC's Consolidated Coal and Renewable Energy Database 2017 [55]. This data was crosschecked with investment data from the China Global Investment tracker [56] and with the Financial Times' FDI Markets database. The resulting database of plants that are above 50 MW of power is available from Dataverse [57]. The database includes details of new variables. New variables indicate the status of the plant (i.e., open for tender was created to differentiate announced projects that have yet to receive any interest from potential investors); to show the year of announcement and the expected completion; and to display the leading country(ies) responsible for investing, financing, building, or supplying materials for each plant. The sources were at times conflicting or had to be updated or modified based on available information. The manual analysis of each coal power plant revealed GEM to be the most updated source, but that at times the data still needed updating based on the latest available news, which was recorded in the dataset. The database includes notes on modifications, alterations, and correspondence between data sources.

To examine H3 and H4, the background information of coal power plants on GEM.wiki (formerly SourceWatch) was used to create another dataset, which was coded to show evidence of different adverse impacts. Categories of impacts include (1) environmental impacts related to the quality of the environment and local livelihood; (2) incidents triggered by the plant; (3) legal issues that may have been triggered by a lack of permits, irregularities in respecting certain geographical boundaries or procedures, or corruption; (4) issues related to illegal workers being hired by the plant.

The plants built under the Fast Track Program 1 (FTP1), Fast Track Program 2 (FTP2), and 35,000 MW were classified accordingly, using available sources (see Refs. [58,59]. In this way, the study provides an overview of the role of Chinese investments in the last three large-scale government programs for electrification.

4. Chinese firms in Indonesia's coal power sector

The first large-scale programs to address the lack of energy infrastructure in Indonesia were launched by Widodo's predecessors in 2006 and 2010. They were the Fast Track Program 1 (FTP1) and Fast Track Program 2 (FTP2). By the end of 2013, the FTP1 had accomplished 63% of the planned 10,000 MW capacity and was scheduled for completion in 2015, five years after the originally planned time [60]. The FTP2 had a target capacity of 17,900 MW, and its expected completion time had shifted from 2014 to 2020 [61]. Delays related to licensing issues, land clearing, and technical difficulties with the lack of transmission lines [60]. This section explores the role of Chinese firms and institutions in these two programs, which most interviewees viewed negatively. The leader of a local business association mentioned, "Chinese companies have a bad reputation from the past. They built power plants that then broke down and lost 700 MW of capacity" (Interview2). Other studies [62,63]:187 also mention that during the first "Crash" program, plant equipment was "purchased cheaply from China and assembled quickly." While "dirty and inefficient," these served the purpose of alleviating the lack of electricity supply and diverting the energy mix away from oil fuel.

Table 1 shows the results of the combined database. The FT1 includes eighteen unique coal power plants (CPP) and three extension projects of existing coal power plants for a total of forty-two units and 9648 MW. They all have "operating" status. The FTP2 includes ten coal power plants and three plant extensions for a total of twenty-five units and 9686 MW, with mixed completion status. Jawa5 (2000 MW) and Jawa6 (2000 MW) were canceled and shelved respectively, and Kaltim FTP2 (200 MW) was open for tender in 2015, but received no interest from potential investors, leaving nine plants (5060 MW of power) that are either announced (2), obtaining permits (2), under construction (4), or operating (1). During both programs, PLN retained ownership over most of the plants, which were largely financed and built by foreign investors. During the FTP1, foreign investors were primarily from China and Japan, while during the FTP2 other countries' institutions and firms from Malaysia and Korea also participated in the investment and construction of coal power plants, drawing financing from Hong Kong and Singaporean banks. Chinese institutions were the top source of financing for coal power plants in both programs, with a much more pronounced percentage of construction contracts awarded to Chinese companies during the FTP1. While Chinese investments outnumbered Japanese ones, Japanese-linked plants were larger.

