


Pioneering a Green Belt and Road Initiative (BRI) alignment between China and other members: mapping BRI's sustainability plan

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ABSTRACT

This study is the first attempt to explore the green development alignments between China and other BRI countries. It maps and presents the green agendas practiced in BRI countries by 2017 before exploring on the ground practices of China-led physical developments in these countries. 2017 is marked as the year China pledged to promote a greener BRI. This is achieved by examining how China's green BRI agenda and infrastructure development projects were undertaken in different partner countries. By doing so, we sought to identify gaps and opportunities for pursuing green developments across and through the BRI. The findings from this study contribute to the overall debate and exploration of sustainable development of BRI.

Key words: BRI, China, green agenda, green development, partnership, sustainable development

HIGHLIGHTS

- This study is the first attempt to explore the green development alignments between China and other BRI countries.
- Maps presents the BRI countries and their green agenda.
- We identify gaps and opportunities for green development.
- The study's findings are aimed to utilise knowledge for a green BRI opportunity.

1. INTRODUCTION

Green development is one of the common pursuits across the globe in the modern time, and China has since the end of the 20th century held green and sustainable agendas for its future development, alongside the continuous endeavour for economic growth. In 2013, the Chinese government launched the Belt and Road Initiative (BRI, or B & R), known in Chinese and formerly in English as One Belt One Road or OBOR for short, which is a global infrastructure development strategy that aims to invest in 70 countries (by 2017) and international organisations. This initiative is ambitious, representing 'the largest infrastructure and development project in human history' (Hughes *et al.* 2020, p. 1), which nevertheless should be taken both positively and negatively (Ascensao *et al.* 2018; Cheshmehzangi *et al.* 2018a; Aung *et al.* 2020). From a positive perspective, it poses an opportunity for new development, economic growth, and stronger multilateral and bilateral relations. From a negative perspective, the large-scale development projects through the BRI, largely in transportation, energy, and telecommunications infrastructure, industrial capacity and technical capacity building, come significant environmental challenges (Teo *et al.* 2019). Responding to the mounting concerns and criticisms, in 2016, NRDC launched the 'Greening Belt and Road' project, aiming to support BRI's green development, to enhance China's global green leadership, to implement the Paris Agreement, and to promote UN's 2030 Sustainable Development Goals (SDGs). However, to date, the nexus between the BRI and green or sustainable development remains unclear.

Considered as a multilateralism initiative, the BRI is more than just an 'all-encompassing slogan' (Carey & Ladislav 2019), which has been boosted towards sustainable development after the first meeting of the BRI International Green Development Coalition in 2017. Such approach is also an important part of the green transitions

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of not only individual countries, but also regional economies (Cheng & Ge 2020). This strategic initiative also aims to get more connected with the 2030 agenda for sustainable development (Xue & Weng 2018; Carey & Ladislav 2019; Cheng & Ge 2020) through addressing and achieving the SDGs. Amid all international and environmental concerns, this is expected to be a unique opportunity for a new global leadership and alignment in green development. Five years from its inception, it has proven to be an opportunity that is yet to be developed further.

In many ways, China is pioneering green development by undertaking various sustainable/eco/green/low-carbon initiatives towards a sustainable development pathway. From the grand plan and policy of Ecological Civilization to more concrete eco-city, smart city, and low-carbon development project (Deng & Cheshmehzangi 2018; Xie *et al.* 2020), China has been shifting its policy paradigms and actively exploring the ways for achieving sustainable development. In addition, China also has implemented particular development initiatives with some of the BRI countries, which are particularly encouraged since 2017. This occurred after China committed to include a sustainable development plan in the BRI initiative and partnerships. In this paper, we will explore these developments with a focus on physical constructions, such as housing, infrastructure, road development, etc. These projects may not necessarily be 'green' or 'sustainable', but often adopt some of China's own green development strategies. We seek to examine these projects to understand whether and how China plays a role in developing its partner BRI countries' green agenda. By doing so, we also highlight the gaps and possibilities of such development projects that are led, invested by, or contracted by China.

Although many studies have explored the topic of BRI and more are emerging as new development projects are increasing, none has looked at the mapping of the bilateral relations and specifically for green and sustainable development. Prior to the establishment of BRI as a global initiative, China already launched several new initiatives, roadmaps, and blueprints that suggested sustainable development plans at a large scale. Some examples include the earlier 'Made in China 2025' and 'Internet Plus' initiatives that suggest pathways to the next production revolution, green manufacture, digital technologies, and the establishment of new development modes (Linster & Yang 2018). The BRI, however, became the enabling mechanism to go beyond China's physical borders and provide a more global approach to development and economic growth. The shared prosperity approach gained the interests of many countries of not only the developing nations, but also those of developed countries in the West. This major initiative also coincides with China's own plan towards a green economy (Weng *et al.* 2015), which started with a much earlier learning phase for gathering knowledge, towards the later experimentation and the final exportation phase (Cheshmehzangi *et al.* 2018b). As part of this procedural approach, many initiatives were development on green low-carbon development (Ohshita *et al.* 2017), smart development (Tan-Mullins *et al.* 2017), green development, etc.

1.1. BRI: an overview

Covering nearly 71 countries (70 + 1, including China) in multiple continents till 2017, the BRI currently encompasses over 4.8 billion people, or 63% of the global population. The combined primary energy use across BRI countries accounts for 50.8% of global energy consumption, and BRI countries are responsible for 41.1% of global oil consumption, 47.1% of global natural gas consumption, and 72.7% of global coal consumption (UNFCCC 2017; The World Bank 2018). As of January 2021, the number of BRI countries that have signed a Memorandum of Understanding (MoU) with China has been doubled, reaching 140. This shows the increasing popularity through either official partnership or a mode of cooperation agreement under the BRI. More importantly, the BRI has so far developed several infrastructure corridors that include 60 countries in multiple regions, mostly in Asia, Europe, Oceania, and East Africa. Examples of these are land corridors such as the new Eurasian Land Bridge, the China–Mongolia–Russia Corridor, the China–Central Asia–West Asia Corridor, the China–Indochina Peninsula Corridor, and the China–Pakistan Economic Corridor (CPEC). There are also signs of the growing Silk Road Economic Belt as well as the contiguous Maritime Silk Road in several areas, such as the South China Sea, the South Pacific Ocean, and the wider Indian Ocean (Liu 2014). There are tangible benefits in particular regions such as in ASEAN countries, East Africa, Central Asia, and Eastern Europe, which also show how progressive BRI has been in the past decade. Therefore, whether or not the BRI is green will be critical to the global efforts to tackle pressing environmental problems, address climate change, and to achieve the UN's SDGs. Meanwhile, there is also a large opportunity and dire need for green development and low-carbon energy and technology cooperation between China and BRI countries (UNFCCC 2017). This potentially puts the BRI at the forefront of green development and green economy initiatives.

