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The Potential of Energy Cooperation between China and Australia under the Belt & Road Framework

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Abstract

While there is a proliferation of studies on China's Belt and Road Initiative (BRI), there is a gap in the literature in terms of an exploration of the costs and benefits from the perspective of the energy sector, in both the areas of sectoral development and energy transition. This paper provides a perspective from the energy sector, using Australia as a case study. The paper is the first to quantify the impact of BRI from the energy sector perspective and the analysis informs the current debates on BRI in Australia. We find that energy cooperation under the BRI enhances the performance of energy companies, but Chinese energy investment in Australia faces mounting challenges. We suggest some areas for cooperation and such cooperation could be extended to third countries. Amid the increasing trade and political tensions, the two countries need continued, level-headed discussion and debate about the potential cooperation areas at all levels.

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1 Introduction

The Belt and Road Initiative (BRI) is China's foremost foreign and economic policy initiative under the presidency of Xi Jinping. It is the overarching framework that guides China's international economic relations, welcomed by most countries and resisted by some despite the US and many other countries' resistance. The BRI was announced in two addresses by President Xi in 2013, outlining a vision for an overland 'New Silk Road Economic Belt' connecting Central Asia and China's western provinces during a speech in Kazakhstan, then announcing the development of a 'New Maritime Silk Road' spanning Southeast Asia during a speech in Indonesia (Collinson and van Nieuwenhuizen, 2017). The first comprehensive official document, the Action Plan on the Belt and Road (the Action Plan)[1], was jointly released by the National Development and Reform

[1] The full title is "Vision and Action for Advancing the Joint Construction of the Silk Road Economic Belt and 21st Century Maritime Silk Road". http://news.xinhuanet.com/world/2015-03/28/c_127631962.htm

Commission, Ministry of Foreign Affairs and Ministry of Commerce on 28 March 2015. The Action Plan outlined China's rationale for the BRI, and its stated purpose: to integrate China's national strategy for development with enhanced international cooperation through policy communication, infrastructure connectivity, trade and investment, financial and people-to-people links. And within this rubric, the promotion of sustainable development, the coordination of development strategies and the furthering of economic integration. President Xi, during a speech at the second Belt and Road Forum in 2019 emphasised the 'need to pursue open, green and clean cooperation', noting that the 'Belt and Road is not an exclusive club; it aims to promote green development' (Xi, 2019). According to China's estimation, at the initial stage, the BRI covers an area of 65 countries (including China itself) and 4.4 billion people; 55 per cent of world GNP; 70 percent of global population, and 75 percent of known energy reserves (Xinhuanet, 2015a, 2015b; Grieger, 2016).

Energy cooperation is a core part of the BRI, going towards green development and sustainability, and has the potential to bring mutual benefits for countries which participate in some capacity. Energy cooperation under the BRI is important to ensure China's energy security by establishing multiple sources of oil and gas supply. It also benefits energy importers, energy exporters and countries through which energy transits, especially energy exporters which are faced with financial and technological constraints (Shi and Yao, 2019).

Australia and China are salient case studies to examine the BRI from an energy perspective. China and Australia, the second and fourteenth largest world economies, respectively (Austrade, 2020; World Bank, 2020), are important trading partners and investment destinations for each other. Energy plays a substantial role in their trade and investment ties – Australia is a global leader in the export of fossil fuels and China fossil fuel importer (The Economist, 2020) a developed country with transparency and good governance and has not indicated interest to join the BRI, citing issues such as environmental degradation, international standards of governance, transparency and debt sustainability (Adamson, 2019; Ascensão et al., 2018; Han et al., 2018). Such hesitation may not only undermine the cooperation potential between the two countries, but also undermine the global environment. A recent study reveals that due to the comparative advantages, the Australia-China trade can lead to negative emission reduction for both countries (Huang et al., 2020). Hence, it is important to discuss the potential and new forms of energy cooperation between China and Australia under the BRI.

While there is a proliferation of studies on the BRI, there is a gap in the literature in terms of an exploration of the costs and benefits from the perspective of the energy sector, in both the areas of sectoral development and energy transition. Previous studies on the BRI and energy have focused on issues such as China energy product competitiveness (Shuai et al., 2018), energy efficiency convergence (Han et al., 2018), investment into the energy sector (Shi and Yao, 2019), energy infrastructure development (Yao et al., 2019), energy relations between China and BRI countries (Zhao et al., 2019), energy and sustainability (Rauf et al., 2018), risks (Zhang et al., 2020), and the impact on emissions and energy consumption (Liu and Hao, 2018; Shi et al., 2018; Zhang et al., 2017). However, there is a lack of evaluation of these controversies and proposals to address them. Studying such controversies could help strengthen the BRI while minimizing its risks to both China and countries that engage with the initiative.