During the FTP1, all plants used subcritical technology – the least advanced and cheapest, except for two plants: Teluk Sirih that uses Circulating Fluidized Bed and Adipala power station, which uses Supercritical technology. PLN owns both plants, but Chinese banks and companies financed and built them. All plants built during the FTP2 use subcritical technology except the Tanjung Jati B power plant, which uses Ultra-supercritical technology. Japanese companies and institutions invested, financed, and built this plant with a Singaporean bank included in the financing. The adverse impacts brought by power plants built during the FTP1 included environmental issues, protests, incidents,

Table 1
Ownership, financing, and construction contracts during the FTP1 and FTP2.

	Fast Track Program 1			Fast Track Program 2		
	Ownership	Financing	Construction	Ownership	Financing	Construction
Indonesia	19.5, 8593 MW (89%)	3, 540 MW (6%)	9.5, 4056 MW (42%)	5.5, 1900 MW (38%)	1, 100 MW (2%)	3, 1500 MW (30%)
China	0.5, 110 MW (1%)	8.5, 5436 MW (56%)	11.5, 5593 MW (58%)	1.5, 500 MW (10%)	3, 700 MW (14%)	2.5, 600 MW (12%)
Japan	1, 945 MW (10%)	1.5, 320 MW (3%)	–	1, 2000 MW (40%)	0.8, 1066 MW (21%)	1, 2000 MW (40%)
Korea	–	–	–	0.5, 100 MW (2%)	0.3, 66 MW (1%)	1, 200 MW (4%)
Malaysia	–	–	–	0.5, 660 MW (13%)	–	0.5, 660 MW (13%)
HK, SNG	–		–	–	0.8, 1066 MW (21%)	–
N/A	–	8, 3362 MW (35%)			3, 2060 MW (41%)	1, MW 100 (2%)

Each country's cell shows the number of plants (not units), the combined MW, and the percentage calculated on the total MW in the program. Plants whose ownership, financing, or construction was shared among entities of different countries were equally divided.

and legal issues. All of them related to plants built by Chinese companies either alone or together with Indonesian companies. Data, therefore, supports the previous quote on the reputation of Chinese companies during this government program. During the FTP2, labour and legal issues emerged in relation to the Parit Baru power plant, jointly owned by Chinese and Indonesian companies, while an incident incurred in the Tabalong power station, a joint Indonesian-Korean investment, and an extension of the Tanjung Jati B, a Japanese investment, triggered environmental protests and legal issues.

5. Chinese firms before and after the Belt and Road Initiative

Based on the analysis in the previous section, it is crucial to make a distinction between investors and contractors-type of companies. Table 2 shows data on these types of companies dividing them according to the time they carried out coal power projects, to see if there are any changes over time. Appendix 1 shows companies that carried out construction contracts. Investments and construction contracts are considered as part of the BRI if they happened from the year 2013 onwards. While the 21st Century Maritime Silk Road was announced in November, most of the investments and construction contracts negotiated during that year became part of the Belt and Road Initiative.[1] One example is the Sulawesi Mining power plant, which is part of the Morowali Industrial Park (IMIP), a ferro-nickel mining and smelter cluster that emerged as one of the largest investments by Chinese companies in the country [64].

The data clearly shows that large companies' presence in the country started with construction contracts and developed through increasing investments. With a few exceptions, contractor companies seem to be mostly the same. While construction contracts have a stable or decreasing trend, investments rose after 2013, revealing a different pattern concerning the type of investor. Namely, aside from leading companies in the coal power sector like Shenhua, Huadian, the Power Construction Group, and CEEC, leading companies in other key investment sectors such as aluminum (i.e. China Hongqiao Group), steel, and stainless steel producers (i.e. Dingxin Group, Huadi Steel Group) are also investing in coal power plants. They are investing in what this study calls "instrumental" coal power plants - plants that do not add capacity to the national or regional grid, but rather provide electricity for the industrial complex or manufacturing plant of the firm.

Table 2
Number of projects by Chinese investors.