The BRI has grown significantly in various areas, including multiple partnerships, enhanced economic trade cooperation, non-financial direct investment, cooperative deals, contracting projects, technology transfer, infrastructure construction, financial cooperation, and cultural exchange projects (Fallon 2015; Zhao 2015; Clarke 2016; Huang 2016; Li 2016). The thriving BRI also demonstrates the rapid development of China's multilateral approach to international diplomacy and foreign policy (Liu *et al.* 2014; Asian Infrastructure Investment Bank 2019; Tambo *et al.* 2019). Under the overarching idea of 'shared prosperity', this growing initiative aims for common development and win-win cooperation, strengthening China's rapidly developing multifaceted global cooperation and participation (Tambo *et al.* 2019). This also means a greater opportunity for 'trade and investment prospects via greater connectivity in the sea and land links' (Tambo *et al.* 2019, p. 47). These developing cooperation and participation are not specified in particular sectors or regions. This major initiative is phrased as 'inclusive globalisation' (Liu & Dunford 2016), which enables the opportunities to speed up the process of new or much-enhanced partnerships and collaborations.

According to the 'Belt and Road Action Plan' released in spring 2015 (Belt and Road Action Plan ('一带一路'规划 双语全文) 2015), China states that 'efforts should be made to promote green and low-carbon infrastructure construction and operation management, taking into full account the impact of climate change on the construction'. (Note: The Vision and Proposed Actions outlined on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road were issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and the Ministry of Commerce of the People's Republic of China, with State Council authorisation, in March 2015.) Furthermore, a report produced by the Chinese Academy of Social Sciences (CASS) highlighted the BRI as an opportunity for China to help developing countries improve their environmental institutional capacity and called on the country to carry out environmental impact assessments at the policy, strategy, and planning phases (Zhang 2016; Aung *et al.* 2020). Meanwhile, it is stated that with shared visions and interests in promoting green and low-carbon development, the BRI is closely aligned with the 2030 Agenda for Sustainable Development that echoes the SDGs (Cao & Gong 2016; Feng *et al.* 2019). While there is a common belief that the BRI will play a determining role in shaping the sustainability of global development, particularly among emerging economies (Pike 2017; Zhai 2018), whether or not the green BRI will be achieved depends heavily on how China and Chinese enterprises approach the Belt and Road Initiative. Thus, how China can help to coordinate development efforts towards bilateral mutual-cooperation that jointly strives towards the path of sustainable development deserves further exploration and discussion.

The latest BRI members (recorded in 2017 and then until the end of 2018) are classified into two categories of regional and non-regional. The regional members are mostly the ones in the context of Asia, Australia, and Oceania; a large context that includes most of the Asian countries as well as the one part of the Asian and Pacific region. The non-regional partners are the ones outside the regional context, including members from Africa, America (North, South, and Central), and Europe. Also, each of these two categories is divided into two sub-categories of members and prospective members. The latter are the countries that have an interest in joining the BRI group but are not yet members. Currently, there are three visible gaps in the regions of Africa, Central and North America, and Eastern Europe, where fewer BRI members are included. The figure below demonstrates this categorisation accordingly.

Based on the current scholarly work relating 'sustainability' and the 'BRI', we see a growing argument around the emergence of new forms of international and cross-industry collaboration that address the overarching ideals of sustainable growth and development (Cheshmehzangi *et al.* 2018a). This has been questioned broadly from the Chinese outward foreign direct investment, both in general (Du & Zhang 2018; Yu *et al.* 2019) and in specific regions (Ma *et al.* 2019). The existing studies also highlight the environmental impacts of sustainable development (Teo *et al.* 2019), challenges of energy and ecological sustainability, or project-based examples of sustainable development (Duan *et al.* 2018; Benintendi *et al.* 2020). Some of these studies also explore BRI sustainable plans of country-level development and support (Cheshmehzangi *et al.* 2018a) as well as those of sustainable regional development approaches (Khan *et al.* 2018). But so far, none of the BRI studies have mapped the BRI sustainability plan from the perspective of developing and pioneering a green BRI between China and other members. This study addresses this research gap and aims to provide a holistic overview of BRI sustainability studies. It is anticipated with the growing number of research in the field. This study could help to establish more specific project-based or sector-based analysis of sustainability assessment and alignment between China and other BRI members.

1.2. Study's aims and objectives

Existing studies have explored many topics related to the sustainability of BRI such as the compatibilities between China and other BRI countries (Aung *et al.* 2020), the convergence of energy intensity in BRI countries (Qi *et al.* 2019), the nexus between economic indicators and environmental quality in the BRI (Rauf *et al.* 2020), and the framework for constructing the green BRI (Cheng & Ge 2020). While the BRI has already encouraged more 'bilateral cooperation and strategic relationships among the nations' (Rauf *et al.* 2020, p. 1), it has also provided a chance to develop from a global strategy into a green strategy and in line with the SDGs. In this study, we aim to map the green development initiatives jointly promoted by China and other BRI partners. The study includes the mapping of both regional and non-regional BRI partners, mainly to highlight where these projects are taken place in the different regions, and in what modes these projects are initiated or conducted. In doing so, this study highlights the nexus between sustainable development and the BRI, through which a detailed assessment would then be required to elaborate on the potential future directions.

Furthermore, this mapping study is proposed to identify: (i) current partnerships on specific fields of development and relations; (ii) gaps in green development engagement of China in or with other BRI members; and (iii) opportunities for the future progress of green development alignments between China and other BRI members. By identifying these, we are able to explore the position and influence of BRI on sustainable development through the developed and developing bilateral relations between China and other BRI countries. The findings would then contribute to research on green transitions, green investment, sustainable development modes, and dependency on collaborative green development opportunities. The findings apprise the readers of the existing development trends and what could be accomplished through the many projects of the BRI.

The following sections of the study are structured based on the overall narrative of the study, starting with methodology and research study in three stages, findings from them, and discussions on BRI and sustainable development. Finally, this study completes with contributions of the study and conclusions in the field of BRI and sustainable development.

2. METHODOLOGY

The primary method of this study is a mapping exercise, but not like a review study. This mapping study differs from those review-oriented mapping approaches, but instead seeks to identify linkages from published items and other media sources. This study's mapping approach explicitly conducts a question-guided mapping/search approach (see PJP-EU 2014, as an example), which entails three main questions. The first question is 'Whether or not the BRI country has been collaborated with China on promoting green development?'. By answering this question, the study approaches original data and online search from both Google and Baidu, one international and one Chinese search engines. The second question is 'What are the main themes (e.g., Eco, low-carbon, smart, or resilient development) of the green development initiatives between China and BRI countries?'. This approach helps us to mainly focus on the linkages between China and BRI partners (see Figure 1), based on their green development agenda and collaboration (see Supplementary Material, Files A and B). The third question is 'What are the features (e.g., government-led or non-government-led) of existing collaborative projects on green development?'. This mapping search stage specifically explores the collaborations that are verified through published materials and other studies in other media. In doing so, the study is divided into three stages; in each stage, the findings demonstrate explicit results of China and BRI partners' collaborations on green development projects.