In this paper, we provide a perspective from the energy sector, using Australia as a case study. The paper makes the following contributions. First, it is the first to quantify the impact of BRI from the energy sector perspective. Second, it analyses the potential benefits for Australia's energy sector, which can inform the current debates on BRI in Australia.

The rest of the paper is organized as follows. Section 2 discusses the background of energy cooperation under the BRI, including its benefits that have been revealed in the literature. Section 3 discusses the current status of Australia-China energy cooperation and empirical evidence of the BRI's spillover effects that support closer cooperation between Australia and China. Section 4 describes the potential energy cooperation between Australia and China under the BRI. Section 5 concludes and provides policy implications.

2 Energy cooperation under the BRI: background

2.1 Energy security under the BRI framework

The BRI is aimed at improving the connectivity of Asian, European, and African continents and their adjacent seas; establishing and strengthening partnerships among participating countries; setting up all-dimensional, multi-tiered and composite networks of connectivity, and ensuring diversified, independent, balanced, and sustainable development in these countries (NDRC, 2015). The BRI is designed to enhance the orderly and free flow of economic factors and the efficient

allocation of resources. It is also intended to help create a regional framework of economic cooperation of beneficial for all.

The BRI features six economic corridors, as shown in Table 1. On land, it will focus on jointly building a new Eurasian land bridge and developing China-Mongolia-Russia, China-Central Asia-West Asia, and China-Indochina Peninsula economic corridors by taking advantage of international transport routes, relying on core cities along the belt and road and using key industrial parks as cooperation platforms. At sea, the BRI will focus on jointly building smooth, secure, and efficient transport routes connecting major sea-ports along the belt and road. The China-Pakistan Economic Corridor and the Bangladesh-China-India-Myanmar Economic Corridor are key routes of the initiative, necessitating even closer cooperation and greater progress (NDRC, 2015).

[Insert Table 1. here]

Table 1. Countries along the Corridors of the BRI

Energy cooperation is a core part of the BRI. In building connectivity networks, the BRI features several cooperation priorities, one of which is the connection of energy facilities, including cooperation in traditional energy such as oil and gas, as well as clean energy. China has signalled an intent to "promote cooperation in the connectivity of energy infrastructure; work in concert to ensure the security of oil and gas pipelines and other transport routes; build cross-border, power-supply networks and power-transmission routes, and cooperate in regional power grid upgrading and transformation" (NDRC, 2015).

Energy cooperation with countries along the BRI is a means to ensure China's energy security. China's oil and gas supply is predominantly shipped through the Strait of Malacca and the South China Sea. The BRI will ease China's reliance on the Strait of Malacca, which accounts for over 60 per cent of its international trade and 90 per cent of its energy resources in the beginning of the 21st century (Jiang and Marro, 2015). This large volume is sourced through a geopolitically unstable region, heightening the importance for China to have a satisfactory import policy. Hence, an all-inclusive oil and gas distribution network via land and sea could, to a large extent, change the energy trade pattern in the Middle East, Central Asia, and Southeast Asia, thus improving China's energy transport security. Besides, route countries are not only vital to ensuring China's energy security,

but are also key markets for its infrastructure companies.

A good example is energy cooperation in Gwadar, Pakistan, a port city just outside the Straits of Hormuz. A port, airport, pipeline, railway, and highway are all part of China's plan to invest US$46 billion to develop energy infrastructure according to the China-Pakistan Economic Corridor scheme agreement signed in April 2015. Shipping oil through Gwadar is expected to reduce the transit time by 85 per cent compared to that through the Strait of Malacca. In November 2015, state-owned Chinese Overseas Ports Holding Company Limited started a 43-year lease to operate the free-trade zone at the port of Gwadar in Pakistan (ICSANA, 2016).

Energy potential in the BRI countries, if unleashed, can significantly advance global sustainable growth. For example, a study suggest that the BRI region has a PV generation potential 449 PWh annually, which is 41.3 times the regional demand in 2016 and developing 3.7 per cent of the potential will meet the region's entire projected demand in 2030 (Chen et al., 2019). Liu and Hao (2018) find a long−run bidirectional causalities among carbon emissions, energy use, industry value added and GDP per capita in the BRI countries and suggests significant cooperation potential in growth and trade between China and the BRI countries. Zhang et al. (2020) find that the energy saving potential in the 56 BRI countries is around 9.95 billion tonnes of oil equivalent during the period of 1995 to 2015.