Investing companies		
	Before BRI	After BRI
Shanghai Electric[a]	1	1
Shenhua Group[a]	1	3
China Huadian Corporation[a]	2	3
China Electric Power Construction[b]	1	–
China Energy Engineering Corporation (CEEC, Gezouba)[a]	1	2
Power Construction Group (Sinohydro, PowerChina)[a]	1	4
China Hongqiao Group/Shandong Weiqiao[b]	–	1
Dingxin Group[b]	–	1
Huadi Steel Group[b]	–	1
China's Golden Concord Holdings (GCL-Poly)[b]	–	1

[a] SOE.
[b] Private.

A point worth noting is that interviewees perceived most of the investing companies coming from China as overly confident and boastful during business talks (Interview1; Interview8). As a result, some interviewees claimed they felt more familiar with Japanese companies, who have a much longer and established presence in the country as investors and have a more established reputation (Interview1; Interview8; Interview13). Interestingly, Soebagjo [62] also brings up this point in her analysis of the FTP1. The political and financial support by the BRI to "go outward" is one of the leading factors that galvanize Chinese companies and makes them more confident in investing. Data, in fact, clearly shows that the top investing companies are mostly SOEs, which enjoy strong government support and easier access to financing by state banks. At times, this makes collaborations with leading companies in the private sector difficult (Interview8; Interview15). A senior executive of a Hong Kong utility company explained, "Companies or entities partnering up with the Chinese SOEs need to analyze the situation rationally. These are big companies with plenty of financial resources, and they always feel that they can buy anything they need or want. If they do not have the expertise, they can buy it. If they do not have the technology, they can buy it, and in addition to that, they can perfect it, as they also have their R&D departments. Hence, because of that financial power, they do have the upper hand, and there is very little bargaining room for the other party" (Interview15). A diplomat in Hong Kong mentioned that high-level meetings usually facilitate and speed up the projects, but negotiations are usually quite complex, and the Indonesian side tends to suggest collaborations with local companies to obtain access to land (Interview14).

6. Financing and funding institutions

The data from this study shows that China is the single leading funder of coal power plants in Indonesia with USD 13.4 billion funds provided from 2000 to 2016, confirming the results of the "Power Shift" report [43]. In particular, a T-test with unequal variance showed that Chinese institutions financed a significantly higher share of coal power plants during the FTP1 and after the BRI compared to other countries (see Appendix 2 for results).

Japanese companies and institutions tend to co-finance plants with other institutions, mainly from Korea, Singapore, Hong Kong, and, in one case, a plant was co-financed with institutions from mainland China. Overall, groups of financial institutions from multiple countries in which

[1] The Maritime Silk Road (MSR) is the sea route of the Belt and Road Initiative (BRI) that includes Indonesia among other countries. This paper refers to the BRI rather than to the MSR.

Japan was one of the main funders provided USD 15 billion, whereas Japanese institutions solely financed USD 6.4 billion of coal power plants. Malaysian institutions also provided 1.6 billion of financing for coal power plants in Indonesia. Hence, one key pattern that emerges from the analysis is that Chinese financial institutions tend to finance on their own or together with Indonesian banks and institutions, while other countries engage more in co-financing with other foreign investors, a common de-risking practice.

Fig. 3 shows the source of external financing of coal power plants with active status by looking at the size of the plant in Megawatt. Both Chinese and Japanese institutions have a constant presence, with a marked increase in funding after 2013, and a sharp decrease after 2015. The data also shows that the already scarce financing from the United States and European companies, as well as international agencies such as the World Bank, decreased (these are marked as 'US, EU'). However, nine new power plant projects for 3000 MW are currently open for tender, and therefore, it is essential to monitor further changes. In 2018, most of the financing for new coal power plant projects came from Indonesia itself.

Another observation from the data is that the BRI has not changed the profile of Chinese institutions financing coal power plants (see Table 3). China Development Bank, China Exim Bank, and Bank of China played a crucial role in financing plants built during the FTP1, as data confirms they provided at least USD 4 billion in funding for a combined capacity of 5546 MW of power, as well as during the FTP2, for which they financed at least 2726 MW of power.