The study is conducted through a multi-stage data mining method, mainly through desktop research and evaluation. This question-guided mapping approach is done through three consecutive stages: (1) general question-guided mapping of BRI partnerships with China; (2) question-guided mapping approach to identify initiatives associated with the green development agenda or equivalent; and (3) specific question-guided mapping approach of partnership types with typical examples (Figure 2). For the first stage, the question-guided mapping approach includes a general mapping exercise, including both regional and non-regional BRI partners. In this data mining exercise, collaboration between China and BRI partners in sustainability-related projects or programmes are included. In the second stage of mapping exercise, projects were identified from a search of keywords, including 'eco', 'green', 'smart', 'intelligent', 'resilient', and 'low carbon', as these keywords are related to the theme of sustainable or green development and are identified under the key sustainability agenda of China. In this stage, each country is assessed based on its agenda from the specified keywords. This is conducted through the country

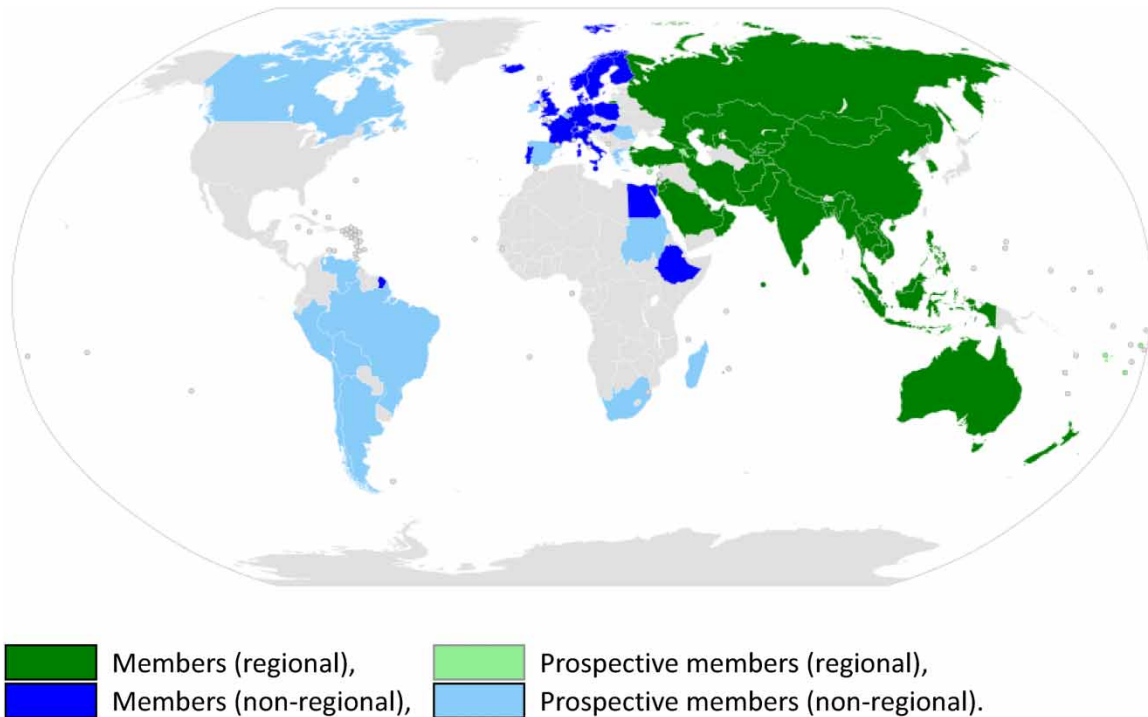


Figure 1 | Members of BRI (source: adapted from the Asian Infrastructure Investment Bank, Created: 25 July 2015, accessed 15 March 2018).

search on two main search engines (i.e., ‘Google’, as a major international search engine, and ‘Baidu’ as a major Chinese search engine) by using the words and the country name together, e.g., [*Thailand+Smart*]. A secondary study is also done for the validation of the results. This is conducted by checking the extracted data through official websites of individual countries. This dataset is then utilised for further assessment of the regional and non-regional initiatives and projects (see Supplementary Material, Files A and B). In doing so, the study determines different types of development projects as well as the individual country’s agenda on sustainable development. By conducting a country-based search, this study highlights the existing trends of collaborative projects between China and individual countries, gaps in collaborative projects in green and sustainable development, and opportunities for future consideration. In the final stage, the partnerships are identified as ‘state partnerships’ or ‘non-state partnership’ (i.e., through enterprises). In this stage, the study provides a project search exercise for those specified countries in stages 1 and 2. All details are included in the two supplementary files as the main references.

Through this multi-stage question-guided mapping study, as shown in [Figure 2](#), this project provides an overview of the green development projects and partnerships along the BRI. Findings could shed light on the role of sustainable and green development in established partnerships.

3. FINDINGS

This mapping study generates two sets of findings, statistical and non-statistical. This enables us to have a better overview of the current status of BRI partnerships and collaborations and is particularly associated with green development projects and initiatives that are made or not made between China and other BRI members ([Figure 3](#)).

As shown in [Figure 3](#), the majority of countries have their own green development agenda. In some cases, we verify that some countries had their green development agenda established earlier than China’s agenda and BRI partnerships. Some examples include the EU states and Latin American countries as non-regional partners, and some of the regional BRI partners, such as South Korea, Singapore, Russia, Iran, and the UAE. In the following two sub-sections, the data are assessed both statistically and non-statistically. These are evaluated based on the combined stages of mappings, comprised of country mapping, initiative mapping, and project mapping. These mapping stages are purposely put together to highlight the correlation between individual country agenda,