2.2 Benefits of energy cooperation under the BRI

The 65 core countries in the initial BRI plan can be divided into three groups. The first group is composed of energy exporters, mainly in the Southeast Asian, West Asian, and North African, and Central Asian regions, such as Russia, Mongolia, Kazakhstan, Saudi Arabia, Iran, Indonesia etc. The second group includes energy importers, mainly in Central and Eastern Europe and South Asia regions, such as China, India, Poland, Czech Republic, etc. The third group is composed of the countries which are along the pipeline routes — mainly CIS countries such as Ukraine and Azerbaijan. Some countries take all three roles at the same time, as energy exporters, importers, and transit nations. For example, China now is the largest oil importer, the largest energy producer, and the greatest consumer of energy. It is also the largest carbon emitter, as well as the top investor in the installation and consumption of renewable energy. Therefore, one motivating factor for China in developing the BRI is to address its economic security challenges, especially with respect to

energy security, which are concerns shared with most BRI countries. Large-scale overseas investment on energy projects, such as multinational pipelines (for oil and gas), terminals (for liquefied natural gas) and high-voltage power lines, has become a new normal in China's foreign policy practice.

Each group has its own specific understanding of energy security (Xu and Chung, 2016). Take the first group to start with. To energy exporters, relying on revenue from selling energy resources and products (such as Russia, Saudi Arabia, Kuwait, Indonesia, Kazakhstan, Turkmenistan, etc.) energy security means enough market capacity and favourable energy prices to cover their budget. To the energy importers such as China, India, the Czech Republic, Poland, Tajikistan etc., it means enough economic and environmental energy to sustain their national economy. To the countries through which energy transits (such as Ukraine, Georgia, etc.), it means fully enjoying returns from the energy crossing their land.

Although some energy exporters are rich in energy resources, they are faced with financial and technological constraints. Under the BRI framework, there are natural advantages of cooperation between energy exports and imports, such as investment facilitation in the joint exploration, development, and construction of energy pipelines and power facilities (Shi and Yao, 2019).

Past studies have highlighted several positive dimensions of BRI energy cooperation. One significant role that the BRI can perform is the mobilization of investment to alleviate financial resources shortages in many countries, especially developing countries. For example, the BRI is expected to help the ASEAN electricity market integration in the early stage and the ultimate effectiveness will depend on the ASEAN countries rather than China (Yao et al., 2019). Improvement to environmental performance is also reported in the literature. Tian et al. (2019) finds China retains pollution-intensive and resource-intensive industries after the BRI, challenging the claim that the BRI will relocate pollution from China to other BRI countries. Another study (Zhang et al., 2018) showed more than 40 spanning countries eased their water shortage through virtual water trade surplus with China.

Han et al. (2018) suggest that the BRI can advance energy efficiency convergence between China and the BRI countries, indicating that the BRI can improve the environmental performance of the participating countries. More recently, Qi et al. (2019) found that among the BRI countries, low energy efficiency countries are catching up with higher efficiency countries, and the speed of

convergence is higher in higher-income countries. However, it also suggests that weak innovation and research and development absorption capacity may undermine the convergence.

Energy input change is also found to be the most important factor that driving environmentally sensitive growth, or green growth in the BRI countries (Zhao et al., 2020).

3 Australia-China energy cooperation under the BRI: empirical justification

While energy cooperation under BRI should theoretically be beneficial to participate countries, not all countries that might benefit from BRI will join it. Australia is one such example. Australia and China's economies are highly complementary and their bilateral trade relationship is critical for both countries. As exhibited in the literature, energy cooperation under the BRI should be able to bring benefits for both Australia and China. In this section, we empirically demonstrate that the energy cooperation under the BRI can bring additional benefits.

3.1 The spillover effects of energy cooperation under the BRI

In order to investigate the impact of energy cooperation on the performance of energy companies along the Belt and Road, we selected publicly listed companies worldwide from 2010 to 2019 as the sample, including 1947 companies from 90 economies and construct the following regression set-up:

$$Performance_{i,j,t+1} = \alpha + \beta_1 Co_{j,t+1} + \delta X_{i,t} + A_i + B_t + \varepsilon_{i,t} \quad (1)$$

where *i*, *j*, and *t* represent company, country, and year, respectively. We use return on assets (*ROA*) to measure $Performance_{i,j,t+1}$. A_i and B_t are vectors of company and year dummy variables that account for company and year fixed effects. $X_{i,t}$ is a set of time-vary company-level control variables, including the natural logarithm of the total assets (*Size*), the current minus the year of establishment (*Age*), the operating revenue growth rate (*Growth*), the ratio of the cash flow over the operating revenue (*Cash*), the ratio of the R&D expenses over the operating revenue (*R&D*), and the ratio of the costs of employees over the operating revenue (*Labor*). The $\varepsilon_{i,t}$ is the error term. Data on company characteristic data comes from BVD-Osiris database.

As we mentioned above, China conducts energy cooperation with countries along the Belt and Road through direct investment and the connectivity of energy infrastructure. Hence, we use two kind of indicators to measure the key variable-energy cooperation $Co_{j,t+1}$. The former is Chinese

energy investment amount variable ($Invest\ Amount_{j,t}$). It is the natural logarithm of one plus the amount of Chinese energy investment in the country *j* in the year *t.* The latter is Chinese energy investment dummy variable ($Invest_{j,t}$), which equals one in the year *t* when there are Chines energy investment in the country *j* and zero otherwise. That is, $Invest_{j,t} = 1(Invest\ Amount_{j,t} > 0)$. Data on Chinese energy cooperation with foreign countries comes from the Chinese Global Investment Tracker compiled by the American Enterprise Institute.