Looking ahead, while foreign financing is decreasing, Chinese institutions are set to continue financing most new coal power plant projects in Indonesia with a combined capacity of 5435 MW and USD 6.7 billion committed in the fourteen current projects.

7. Impacts: from technology to environmental, compliance, and societal-related issues

The last hypotheses look at the type of technology brought by Chinese investments, as well as at the environmental, social, and compliance-related issues that may arise from Chinese-invested coal power plants. In the dataset, technologies are classified into three groups, starting from the lowest, cheapest, and most environmentally damaging ones to the most advanced ones: subcritical, supercritical, and ultra-supercritical/circulating fluidized bed.

Fig. 4 shows the type of technology of the coal power plants and the country of the foreign institution that provided the funding. The figure is based on a subset of the database that covers active projects from 2008 until 2018. During this time, China invested either alone or together with Indonesian companies in at least 3019 MW of subcritical power plants (11 plants) and 2000 MW of supercritical technology (one plant), with 2790 MW (six plants) unknown due to missing data. Japanese investments, either alone or in conjunction with Korean investors accounted for most of the ultra-supercritical type of plants, whereas

Table 3
Key Chinese financing institutions of coal power plants in Indonesia.

	FTP1	FTP2	BRI (After 2013)
China Development Bank	5 (2979)	1 (1641)	8 (4969)
China Exim Bank	4 (1073)	2 (413)	2 (970)
Bank of China	5 (1397)	–	3 (2789)
China Shenhua Overseas Development and Investment	–	–	1 (972)

Data shows the number of coal power plants that each institution financed either alone or in conjunction with other institutions and the sum of funding provided in USD million in parenthesis.

investments from Malaysia brought coal power plants for a similar capacity of subcritical and supercritical technology.

Table 4 shows the results of multiple independent samples t-tests to compare the different level of technologies in plants owned by foreign investors. Results show that Chinese institutions invested in a significantly higher number of subcritical coal power plants as opposed to other foreign investors. To the contrary, Japanese companies and institutions invested in plants using the latest technologies such as ultra-supercritical and circulating fluidized bed, investing in significantly less subcritical power plants than other foreign investors do.

Table 5 shows the results on multiple independent samples t-tests to measure adverse environmental impacts voiced by either residents or NGOs, which often include concerns over impacts on communities and their livelihoods; recorded incidents related to the malfunctioning of the power plants; issues related to illegal and foreign labour; and compliance-related issues, including lack of environmental permits, land or corruption issues. Results compare all main foreign investors and show that investments from Chinese companies tend to incur in a higher number of issues related to foreign labor. One example is the Celukan Bawang power plant in Bali. According to GEM local news outlets, in December 2012, immigration officials seized the passports of 75 illegal foreign workers during an inspection [65] and in 2017, seven workers at the plant who were found without immigration documents were deported [66]. The same *t*-test performed using plants that were built by Chinese companies through construction contracts does not show any higher value of illegal labour issues.

Despite bringing more advanced technologies, Japanese investments in coal power plants (alone or in conjunction with other foreign investors) were associated with a larger number of environmental and community-related issues. The reason for this may be that being long-established, Japanese investments initially brought subcritical technology, but are now bringing ultra-supercritical by expanding the earlier power plants. There are few examples of this type of situation, whereby the cumulative adverse effects of the plant resulting from several

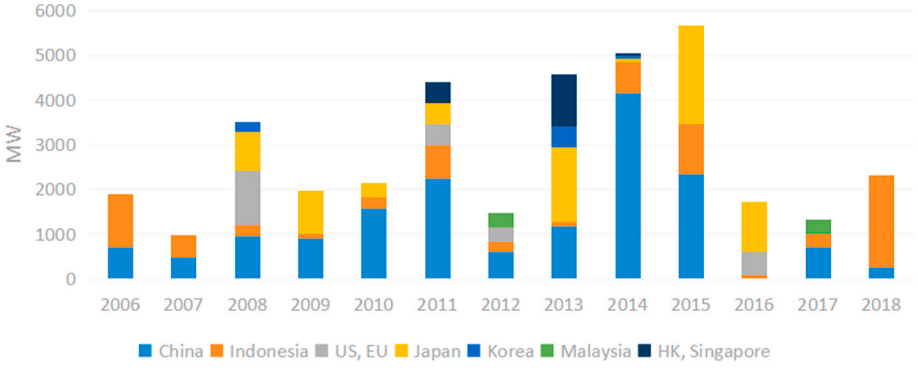

Fig. 3. Financing of coal power plants in Indonesia, by MW.