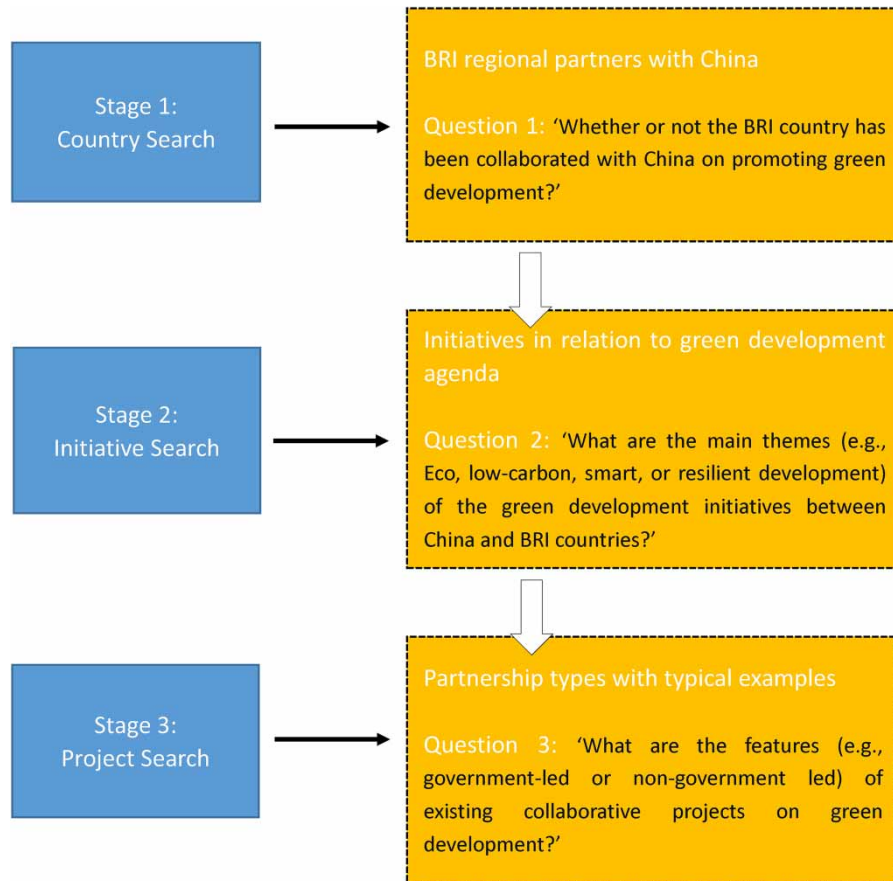


Figure 2 | The multi-stage mapping studies based on country mapping, initiative mapping, and project mapping – source: authors’ own.

established collaborations and partnerships with China on sustainable development, and examples of projects under these initiatives.

3.1. Statistical findings

Based on the survey mapping studies of partnerships between China and other BRI countries, the data indicate the following findings for all four country categories (Figure 4):

Regional (members):



Figure 3 | BRI member countries (excluding China) with/without green development agendas.

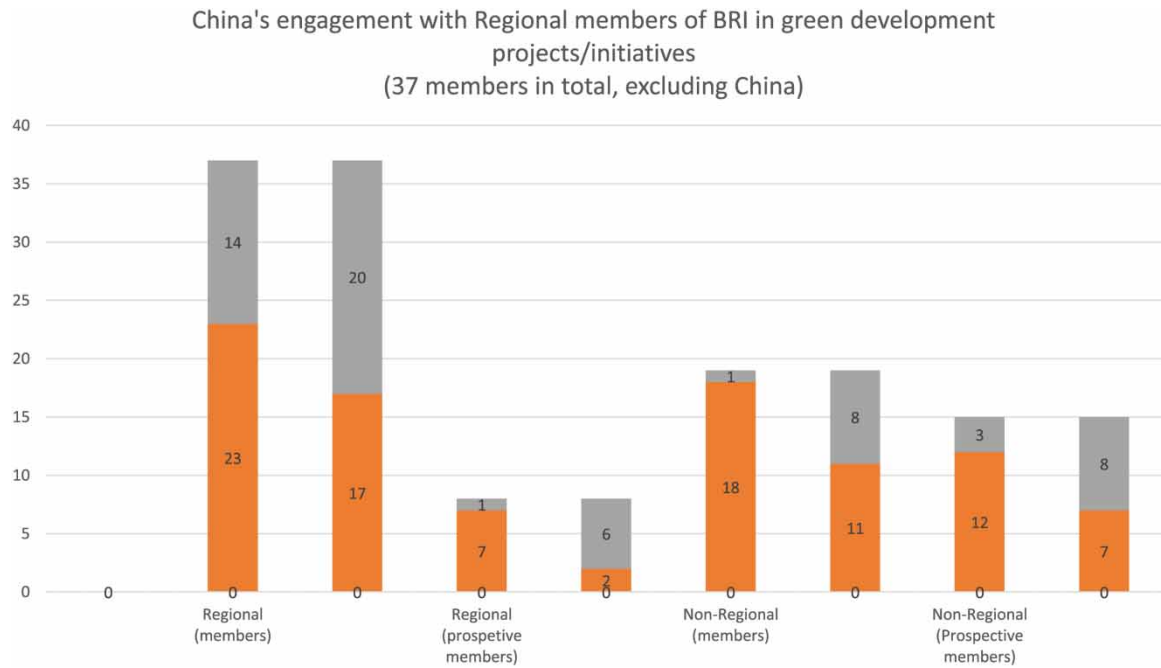


Figure 4 | Chinese governmental partnership engagement with different BRI countries in green development projects – source: authors' own.

A total of 37 countries (excluding China) are regional members of the BRI. Six of these countries do not have any agenda on green/eco-development. The other 31 countries have these agenda, and mostly in the areas of smart city and eco/green city, which are similar to the ones in China. Out of the 37, the data indicate that 23 countries are collaborating with China's direct state engagement, and 17 countries with the engagement of non-state enterprises from China. These engagements are mapped across pollution treatment projects, smart city labs, waste water treatment, and in sectors of energy and environmental infrastructures. Projects on water treatment are mostly concentrated in the Southeast (SE) Asian region.

Regional (prospective members):

A total of eight countries/regions are in this category of BRI countries/members, which also include Hong Kong SAR as one of the prospective members. Two of these members, i.e., Bahrain and Tonga, have no green/eco-development agenda of their own, where China has engagement of related projects, such as the water/sewage treatment project in Bahrain, and the solar energy system project of Tonga. With an exception of Samoa, the Chinese state has direct engagement on projects with all other seven members. However, the majority of the members, i.e., six out of eight have no trace of China's non-state engagement in their projects on green development.

Non-regional (members):

A total of 19 countries are non-regional members of the BRI (mostly European states). All of these countries have their own agenda on green/eco-development. Apart from Norway, 18 out of the total of 19 countries appear to have Chinese state engagement in green development projects or initiatives. Some of these projects could be identified as knowledge transfer projects between those BRI members and China (e.g., the projects may be located in China). Also there is non-state engagement of Chinese enterprises that accounts for 11 of those BRI non-regional members. Most of these projects are in the sectors of new energy, clean energy, and environmental science and technology.

Non-regional (prospective members):

Out of 15 non-regional prospective members of BRI, only Sudan and Bolivia do not have their own green development agenda. The remaining 13 nations have their own green development agenda. Out of 15, China has governmental engagement with 12 of these non-regional prospective members. But only seven of these nations involve in non-state engagement with China, with the remaining eight having this area of cooperation unexploited. Most of these projects are within the sectors of clean technology (such as pollution treatment), green technology, environmental, and bioremediation.