In addition, we are more concerned about whether energy cooperation under the BRI is more effective and promote the performance of energy companies more. Therefore, following a difference-in-difference approach, we add the interactive item of $BRI_{j,t}$ and $Co_{j,t}$ based the equation (1).

$$Performance_{i,j,t+1} = \beta_1 BRI_{j,t+1} * Co_{j,t+1} + \beta_2 Co_{j,t+1} + \beta_3 BRI_{j,t+1} + \delta X_{i,t} + A_i + B_t + \varepsilon_{i,t} \quad (2)$$

where $BRI_{j,t}$ is a dummy variable that equal one if country *j* is under the cooperative framework of BRI after 2013 and zero otherwise.

To reduce the influence of extreme values, we winsorize all continuous variables at the 1 per cent level. Table 21 reports descriptive statistics of company characteristics and energy cooperation indictors. There are Chinese energy investments in 56.5 per cent observations.

[Insert Table 2. here]

Table 2. Company Characteristics and Energy Cooperation Indictors

As shown in Table 3, there are significantly positive impact of Chinese energy investment on energy companies. If China makes energy investment in a country, the ROA of energy companies in this country will increase by 0.96 on average. For every one percentage point increase in Chinese energy investment amount, the ROA of energy companies in the corresponding country will increase by 0.2 on average. From the regression (3), we find that the key variable of interest, the interaction term between energy investment and BRI, is significant and positive. This suggests that energy investment under the BRI framework has further enhanced the performance of energy companies, highlighting the natural advantage of energy cooperation under the BRI framework.

[Insert Table 3. here]

Table 3. The Impact of Chinese Energy Investment and the BRI

3.2 Australia-China bilateral energy cooperation: a reality check

As shown in Figure 1 and Figure 2, after China became a member of the World Trade Organization in 2001, the trade volume between China and Australia began to grow rapidly, especially in the energy sector. Australian exports of ores and mineral fuels, mainly coal, took off. Iron ore has now been Australia's main export to China for many years. Against the backdrop of the Paris Agreement and environmental concerns, coal, which was up to 2018 Australia's second-largest export commodity to China, started to face challenges from the overall restrictions imposed on coal consumption and the impact of volatile coal industrial policy on production.

[Insert Figure 1. here]

Figure 1. Bilateral trade between Australia and China

[Insert Figure 2. here]

Figure 2. China's energy import from Australia

Liquefied natural gas (LNG) replaced coal as Australia's second-largest export commodity in 2018. China began to import LNG in 2006, bringing Australia into China's energy landscape. Now LNG is one of Australia's main export commodities, second only to iron ore (Liu et al., 2020). Australia has surpassed Qatar to become the world's largest exporter of LNG in 2018 and the largest supplier of LNG to China, which comprises 46 per cent of China's imports as of November 2018 and 33 per cent of Australian total export.[2] The LNG market in China remains broad and continues to expand rapidly. In 2017, LNG in China accounted for 8 per cent of the total energy supply, far below 23 per cent of the world (BP, 2019). The trade volume and proportion of LNG between the two countries is expected to increase further. Despite the declining export of iron ores and coal, China is Australia's largest two-way trading partner in goods and services (valued at US$145.4 billion in 2018) and Australia's largest resources and energy market, with imports from Australia

[2] We would like to thank He Quanlin and Li Haoyang, masters from School of International Studies of Renmin University of China, for their data in the report on China's international energy cooperation (2018).

worth more than US$57.7 billion in 2018, more than a quarter of Australia's total exports of goods to all countries (UN Comtrade International Trade Statistics Database, 2020).

It is worth noting that bilateral energy trade between Australia and China showed significant decline in 2015 and 2016 instead of continuous growth, even after both countries signed the China-Australia Free Trade Agreement (ChAFTA) in 2015. This was mainly due to the downturn in international commodities, the decline in demand for iron ore in China, and the decline in political relations between China and Australia. Bilateral trade between the two countries quickly resumed in the following years. In the long-term, bilateral trade between Australia and China has shown a continuous upward trend, notwithstanding a short-term decline in the trade volume and adjustments in the trade structure.

In fact, China has been Australia's largest trading partner since late 2007 and Australia's largest export market since 2009 (Australian Embassy China, 2020), presently accounting for over 30 per cent of its total exports. This has sparked vigorous domestic debate in Australia whether Australia is overly economically dependent on China, where energy trade dominates (Mao, 2020). Hence, multi-channel energy cooperation will benefit the long-term energy cooperation between the two countries.