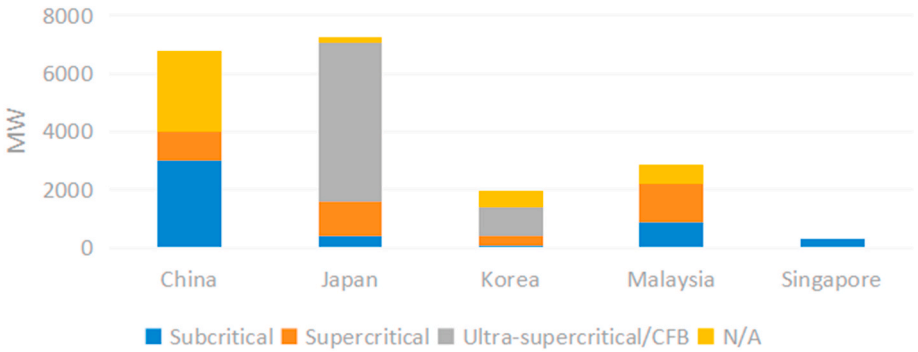

Fig. 4. Technology of foreign-invested coal power plants in Indonesia (2008-2018), by MW.

Table 4
T-tests - technology of coal power plants.

Main investor country:	China	Japan	Korea	Malaysia
Subcritical	0.94	0.31	0.40	0.50
	SD = 0.24	SD = 0.48	SD = 0.58	SD = 0.58
Mean difference	0.49***	−0.52***	−0.32	−0.21
Supercritical	0.06	0.13	0.20	0.50
	SD = 0.24	SD = 0.34	SD = 0.45	SD = 0.58
Mean difference	−0.11	0.40	0.11	0.43
Ultra-supercritical/CFB	0.00	0.56	0.40	0.00
	SD = 0.00	SD = 0.51	SD = 0.58	SD = 0.00
Mean difference	−0.10***	0.56***	0.28	−0.15***
Total cases	39	16	5	4

T-test with unequal variance was conducted on a subset of active plants from 2000 onward, excluding plants invested by Indonesia only and dropping missing data on technology. All variables take a value of zero or one. Total number of 63 units, current numbers total 64 because of a shared project between Japan and Korea * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

Table 5
Environmental, social, and compliance-related issues in foreign-invested coal power plants.

Main investor country:	China	Japan	Korea	Malaysia
Environmental & livelihood concerns	0.15	0.44	0.17	0.00
	SD = 0.36	SD = 0.51	SD = 0.41	SD = 0.00
Mean difference	−0.13	0.36***	−0.03	−0.21***
Incidents	0.00	0.11	0.33	0.00
	SD = 0.00	SD = 0.32	SD = 0.52	SD = 0.00
Mean difference	−0.14***	0.08	0.31	−0.06***
Labor issues	0.19	0.00	0.00	0.00
	SD = 0.39	SD = 0.00	SD = 0.00	SD = 0.00
Mean difference	0.10***	−0.15***	−0.13***	−0.13***
Legal issues	0.27	0.39	0.50	0.17
	SD = 0.45	SD = 0.50	SD = 0.55	SD = 0.25
Mean difference	0.01	0.15	0.25	0.12
Count	48	18	6	6