3.2. Non-statistical findings

As part of our survey mapping studies, we have also identified the variety of categories of the partnerships between China and other BRI countries in the main sector of green development. Some of these are explored as the main realms of China's exports of knowledge and technology, particularly in countries of the global south, such as in South and Southeast Asia, as well as African and Latin American countries. Also, for the case of the European members of non-regional members, we can identify the export of knowledge and technology to China (Cheshmehzangi *et al.* 2018b). These are, in particular, related to the projects/initiatives on smart/digital agenda, eco-development (in the form of eco-cities and eco-districts), low-carbon development, and sustainable development projects. Most of these projects are done through bilateral agreements with Chinese enterprises or state-owned companies and those of the other counterparts. Some of the earlier projects were with ASEAN countries, as promoted by China's BRI green and low-carbon agenda. Other major partnerships are related to China-Africa Environmental Cooperation Center, achieving the 2030 SDGs, and BRI international green development coalition (CCICED 2019). In their report, CCICED (2019) has highlighted the use of 'greenization' strategy for green development, promoting environmental sustainability agenda, and a cross-sectoral approach to greening the BRI through a leadership platform and improving the environmental policy.

Meanwhile, as many countries have their own green initiatives but currently have no connection with China; future potential for Chinese enterprises is significant. This is particularly seen in the data for regional members and regional prospective members – within the reach of China's closer engagement, project opportunities are booming. An example of these is regional development initiatives that are booming in Southeast Asia and Central Asia (i.e., in countries of ASEAN region, Kazakhstan, Afghanistan, Tajikistan, etc.) and in African, Middle Eastern, and South Asian regions (mainly Pakistan and Sri Lanka). For instance, in Indonesia, there are four major regional development projects in four regions of North Sumatra, North Kalimantan, North Sulawesi, and Bali. Also in countries like Malaysia, we see a range of projects from airport, expressway and port development, to joint industrial park projects, forest city projects, and high-speed rail development. Similarly in Thailand, we see major projects and/or initiatives on smart electronics, agricultural and biotechnology, tourism, technology and innovation such as digital development, and major infrastructural projects between major airports and seaports, highways and motorway, and digital infrastructure. In the same region, other larger-scale projects are the development of economic corridor in Myanmar, seaport connections in Vietnam, and physical infrastructure development in the Philippines (HKUST IEMS 2021). The current situation of such partnerships and development projects also indicates that the actual alignment between BRI countries and China on the green agenda is not as obvious as it should be. Some of these collaborations are made before the establishment of BRI. But our study here mainly highlights the current status, gaps, and possibilities of such opportunities of bilateral cooperation on green development. It is likely that some of the earlier projects were then recognised as part of the BRI projects, or some that may have started differently have transformed into a sustainable development model of collaboration.

4. DISCUSSION: BRI AND SUSTAINABLE DEVELOPMENTS

The findings in the previous section highlight the role China plays through bilateral partnerships on green or sustainable development of other BRI country partners/members. Yet, these partnership mechanisms are not only defined within the boundary of bilateral trading partnerships but also to sustain 'a geopolitical solidity and shared future' (Ho 2017). This approach, therefore, boosts many resolutions and initiatives, such as sharing technologies, economic progression, training of human resources, policy coordination, free trade, financial integration, and infrastructural connectivity (Rauf *et al.* 2020). The latter on infrastructural connectivity puts huge pressure on the environmental sustainability of those projects and yet suggests prosperity from economic and socio-cultural opportunities in specific regions. This is particularly evidenced in the BRI's plan for investment, with two-thirds of the funds deployed to emerging and developing nations (IEA 2014; Rauf *et al.* 2020), which are then used mostly for the infrastructural development of various types. The earlier data indicate over 7,000 project schemes for such infrastructural development projects, mostly focused on poverty alleviation, economic growth, and strategic collaboration (Laurance 2018). These are expected to also boost the regional development and nurture what can be described as the 'sustainable economic development'. Will this be under the category of green development? The answer is not yet. But will this be under the category of sustainable development? The answer is yes, from economic development and regional development opportunities. As the environmental sustainability

and green development are interlinked, we anticipate seeing the transition towards green development in the next decade and before the end of 2030 UN Agenda.

Following the extracted data from this analysis, the main question remains on whether we are foreseeing a green BRI or not? The answer is threefold: (a) green agenda has been increasingly rising in China and other BRI countries, (b) there is a growing demand for green development in emerging economies, and those countries are working closely with China to make green development into reality in a gradual pace, and (c) in developing countries, the focus remains on economic development plans before green development could be seen in a transitional process. This means that the focus has been gradually shifting, from the initial economic development agenda to an increasing emphasis on green development agenda that came after the birth of the SDGs in 2015 and China's pledge to promoting a greener BRI in 2017. The existing literature demonstrates little exploration of issues of innovation in specific sectors (Editorial 2019), and those that lead to greening policies, practices, and interventions (Sinayi & Rasti-Barzoki 2018). This is also discussed by Niu *et al.* (2019) through the assessment of relationships between Chinese firms and consideration of sustainability. Through this assessment, there can be win-win solutions in some regions where Chinese firms are active and influential. The example of the Southeast Asian region suggests a similar trend that is focused mostly on regional economic development, infrastructural development, and regional connectivity. Connecting south of China, particularly Yunnan province, to those neighbouring countries in the Association of Southeast Asian Nations (ASEAN) region, suggests this fact from the perspective of regional and infrastructural developments. Major infrastructural development projects that include railway development, road construction, etc., are part of such regional projects.

Furthermore, we see an opportunity for green transitions. This is evidenced through the combination of policy development and an increase of awareness, which are mainly seen in the recent stages of the BRI progression. These are highlighted by (Rauf *et al.* 2020, p. 2) as the stage that policy architects familiarise with '*environmentally convivial strategies such as renewable energy sources, awareness about green investments, carbon taxes, industrialized handling plants, power-efficient technologies, and transportation to curb the level of GHG emissions (CO₂)*'. In return, we expect to see more investment in green energy, green innovation, and green developments. Such approaches could advance financial development and lead to the deployment of new '*financial funds for green environmental sustainability schemes*' (ibid, p. 12), new policy development, and higher-level benchmark for sustainable development opportunities. Therefore, we are yet to know if the BRI's sustainability plan is an Illusion or a Reality. Nevertheless, this study sheds light on this important factor by identifying the gaps, opportunities, current practices of collaboration and partnership, and multi-stage mapping of partner countries, initiatives, and projects.

The collated data from this multi-mapping survey study indicate an array of gaps and opportunities for green development alignments between China and other BRI countries. While China has focused, in recent years, on extending the partnerships in the region and beyond, it appears that some of the projects have already initiated in the form of bilateral agreements and through knowledge transfer platforms. These initiatives support the ideas of green development investment (Rauf *et al.* 2020) and green transitions (Cheng & Ge 2020) for both China and specific regional development strategies. For instance, empirical data of the recent study, conducted by Rauf *et al.* (2020), demonstrate that '*energy consumption, high-tech industry, and economic growth deteriorate environmental quality but financial development and renewable energy consumption have a favorable effect for the environment*'. Hence, on one hand, we see increasing collaboration between China and BRI partners in the latter category in the context of China. On the other hand, we see the physical development of various sorts in developing countries with China's direct investment, such as road development, railway development, port development, new zone development, and high-tech industry development. Furthermore, China's own focus on multiple streams of green development agenda, namely 'smart' (or intelligent/digital), 'eco', 'green', 'low carbon', and 'resilient', enables the involvement of many sectors and stakeholders in various aspects of each initiative. Also, this enables China to find more channels to build partnerships with other BRI members. The collaboration is seen to be mutual, as developing countries also directly or indirectly invest in various sustainable development projects in China. Examples include resilient/sponge city projects, eco-development projects (Deng & Cheshmehzangi 2018), smart city communities and cities/districts, low-carbon development, etc. Some specific projects are the Sino-Singaporean Tianjin Eco-City project in North China, green transport innovation project in Shenzhen, the sponge city initiative in pilot city projects such as those with the UK and the US firms, smart and digital infrastructure developments in many cities, and other national flagship projects in China.