Apart from trade, Chinese investment in Australia has substantially increased over the last decade, and overwhelmingly concentrates on Australia's natural resources, including iron ore and LNG, driven mainly by China's rising domestic demand. Consolidating production and supply chains and acquisition of overseas resources are considered to be key measures for ensuring China's energy and resource security and its economic growth. However, after the global financial crisis in 2008 and the emergence of a "new normal" growth model, China's demand of energy and resources has slowed down. Although the levels of investment from Hong Kong SAR (fifth largest foreign investor) and from China (ninth largest foreign investor) in Australia have grown significantly over the last decade, China's direct investment in Australia has experienced a decline for two consecutive years, from AU$85.0 billion in 2016 to AU$64.0 billion in 2017 and AU$63.6 billion in 2018 (Dfat, 2020).[3]

Most investment has flowed into resources, but is gradually moving towards agriculture,

[3]

tourism, and infrastructure with a shrinking demand for energy and resources in China. Coincidentally, Chinese investment into Australia also shifted away from coal and LNG in the past few years. As show in Table 2, Chinese total investment in energy/resource sector of Australia amounted to AU$1,585 million AUD in 2018 and AU$231 million in 2019, with 85 per cent decline in 2019. However, different sectors show quite different trend. For example, Chinese investment in mining decreased by 90 per cent while that in conventional energy and renewable energy in 2018 increased by 295 per cent and 217 per cent, respectively compared with the total in 2017. Whereas in 2019, Chinese investment into energy and renewables showed more of a decline compared to that in mining (KPMG and University of Sydney, 2019;2020).

[Insert Table 4. here]

Table 4. Chinese Investment in Australia by Industry in 2018 and 2019

As part of this new trend, large strategic investments in resources, energy and infrastructure have given way to smaller investments, primarily by private investors, into projects that are tactical and directly linked to Chinese consumer market demand. Mining investment has likewise shifted towards lower deal sizes. The only large deal in 2018 is the acquisition of a majority stake in a mining asset in Laos owned by MMG Australia. There were no major Chinese investments in 2018 in areas such as energy (oil and gas), infrastructure and renewable energy in Australia.

Moreover, such investment has been subject to closer scrutiny by the Australian government based on national interest, resource security, resource pricing, corporate social responsibility, environmental regulation, and local culture protection. In recent years, the political tensions between Australia and China have paralleled with a significant decline of Chinese investment in Australia.

Although there is no overarching consensus, economic, political, and social factors are widely discussed in explaining the challenges of the Chinese energy investment in Australia. The substantial investment in the energy and mining sector by Chinese investors, with the majority of Chinese state-owned enterprises (SOEs), has raised concerns about weakening local energy suppliers' bargaining power. Immature investment arrangements can also cause failure. Take the case of Rio Tinto, for example, where Chinalco tried to reach a complex joint venture arrangement with convertible bond proposals, making it miss the optimum window of opportunity in making a straightforward equity deal (Yao et al., 2010).

The market-based nature of Chinese SOEs is viewed with suspicion and the support from state-owned banks they receive leads to anxiety, raising the doubt that they are investment decisions of the Chinese government instead of firms and making the sensitive deals even more difficult. The other concern is that more Chinese interference in Australian policymaking could been seen though the mining industry. The more powerful influence energy/resource sector has exerted on politics (the so-called resource-politics) maybe lead to the backfire on Chinese investment. What's worse, some states seek to influence the federal trade and investment policy with China, embarking on infrastructure reform and seeking to shape policy in areas such as migration that have clear Commonwealth jurisdiction, which will strengthen the political concern (Jayasuriya and Cannon, 2015).

The intention to ensure supply security by pursuing upstream investment also leads to the backfire towards Chinese resource investment in Australia (Beeson et al., 2011). An anti-China sentiment on the rise in Australia has also started to impact on Chinese energy investment. Moreover, there is an increasing tendency for economic issues to be politicised. Both society and political circles are increasingly divided into 'doves' and 'hawks' in terms of their positioning on China, which is the foundation for Australia's nuanced position (Bisley, 2018).

4 Suggestions on Australia-China Energy Cooperation under the BRI

Based on the natural advantage of energy cooperation under the BRI framework, we further analyse the potential of Australia-China cooperation in energy. A framework (Table 5) with two dimensions is proposed: a country dimension and a fuel-type dimension. On the first dimension, three types of countries are focused on: Australia (A), China (B) and Third Countries (C); on the second dimension, energy is divided into three groups: fossil fuels (1), low-carbon fuels (2) and infrastructure (3) which includes physical infrastructure and institutions. The analysis is done based on the framework, staring with the country dimension.