T-test with unequal variance was conducted on a subset of active plants from 2000 onward, excluding plants invested by Indonesia only and dropping missing data on technology. All variables take a value of zero or one. Total number of 77 units, current numbers total 78 because of a shared project between Japan and Korea * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

expansions have triggered strong opposition. The Paiton power complex, for instance, is the result of three main expansions and now accounts for 4950 MW of power and 80% of Hazardous and Toxic B3 waste produced annually in East Java [67]. While in this case, the technology to be added is subcritical, the similar cases of the Tanjung Jati B and the Indramayu power station upgraded their technology to either supercritical or ultra-supercritical. This is an interesting result since interviews seemed to point out plenty of issues and resistance to Chinese-invested coal power plants. Interviewees claimed that at times the surrounding communities were deceived into believing that the power plant was going to be a manufacturing plant (Interview9) and that Chinese investors often look at Indonesia as a pollution haven, and exploit the competitive bidding system to export lower types of technology (Interview9; Interview10; Interview11; Interview16). One interviewee mentioned "There are not very strict standards here in Indonesia as to how a power plant needs to be built or ran. By comparison, in China there are codes specifying down to the kind of door you need to use. The upside for investor is you have more room to play around with the CAPEX, and the downside is, the standards between different power plants can vary greatly, thus affecting the reliability of these power generators." However, data from the media reports do not show any significantly higher number of concerns when compared to other coal power plants. Finally, data show that when compared to other foreign investors, Chinese companies have invested in a significantly higher number of instrumental coal power plants (see Table 6). These are, as previously mentioned, plants that provide electricity for another investment (i.e., aluminium factory or stainless-steel production).

The above results represent some of the BRI investment in industrial parks connected to mining and smelter activities, which are sprouting all over Indonesia and, therefore, this could be an important dynamic to monitor. These plants may use less advanced technologies due to budget constraints, but also because of a problem of flexibility of technology, as remote areas may have smaller grid capacity, which may only be able to accommodate subcritical power plants. This in turn would lead to adverse environmental and social impacts. So far, data on these plants seems often unavailable, but two plants co-invested by China and Indonesia (Ketapang Smelter and Medan Steel), both use subcritical technology, showing this may be the case.

8. Discussion

When looking at the statements from the interviews and the results from the quantitative analysis, it is possible to see both overlaps and differences. Data have not always confirmed the perceptions revealed by the interviews, and at times, these denoted a somewhat distorted and negative view of Chinese investments. Hence, these statements reflect

Table 6
T-tests on the type of plants from Chinese investors.

	Main investor: China	Main investor: other	Group difference
Instrumental	0.22	0.07	0.15**
	SD = 0.42	SD = 0.26	

T-test with unequal variance was conducted on a subset of active plants from 2000 onward, excluding plants invested by Indonesia only and dropping missing data on technology. All variables take a value of zero or one. Total number of 77 units, current numbers total 78 because of a shared project between Japan and Korea * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%.

the difficult history of Chinese-Indonesian relations and the consequent anti-Chinese sentiment amongst various groups [68]

Chinese companies entered Indonesia's coal power sector via construction contracts, mostly during the FTP1 program. The recent study of Soebadjo [62] unravels the reasons why this program was so influential in shaping local business elites' perceptions of Chinese companies, which range from unfamiliarity with Chinese business models - something still relevant nowadays, to unmet deadlines, contractual expectations, and issues with service and technical support after the construction. The strong dissatisfaction from this experience led President Widodo to convey this issue directly during a visit to China in 2015 [62]:119). Interviews show that the quality of the investing and contracting companies was perceived as a cause of this issue, but data as well as other studies do not confirm this hypothesis. Soebadjo [62]:134), for instance, uses Pearson's three-tier categorization [69] of Chinese companies and, like this study's results, suggests that Chinese contractors in the FTP1 belong to the first and second tier. The Global Energy Monitor (GEM) [70] also states that Indonesia started to draw large Chinese companies' interest from the early 2000s, and high-level meetings between company executives and government officials started to pave the way for the first investments.