Nonetheless, some recent political tensions have led to halting some of the earlier mutual infrastructure agreements, such as the one with Australia in 2021.

It is noteworthy that arguing the lack of partnership on specific green development initiatives does not imply a lack of engagement in China with those identified countries. It could simply mean that those countries have a different take in those areas, through different partnerships with others, or through their local initiatives. In fewer cases, we can see the absence of green development agenda in some of the countries (such as in Bahrain and Tonga). However, findings have shown that China have engagement in those countries through other means, such as water treatment projects with Bahrain (e.g., Jinluo Water Project), and the renewable energy system project with Tonga (e.g., Xingye Solar and Tonga Power Limited). In another example, for low-to-mid-income developing countries, where economic growth is still the priority, there is still room for green development initiatives to progress. Yet, some of these projects also form regional development projects that could strengthen not only the economic growth of those regions but also their social and cultural attributes. For those, if environmental factors are not prioritised, then the focus would remain on economic factors. Thus, they present a unique opportunity to shift towards models of the green economy, circular economy, or sustainable development.

As part of the BRI, most of the current gaps are between China-African and China-Latin American (including both South and Central American states) contexts. While China's presence in Africa is booming in recent years and many projects have already included green development initiatives, most of the African nations are not yet included in the BRI membership categories. A similar situation is with the Latin American nations, where China's cooperation is steadily growing, too. Nevertheless, China's engagements or partnerships with both African and Latin American countries are still quite different from the ones with the regional countries, particularly in Asia. These gaps are mostly affected by the major factor of 'distance', but are also associated with cultural and historical relations that are beyond the current trades and partnerships of the last few decades. Also partly, these gaps relate to the nature of projects that are on-going in those non-BRI countries. Our data also indicate that there remains a great opportunity for non-state Chinese enterprises and their engagement with other BRI members. In the regional context, we found this gap particularly in the regions of Central Asia and the Middle East. This is yet to be exploited, depending on modes on investment and cooperation that may emerge from bilateral or even regional partnerships. More specifically, this will be related to larger-scale projects of infrastructural development, which are expected to remain as in the form state partnership.

While this study highlighted the main gaps in green development alignments between China and other BRI country members, there remain great potentials for sector-specific collaborations and cooperation between the two sides. As mentioned earlier, this will also become more visible in future scholarly research. With the growing global agenda on green development, and the recognition of global initiatives/plans such as the SDGs, and climate change action plans, we can see the emerging role of the BRI more imperative in the forthcoming years. This is also seen in more recent scholarly research that suggests the integration of SDGs into the BRI (Feng *et al.* 2019) or how it could develop into a form of sector-based (Yu *et al.* 2019), trade-based (Benintendi *et al.* 2020), project-based (Li *et al.* 2019), partnership-based (Alimov 2018; Li 2018), infrastructure-based (Teo *et al.* 2019; Yang *et al.* 2020), and region-based (Szadziwski 2020). It is proven that the research trend in the nexus between BRI and sustainability addresses the importance of this initiative at the global level. This indicates global attention as well as growing concern about BRI projects or regional development studies. With a positive take from these studies, we conclude with the ideals of the BRI and sustainability plan. This has been demonstrated through both statistical and non-statistical assessments of this study and will contribute to the future research work in this field of study. It is expected this study could mark the importance of BRI sustainability-related studies that are expected to focus on specific sectors, trades, projects, partnerships, and regions. Finally, if China is to take a more visible global leadership role in green development initiatives and climate change plans, as it appears to be so, the BRI will be a major platform for China to build on such initiatives, plans, and global directions.

5. CONCLUSIONS

This paper contributes to the emerging studies on the nexus between BRI and sustainability. It presents a multi-stage mapping of BRI countries' green agendas as well as their various initiatives, projects and partnerships and seeks to explore the potentials for greening the BRI. After the announcement of China's 14th Five-Year Plan and China's climate ambitions to carbon neutrality plan (Green BRI 2021), China has set up a new platform on 'Green Belt and Road Initiative Center', which directly focuses on green finance and helping the sustainability

KPIs and targets. Earlier on, as demonstrated in the official reports by the Chinese Government (2017), the attempt to green the BRI has developed significantly. This has been prioritised since 2017, which is aimed to promote eco-friendly infrastructure construction, green trade, green investment, green financing, sustainable modes of production and consumption, and increased cooperation between China and the country partners or regions (Chinese Government 2017). These aspects are all important in implementing and achieving green development in a transition. Hence, we expect to see more research on the topic of ‘Green BRI’ that would address issues of policy development, project-based approaches, green transition, green technologies, etc. This is likely to first develop more on the discourse of BRI construction and global sustainable development from the existing normative research on energy and environment (Zhang & Zhang 2018), cleaner production and energy efficiency (Qi *et al.* 2019), policy arrangements (Ascensao *et al.* 2018; Alkon *et al.* 2019), cooperation and coordination on environmental policies and regulations (Ministry of Ecology & Environment 2017), and in association with the SDGs (Cheng & Ge 2020). These will remain as the continuing trends of research as there would be more criticism on on-going and previous development projects and country-level initiatives, and there will be more reflective assessment of those that could promote green development either through bilateral relations or regional development mechanisms.