[Insert Table 5. here]

Table 5. Potential Energy Cooperation between Australia and China

In Australia, the potential for energy cooperation includes:

In the fossil fuel area, investment goes into resources and export projects for coal and natural gas, as well as power plant upgrading (A1). Australia is the world's largest LNG exporter while China is the world largest gas importer and on the road to be the largest LNG importer as well. Given the synergy in resources, it is in Australia and China's interests to establish a stable, healthy, and long-term relationship based on energy and resource demand and supply. In as early as 2006, such an aim was included in a six-point agreement between then-Chinese Premier Wen Jiabao and then-Australian Prime Minister John Howard. Furthermore, shifting from resource trade to resource investment is a key factor in deepening the bilateral economic relationship. Chinese Premier Li Keqiang had also called in 2011 for both sides to go beyond "a simple buyer–seller relationship" and to "make innovation in new and cooperative ways", indicating some openness on the Chinese government's part to encourage more investment into Australian resources, at least at that point in time. Spillover of tensions between the two countries into the economic realm are altering the lay of the land.

In the electricity sector, Australia's electricity is mainly generated by ageing, inefficient, coal-fired power plants, many of which will not to be replaced within this decade (Climate Council, 2014). Despite mounting pressure to reduce emissions, Australia is still planning to introduce new power plants, albeit with stricter emission and efficiency standards. The closing-down of one of the ageing powers plants, Hazewood, has caused national concern about potential blackouts and price spikes. Australia is said to contemplate closing nine old coal-fired power plants with a combined capacity of 5.4 GW (Uhlmann, 2017).

More importantly, Australia is open to international investors on clean coal technology. Since Chinese thermal power plants are more efficient than most of the Australian ones, China could supply thermal power equipment to the latter. China is the world's leader in coal-generation efficiency and emissions control: its ultra-supercritical generation units perform 11 per cent better than the top plants in Japan and Europe. While higher efficiency in coal-fired power plants often means employing modern technologies, a report shows that China has invented new technology to upgrade existing subcritical coal-fired power plants without dismantling the infrastructure already there (Callick, 2017). On the Australian side, due to the closing down of aging coal mines without proper replacement, the country is facing higher electricity prices. As long as coal-fired power plants

are still active in Australia, Chinese investors can provide Australia with investment and technology. There could also be joint R&D in thermal power technology and equipment (B2) between the two countries in thermal power generation to make generation cleaner in both countries. On March 27 2018, China and Australia launched the carbon dioxide capture and storage technology project, a joint research project on climate change, in Brisbane, which will further strengthen their cooperation on technology and environmental protection and energy. However, cooperation in CCT could drag China into controversial debates on coal-fired power plants in Australia.

China and Australia may also have opportunities to cooperate in building Australia's infrastructure. Despite being the largest LNG exporter, Australia's domestic market claims face gas shortage (Grafton et al., 2018) and thus brings about a few opportunities for cooperation. On the supply side, both countries can discuss the possibility of reviewing LNG contracts to release more supply for Australian domestic markets. They could also jointly develop gas pipelines, and even LNG regasification terminals (A3). The high price in Australia is a result of fragmented markets, which could be solved by pipeline development. Australia, despite being on the way to become the world's largest LNG exporter, still needs regasification terminals to send LNG from Australian producers and international markets to its domestic consumers. Since Australian cities are mostly sitting along coastal areas, such terminals are more cost-effective than pipeline connections.

Investment from China into Australia does not necessarily need to flow into traditional resources such as coal or natural gas. Clean energy, for example, is an important area that both sides are keen to highlight. Australia is the sunniest and one of the windiest countries in the world (Climate Council, 2014). And there is a significant temporal synergy between wind and solar in Tasmania, south-eastern and North Australia (about 40 per cent within a distance of 93 per cent). In fact, in view of the potential energy crisis caused by the closure of old power plants, the number of photovoltaic installations in Australia has exploded in recent years. In 2018, 3.7757GW of photovoltaic power was installed, and one-fifth of households had their photovoltaic systems. However, given Australia's huge electricity consumption, PV generation, 729.2 GWh, accounted for only 0.3 per cent of the electricity generation in 2017-18. Nearly 70 per cent of the electricity generation is still provided by coal and coal by-products (Australian Bureau of Statistics, 2019).

Since China has mature technology and expertise in developing and deploying low-carbon energies such as nuclear, wind and solar power, and since Australia is rich in these resources,

cooperation between them (A2) is not only complementary but also helpful for both to transit to a green economy. Furthermore, Australia and China have significant potential in the future development of hydrogen. Australia is aiming to be one of the op 3 hydrogen exporters (COAG Energy Council, 2019) in the Asian market, while China will be the largest hydrogen user and an importer by 2030 (IEA, 2019). This complexity in the future provides enormous opportunities for bilateral energy cooperation.

The development of renewable energy will create demand for grid extension, particularly in a decentralised scenario, because many of Australia's renewable resources are located far from electricity load centres (Climate Council, 2014). In this case, Chinese investment and even high-voltage transmission technology (A3) would help Australia transport the clean electricity.