Recent years have shown an evident transition of Chinese companies in Indonesia from construction contracts to investments. These investments peaked after 2013, the time of the launch of the BRI, and declined after 2015, in line with the global dynamics shown in the study of Ren et al. [25]. The reasons for this decline may be multiple and need further investigation. They could include the stronger political commitment to build a "Green Belt and Road Initiative" after the Paris Agreement in 2017, the stricter control of capital outflow resulting from the Chinese government regulation, the perceived investment risk before the 2019 Presidential elections in Indonesia, or a combination of these elements. The reason for the sharp increase between 2013 and 2015, which resulted in 14 new deals for coal power plants also deserves attention. A recent report by civil society organizations and an interview with them exposed the already well-known links between the mining sector and Indonesian's economic and political elites [71]; Interview17). In particular, they highlighted links to the current government including President Widodo, Vice President Kalla, and the Coordinating Ministry of Maritime Affairs, Luhut Pandjaitan, which oversees all key negotiations of projects that are part of the BRI. These deeply entrenched local interest in mining are also resulting in more adversary relations between government and civil society organizations (Interview17; Interview18).

Despite what interviewees perceived, the profile of Chinese investors and contractors has not changed over time, except for new investments coming from leading private companies in non–energy industries. Therefore, the BRI is not changing the investor profile by bringing "first tier" companies to Indonesia, as these companies were amongst the firstcomers. Rather, thanks to the impetus generated by the Initiative, large Chinese SOEs are consolidating their presence in the country. While this study, like others [21,25,27], identified the primary role of Chinese SOEs in coal and other fossil fuel investments; it has also highlighted a new emerging trend of coal power plants owned by large private non-energy firms, which are continuing to be built until 2018 despite the overall declining trend.

The above result highlights a new important dynamic, namely, that Chinese companies are not only investing in coal power plants projects tendered by PLN, but they are also establishing power plants as part of other investments. These plants are of considerable size due to the energy-intensity of smelter activities, which are the most common activities in Chinese-led industrial parks and represent the most substantial part of Chinese FDI in Indonesia. Since there is little data available on these "instrumental" plants, there is a need to review their specific dynamics and how can local standards and regulations be adapted to avoid adverse impacts on the local environment and society.

Chinese banks financed a significantly higher amount of coal power plants both during the FTP1 and after 2013, declining in 2015 together with investments. Financing from European, American, and international institutions, which was already low before, significantly decreased in recent years. Chinese institutions, therefore, did fill the gap left by other funders without however changing their profile, as the leading financing institutions remained the same. Hence, data and is in line with the results of recent studies that show China Development Bank and China EXIM Bank as the leading financing institutions [25,50]. This study highlighted that plenty of new plants are currently open for tender, and therefore, it is essential to monitor if this decline in financing will continue. Moreover, the increase of Indonesia-financed coal power plants in 2018 may indicate that in the absence of foreign investments, the country may continue to invest in coal by accessing domestic funds.

Data showed that Chinese companies brought a significantly higher number of subcritical power plants than other foreign investors, confirming claims by Yao et al. Yao et al. [51] but going against the global trend whereby Chinese banks financed mostly supercritical plants [72]. The recent World Energy Investment report by the International Energy Agency [73] also confirms that "the majority of the 2019 final investment decisions for coal-fired plants (almost 90%) were once again in higher efficiency plants, with only a very small portion in inefficient subcritical projects, mainly in Indonesia". Japanese companies are, instead, bringing the latest technologies through their investments. This may indicate that there is a lack of oversight from the Indonesian government in enforcing stricter regulations on environmental standards and shows leniency towards the type of technology brought by new investments. The analysis of environmental, social, and compliance-related issues reported by news outlets did not show any significant results on Chinese investments. Data on recorded incidents shows plants owned by Chinese companies were associated with significantly fewer incidents, despite what claimed by the interviewees, especially concerning the FTP1, indicating a bias in perception. The analysis, therefore, suggests that the issues encountered during the FTP1, as highlighted by Soebagjo [62] most likely relate to policy, management, and monitoring mechanisms. First, the tendering process failed to guarantee the quality and capacity of selected companies to deliver the expected results, favouring mostly speed and cost of construction. Secondly, there was a lack of oversight processes to resolve logistical and maintenance issues that could have avoided costly delays.