It is expected that a green BRI would become even more important to BRI countries, as we anticipate a shift towards low-carbon economies. This is expected based on the increasing number of specific research on individual projects, and in-depth assessment of cooperation between China and individual countries. With the many already developed partnerships, and some at the early stages, it is likely that the BRI could actually become an influencing mechanism for the promotion of green development, green policy coordination, and green transition. Research in this regard is thus of significant importance.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

REFERENCES

- Alimov, R. 2018 *The Shanghai Cooperation Organisation: its role and place in the development of Eurasia*. *Journal of Eurasian Studies* 9 (2), 114–124.
- Alkon, M., He, X. G., Paris, A. R., Liao, W., Hodson, T., Wanders, N. & Wang, Y. 2019 *Water security implications of coal-fired power plants financed through China’s Belt and Road initiative*. *Energy Policy* 132, 1101–1109.
- Ascensao, F., Fahrig, L., Clevenger, A. P., Corlett, R. T., Jaeger, J. A. G., Laurence, W. F. & Pereira, H. M. 2018 *Environmental challenges for the belt and road initiative*. *Nature Sustainability* 1 (5), 206–209.
- Asian Infrastructure Investment Bank (AIIB). 2019 *Environmental and Social Framework*. AIIB Website. Available from: <https://www.aiib.org/en/policies-strategies/framework-agreements/environmental-social-framework.html> (accessed 20 January 2020).
- Aung, T. S., Fischer, T. B. & Shengji, L. 2020 *Evaluating environmental impact assessment (EIA) in the countries along the belt and road initiatives: system effectiveness and the compatibility with the Chinese Eia*. *Environmental Impact Assessment Review* 81, Article 106361.
- Belt and Road Action Plan (‘一带一路’规划 (双语全文)). 2015 Available from: http://language.chinadaily.com.cn/2015-03/30/content_19950951.htm (accessed 21 March 2018).
- Benintendi, R., Gómez, E. M., De Mare, G., Nesticò, A. & Balsamo, G. 2020 *Energy, environment and sustainable development of the belt and road initiative: the Chinese scenario and Western contributions*. *Sustainable Futures* 2, 100009.
- Cao, H. & Gong, T. 2016 *Building a Shared Vision for the Belt and Road Initiative and the Sustainable Development Goals*. Scoping Paper II for 2016 High-level Policy Forum on Global Governance ‘Belt and Road’: A New Path to Regional Development. UNDP.
- Carey, L. & Ladislav, S. 2019 *Chinese Multilateralism and the Promise of a Green Belt and Road*, CSIS Briefs, 5 Nov 2019, Available from: <https://www.csis.org/analysis/chinese-multilateralism-and-promise-green-belt-and-road> (accessed 11 February 2020).
- CCICED (China Council for International Cooperation on Environment and Development). 2019 *Green Belt and Road Initiative (BRI) and 2030 SDGs: Special Policy Study Report*. Published in May 2019, 31 pages report. Available from: <http://www.cciced.net/cciceden/POLICY/rr/prr/2019/201908/P020190830114510806593.pdf>.
- Cheng, C. & Ge, C. 2020 *Green development assessment for countries along the belt and road*. *Journal of Environmental Management* 263, 110344.
- Cheshmehzangi, A., Xie, L. & Tan-Mullins, M. 2018a *Green Development Alignments between China and other BRI countries*. In: *Presented in the 7th EU-China Workshop*, April 2018, Astana, Kazakhstan.

- Cheshmehzangi, A., Xie, L. & Tan-Mullins, M. 2018b The role of international actors in low-carbon transitions of Shenzhen's International Low Carbon City in China. *Cities* **74**, 64–74.
- Chinese Government. 2017 *Guiding Opinions on Promoting the Construction of Green Belt and Road Initiative* <<关于推进绿色'一带一路'建设的指导意见>>. Available from: <https://www.yidaiyilu.gov.cn/wcm.files/upload/CMSydylgw/201705/201705080205025.pdf> (accessed 20 March 2018).
- Clarke, M. 2016 Beijing's March West: opportunities and challenges for China's Eurasian Pivot. *Orbis* **60** (2), 296–313.
- Deng, W. & Cheshmehzangi, A. 2018 *Eco-Development in China: Cities, Communities, and Buildings*. Palgrave Macmillan, Singapore.
- Du, J. & Zhang, Y. 2018 Does one belt one road initiative promote Chinese overseas direct investment?. *China Economic Review* **47**, 189–205.
- Duan, F., Ji, Q., Liu, B.-Y. & Fan, Y. 2018 Energy investment risk assessment for nations along China's Belt & Road Initiative. *Journal of Cleaner Production* **170**, 535–547.
- Editorial. 2019 Logistics and supply chain innovation in the context of the Belt and Road Initiative (BRI). *Transportation Research Part E* **132**, 51–56.
- Fallon, T. 2015 The new silk road: Xi Jinping's grand strategy for Eurasia. *American Foreign Policy Interests* **37** (3), 140–147.
- Feng, T.-T., Kang, Q., Pan, B.-B. & Yang, Y.-S. 2019 Synergies of sustainable development goals between China and countries along the Belt and Road initiative. *Current Opinion in Environmental Sustainability* **39**, 167–186.
- Green BRI. 2021 *Green Belt and Road Initiative Center, On: China's 14th Five-Year Plan's Climate Ambitions: Can Green Finance Help for A Much-Required Overachievement of the Targets?* Written by Wang, C. N., on 27th March 2021. Available from: <https://green-bri.org/chinas-14th-five-year-plans-climate-ambitions-can-green-finance-help-for-a-much-required-overachievement-of-the-targets/>.
- HKUST IEMS (The Hong Kong University of Science and Technology, Institute for Emerging Market Studies). 2021 *The Belt and Road Initiative in ASEAN – Overview*. HKUST IEMS Report No. 2021-03. Available from: <https://iems.usthk.cn/publications/reports/uob-bri-overview>.
- Ho, D. 2017 *Cost of Funding 'Belt and Road Initiative' is Daunting Task*, *South China Morning Post*. Available from: <https://www.scmp.com/special-reports/business/topics/special-report-belt-and-road/article/2112978/cost-funding-belt-and> (accessed 3 February 2020).
- Huang, Y. P. 2016 Understanding China's Belt & Road Initiative: motivation, framework and assessment. *China Economic Review* **40**, 314–321.
- Hughes, A. C., Lechner, A. M., Chitov, A., Horstmann, A., Hinsley, A., Tritto, A., Chariton, A., Li, B. V., Ganapin, D., Simonov, E. & Morton, K. 2020 *Horizon scan of the Belt and Road Initiative*. *Trends in Ecology & Evolution* **35** (7), 583–593.
- International Energy Agency (IEA). 2014 *World Energy Outlook 2014*. International Energy Agency. <https://doi.org/10.1787/weo-2014-en>.
- Khan, M. K., Sandano, I. A., Pratt, C. B. & Farid, T. 2018 China's belt and road initiative: a global model for an evolving approach to sustainable regional development. *Sustainability* **2018** (10), 4234.
- Laurance, F. W. 2018 *China's Global Infrastructure Initiative Could Bring Environmental Catastrophe* *Nexus News*. Available online: <https://nexusmedianews.com/chinas-global-infrastructure-initiative-could-be-an-environmental-catastrophe-25a40e2d1000>.
- Li, A. S. 2016 *Technology transfer in China–Africa relation: myth or reality*. *Transnational Corporation Reviews* **8** (3), 183–195.
- Li, Y. 2018 *The greater Eurasian partnership and the Belt and Road Initiative: can the two be linked?* *Journal of Eurasian Studies* **9** (2), 94–99.
- Li, Y., Shou, Y., Ding, R., Sun, T. & Zhou, Q. 2019 *Governing local sourcing practices of overseas projects for the Belt and Road Initiative: a framework and evaluation*. *Transportation Research Part E: Logistics and Transportation Review* **126**, 212–226.
- Linster, M. & Yang, C. 2018 *China's Progress Towards Green Growth: an International Perspective*. OECD Green Growth Papers, No. 2018/05. OECD Publishing, Paris.
- Liu, C. 2014 *Reflections on Maritime Partnership: Building the 21st Century Maritime Silk Road*. Available from: http://www.ciis.org.cn/english/2014-09/15/content_7231376.htm (accessed 28 December 2018).
- Liu, W. D. & Dunford, M. 2016 *Inclusive globalization: unpacking China's Belt and Road Initiative*. *Area Development and Policy* **1** (3), 323–340.
- Liu, P. L., Guo, Y., Qian, X., Tang, S. L., Li, Z. H. & Chen, L. 2014 *China's distinctive engagement in global health*. *Lancet* **384** (9945), 793–804.
- Ma, D., Lei, C., Ullah, F., Ullah, R. & Baloch, Q. B. 2019 *China's One Belt and One Road Initiative and outward Chinese foreign direct investment in Europe*. *Sustainability* **2019** (11), 7055.
- Ministry of Ecology and Environment (MEE). 2017 *The Belt and Road Ecological and Environmental Cooperation Plan*. Available from: http://english.mee.gov.cn/Resources/Policies/policies/Frameworkp1/201706/t20170628_416869.shtml (accessed 21 March 2018).
- Niu, B., Xu, J., Lee, C. K. M. & Chen, L. 2019 *Order timing and tax planning when selling to a rival in a low-tax one-belt-one-road market*. *Transportation Research Part E: Logistics Transportation Review* **123**, 165–179.
- Ohshita, S., Zhang, J., Yang, L., Hu, M., Khanna, N., Fridley, D., Liu, S., Chen, L., Li, A., Sun, M. & Zhou, N. 2017 *China Green Low-Carbon City Index: Report on Performance of 100+ Cities (2010–2015)*. Available from: https://china.lbl.gov/sites/default/files/chinacityindex052017_en.pdf (accessed 21 March 2018).