In the Chinese market, except for the joint R&D in thermal power that has been discussed, Australia could use investment in China's coal and LNG projects (B2) to integrate China's energy supply chain. Australia's wide experience in electricity markets could also be useful (B3) for China's nascent electricity market reform.

While there is an opportunity for Australia and China to engage directly within the BRI framework, this is not the only avenue for cooperation. The two countries could also look towards cooperating in developing the market in third countries. For example, their firms can jointly invest in coal and LNG facilities (C1) and infrastructure (C3) to facilitate the export of Australian resources and the sale of Chinese equipment and engineering services. The two countries could also join hands in reshaping the much-needed global energy governance (C3) (Andrews-Speed and Shi, 2016). Both countries are members of a few important global and regional clubs, such as G20 and APEC, with the capability needed to set a new agenda for global debates in energy governance. In a joint statement issued after the third RCEP leaders' meeting in Bangkok, the 15 member countries concluded all text negotiations and all market access negotiations. They committed to ensuring the signing of the agreement in 2020, which will set up a new platform for energy cooperation between China and Australia.[4] By doing so, Australia can develop beyond a resource economy with an extended supply chain which may hedge the Australian economy from commodity price fluctuations.

As for China, its significant share in the world total energy sector and its growing overseas

[4] Lin, H., and Wang, J. (2019). Major progress was announced in a joint statement issued by RCEP leaders, Retrieved from http://www.xinhuanet.com/2019-11/05/c_1125192213.htm

interests make the country vulnerable to international energy market changes. Over the last 15 years, China has become the world's largest net importer of oil, a major gas importer, and a significant player in seaborne coal markets (BP, 2015). The overseas investments by its energy companies exceed US$200 billion (Humphreys, 2015), and China is the world's largest exporter of wind and solar energy equipment (Kong, 2011). Therefore, it has a growing interest in joining and reforming global energy governance to protect its interests.

5 Conclusion and Policy Implications

Recent years of economic slow-down have threatened the traditional model of economic relationship between China and Australia (in which resources, energy trade and investment play a key role), and have brought about the risk of unsustainability. This unsustainability is particular serious, given China's recent announced commitment to achieve carbon neutrality by 2060. Both Australia and China have acknowledged the above-mentioned risks and are thus determined to find out ways to avoid them by adopting different hedging strategies accordingly. The Chinese government made the decision to invest overseas in the hope of integrating its productivity and adjusting its supply chains. At the same time, the Australian government is attempting to diversify its services and other exports from China.

We find that energy cooperation under the BRI, especially Chinese energy investments, enhances the performance of energy companies, highlighting the natural advantage of energy cooperation under the BRI framework. However, Chinese energy investment in Australia faces mounting challenges. The Australian community has concerns such as weakening the bargaining power of local energy suppliers, the investment decisions SOEs backed from state-owned banks, resource-politics. An anti-China sentiment on the rise in Australia has also started to impact Chinese energy investment. Moreover, there is an increasing tendency for economic issues to be politicised.

Our analysis suggests that BRI provides potential and new forms of energy cooperation between China and Australia. Our analysis also suggests potential areas under the BRI framework that both countries might have common interests. For example, the gas supply crisis in Australia provides a good chance for both countries to review their LNG contracts and jointly develop gas transportation infrastructure, including pipelines and regasification terminals. More importantly,

China and Australia can deepen their relationship by not only enhancing their current trade and cooperation, but also by exploring market opportunities together in trade and infrastructure in third countries.

In the case when both countries resume cooperation, there are still changes to be made to realize the potential benefits. Chinese firms should learn how to operate in Australia with cooperation and input from local partners and with responsibility and environmental governance. The Australian community needs to deepen its understanding of the increasing activities of Chinese investors. Amid the increasing trade and political tensions, the two countries need continued, level-headed discussion and debate about the potential cooperation areas at all levels.

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The Potential of Energy Cooperation between China and Australia under the Belt & Road Framework[1]

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Abstract

While there is a proliferation of studies on China's Belt and Road Initiative (BRI), there is a gap in the literature in terms of an exploration of the costs and benefits from the perspective of the energy sector, in both the areas of sectoral development and energy transition. This paper provides a perspective from the energy sector, using Australia as a case study. The paper is the first to quantify the impact of BRI from the energy sector perspective and the analysis informs the current debates on BRI in Australia. We find that energy cooperation under the BRI enhances the performance of energy companies, but Chinese energy investment in Australia faces mounting challenges. We suggest some areas for cooperation and such cooperation could be extended to third countries. Amid the increasing trade and political tensions, the two countries need continued, level-headed discussion and debate about the potential cooperation areas at all levels.