Finally, the only issue that was unique to Chinese investments is the issue of foreign and illegal labor. This issue received plenty of negative media coverage, not only in the coal power sector but also in relation to Chinese investments and the BRI. The "Chinese invasion" as branded by local media [74] has resulted in investigations by the Indonesian government, with consequent dismissal of the claim that thousands of illegal workers entered Indonesia. However, a recent official pledge by the Chinese Premier Li Keqiang sought to prioritize the hiring of local workforce [75,76]. This pledge became essential after many commentators observed that in light of the upcoming election politics, the rising anti-China sentiment could have undermined the support for Jokowi's re-election [77–79].

9. Conclusion and policy implications

This paper examined Chinese investments in Indonesia's coal power sector, explaining how the BRI is changing them, focusing on the host country dynamics and stakeholders' perceptions towards them. The results validate and contribute to the emerging literature on the BRI's sustainability and provide insights into the barriers to energy transitions of emerging economies. The case of Indonesia reflects global and regional dynamics highlighted by recent studies, such as the sharp increase in Chinese-led investments and financing of coal power plants between 2013 and 2015 [25,42], along with concerns related to low-end technologies and labor [51]. Results also confirmed that the BRI created a strong political and financial support for Chinese State-owned companies and banks to engage in the coal power sector [25,27,50].

However, they also revealed new dynamics of private, non-energy-related companies that invest in instrumental coal power plants to supply electricity for industrial parks.

This study offered new insights that may inform future conceptualizations and methodologies to analyze the BRI as well as foreign investments in other coal-rich countries. For Indonesia, and for other emerging economies that seek to attract foreign investments to spur economic growth by increasing power generation, the BRI constitutes a vehicle to access much-needed funding and technology. Studies have insofar provided one-sided narratives that imply an active role of Chinese firms to seek and exploit investments opportunities, depicting host countries as passive and subjected to their will, lacking the institutional capacity for managing these investments [17,21]. This study shows that host countries like Indonesia indeed have bargaining power and institutional capacity. Hence, an important barrier to the sustainability of the BRI comes from their policies, policy gaps, and developmental agendas. On the one hand, Indonesia's positive attitude towards using coal was one of the main factors that contributed to the rise in investments in coal power plants. This attitude met with BRI-induced politically and economically motivated Chinese investors, which eventually led to several fast deals. On the other hand, Indonesia's loose requirements and lax enforcement on technological standards are the reason behind the variations in technology between Chinese and Japanese companies. As Soebadjo [62] highlighted, the lack of monitoring and the current tendering system favoring projects with lower costs also constitute major hindering aspects for sustainability in Indonesia's coal power sector. Hence, results from this study clearly show that the solutions to greening the BRI should come both from China, by increasing transparency and accountability of investing and financing institutions [17, 80] and from the host countries, which should strengthen the mechanisms to negotiate, tender, and monitor the quality of coal power plants.

Looking ahead, studies should continue to examine the role of Chinese investments in emerging economies to validate the convergence of the global commitment towards emission reduction set by the Paris Agreement and the intention of building a "Green Belt and Road." How to reconcile the two is an interesting dilemma that now faces most of the rising Asian countries who want to commit to global standards of sustainability while at the same time maintain high growth based on exports and foreign FDI. A possible threat is that China will export its "pollute first and fix later model" [81] of development, locking populous countries like Indonesia in fossil-dependent futures that will exacerbate social inequalities and create considerable public health challenges [82]. The question is whether China will be able to exert its influence over the private sector to drive this change and claim its role of global environmental leader. This study only provided a limited example of the BRI's effect through a "non-typical" BRI industry. It is essential to start to assess the Initiatives' environmental impacts carefully, analyzing country-specific regulations and dynamics to understand how realities can differ from visions.

Authorship statement

I declare that I am the sole author of the submitted manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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