- Pike, L. 2017 *Explainer: Will China's new Silk Road Be Green?* China Dialogue. Available from: <https://www.chinadialogue.net/blog/9775-Explainer-Will-China-s-new-Silk-Road-be-green/-en> (accessed 17 March 2018).
- PJP-EU. 2014 *Mapping Existing Quality Inclusive Education Training Programmes Within the South East Europe Region*. Part of the 'Regional Support for Inclusive Education' Project, Summary Report. Available from: https://pjp-eu.coe.int/inclusive-education/images/140910_mapping_report_final_qa.pdf.
- Qi, S., Peng, H. & Zhang, Y. 2019 Energy intensity convergence in Belt and Road Initiative (BRI) countries: what role does China-BRI trade play? *Journal of Cleaner Production* **239**, 118022.
- Rauf, A., Liu, X., Amin, W., Ur Rahman, O., Li, J., Ahmad, F. & Bekun, F. V. 2020 Does sustainable growth, energy consumption and environment challenges matter for Belt and Road Initiative feat? A novel empirical investigation. *Journal of Cleaner Production* **262**, 121344.
- Sinayi, M. & Rasti-Barzoki, M. 2018 A game theoretic approach for pricing, greening, and social welfare policies in a supply chain with government intervention. *Journal of Cleaner Production* **196**, 1443e1458.
- Szadziewski, H. 2020 Converging anticipatory geographies in Oceania: the Belt and Road Initiative and look North in Fiji. *Political Geography* **77**, 102119.
- Tambo, E., Khayeka-Wandabwa, C., Muchiri, G. W., Liu, Y.-N., Tang, S. & Zhou, X.-N. 2019 China's Belt and Road Initiative: incorporating public health measures toward global economic growth and shared prosperity. *Global Health Journal* **3** (2), 46–49.
- Tan-Mullins, M., Cheshmehzangi, A., Chien, S. & Xie, L. 2017 *Smart-Eco Cities in China: Trends and City Profiles 2016*. University of Exeter Press, Exeter.
- Teo, H. C., Lechner, A. M., Walton, G. W., Chan, F. K. S., Cheshmehzangi, A., Tan-Mullins, M., Chan, H. K., Sternberg, T. & Campos-Arceiz, A. 2019 Environmental impacts of infrastructure development under the Belt and Road Initiative. *Environments* **2019** (6), 72.
- The World Bank. 2018 *Belt and Road Initiative*. Available from: <https://www.worldbank.org/en/topic/regional-integration/brief/belt-and-road-initiative> (accessed 08 February 2020).
- UNFCCC. 2017 *Press Release – Green Development Under Belt and Road Initiative: Pushing Forward the Global Implementation of the Paris Agreement*. Available from: <https://cop23.unfccc.int/sites/default/files/resource/Press%20Release-Green%20Development%20Under%20the%20BRI-Phusing%20Forward%20the%20Global%20Implementation%20of%20the%20Paris%20Agreement-20171108.pdf> (accessed 17 March 2018).
- Weng, X., Dong, Z., Wu, Q. & Qin, Y. 2015 *China's Path to a Green Economy: Decoding China's Green Economy Concepts and Policies*. IIED Country Report. IIED, London. Available from: <https://pubs.iied.org/pdfs/16582IIED.pdf> (accessed 08 February 2018).
- Xue, L. & Weng, L. 2018 Thoughts on China's Belt and Road Initiative for promoting UN 2030 sustainable development goals. *Bulletin of Chinese Academy of Sciences* **33** (1), 40–47.
- Xie, L., Cheshmehzangi, A., Tan-Mullins, M., Flynn, A. & Heath, T. 2020 Urban entrepreneurialism and sustainable development: a comparative analysis of Chinese eco-developments. *Journal of Urban Technology* **27** (1), 3–26.
- Yang, G., Huang, X., Huang, J. & Chen, H. 2020 Assessment of the effects of infrastructure investment under the belt and road initiative. *China Economic Review* **60**, 101418.
- Yu, S., Qian, X. & Liu, T. 2019 Belt and road initiative and Chinese firms' outward foreign direct investment. *Emerging Markets Review* **41**, 100629.
- Zhai, F. 2018 China's belt and road initiative: a preliminary quantitative assessment. *Journal of Asian Economics* **55**, 84–92.
- Zhang, J. 2016 *China's Regional Security Environment Review:2016 [中国周边安全形势评估(2016) '一带一路'战略对接与安全风险]*, 1st edn. Social Science Academic Press China, Beijing.
- Zhang, Y. J. & Zhang, K. B. 2018 The linkage of CO₂ emissions for China, EU and USA: evidence from the regional and sectoral analyses. *Environmental Science and Pollution Research* **25** (20), 20179–20192.
- Zhao, M. H. 2015 China's new silk road initiative. *IAI Working Papers* **15** (37), 1–12.

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