Keywords: The Belt and Road Initiative; Energy security; Energy investment; energy cooperation; China-Australia relationship;

1 Introduction

The Belt and Road Initiative (BRI) is China's foremost foreign and economic policy initiative under the presidency of Xi Jinping. It is the overarching framework that guides China's international

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economic relations, welcomed by most countries and resisted by some despite the US and many other countries' resistance. The BRI was announced in two addresses by President Xi in 2013, outlining a vision for an overland 'New Silk Road Economic Belt' connecting Central Asia and China's western provinces during a speech in Kazakhstan, then announcing the development of a 'New Maritime Silk Road' spanning Southeast Asia during a speech in Indonesia (Collinson and van Nieuwenhuizen, 2017). The first comprehensive official document, the Action Plan on the Belt and Road (the Action Plan)[2], was jointly released by the National Development and Reform Commission, Ministry of Foreign Affairs and Ministry of Commerce on 28 March 2015. The Action Plan outlined China's rationale for the BRI, and its stated purpose: to integrate China's national strategy for development with enhanced international cooperation through policy communication, infrastructure connectivity, trade and investment, financial and people-to-people links. And within this rubric, the promotion of sustainable development, the coordination of development strategies and the furthering of economic integration. President Xi, during a speech at the second Belt and Road Forum in 2019 emphasised the 'need to pursue open, green and clean cooperation', noting that the 'Belt and Road is not an exclusive club; it aims to promote green development' (Xi, 2019). According to China's estimation, at the initial stage, the BRI covers an area of 65 countries (including China itself) and 4.4 billion people; 55 per cent of world GNP; 70 percent of global population, and 75 percent of known energy reserves (Xinhuanet, 2015a, 2015b; Grieger, 2016).

Energy cooperation is a core part of the BRI, going towards green development and sustainability, and has the potential to bring mutual benefits for countries which participate in some capacity. Energy cooperation under the BRI is important to ensure China's energy security by establishing multiple sources of oil and gas supply. It also benefits energy importers, energy exporters and countries through which energy transits, especially energy exporters which are faced with financial and technological constraints (Shi and Yao, 2019).

Australia and China are salient case studies to examine the BRI from an energy perspective. China and Australia, the second and fourteenth largest world economies, respectively (Austrade, 2020; World Bank, 2020), are important trading partners and investment destinations for each other. Energy plays a substantial role in their trade and investment ties – Australia is a global leader in the

[2] The full title is "Vision and Action for Advancing the Joint Construction of the Silk Road Economic Belt and 21st Century Maritime Silk Road". http://news.xinhuanet.com/world/2015-03/28/c_127631962.htm

export of fossil fuels and China fossil fuel importer (The Economist, 2020) a developed country with transparency and good governance and has not indicated interest to join the BRI, citing issues such as environmental degradation, international standards of governance, transparency and debt sustainability (Adamson, 2019; Ascensão et al., 2018; Han et al., 2018). Such hesitation may not only undermine the cooperation potential between the two countries, but also undermine the global environment. A recent study reveals that due to the comparative advantages, the Australia-China trade can lead to negative emission reduction for both countries (Huang et al., 2020). Hence, it is important to discuss the potential and new forms of energy cooperation between China and Australia under the BRI.

While there is a proliferation of studies on the BRI, there is a gap in the literature in terms of an exploration of the costs and benefits from the perspective of the energy sector, in both the areas of sectoral development and energy transition. Previous studies on the BRI and energy have focused on issues such as China energy product competitiveness (Shuai et al., 2018), energy efficiency convergence (Han et al., 2018), investment into the energy sector (Shi and Yao, 2019), energy infrastructure development (Yao et al., 2019), energy relations between China and BRI countries (Zhao et al., 2019), energy and sustainability (Rauf et al., 2018), risks (Zhang et al., 2020), and the impact on emissions and energy consumption (Liu and Hao, 2018; Shi et al., 2018; Zhang et al., 2017). However, there is a lack of evaluation of these controversies and proposals to address them. Studying such controversies could help strengthen the BRI while minimizing its risks to both China and countries that engage with the initiative.

In this paper, we provide a perspective from the energy sector, using Australia as a case study. The paper makes the following contributions. First, it is the first to quantify the impact of BRI from the energy sector perspective. Second, it analyses the potential benefits for Australia's energy sector, which can inform the current debates on BRI in Australia.

The rest of the paper is organized as follows. Section 2 discusses the background of energy cooperation under the BRI, including its benefits that have been revealed in the literature. Section 3 discusses the current status of Australia-China energy cooperation and empirical evidence of the BRI's spillover effects that support closer cooperation between Australia and China. Section 4 describes the potential energy cooperation between Australia and China under the BRI. Section 5 concludes and provides policy implications.

2 Energy cooperation under the BRI: background

2.1 Energy security under the BRI framework

The BRI is aimed at improving the connectivity of Asian, European, and African continents and their adjacent seas; establishing and strengthening partnerships among participating countries; setting up all-dimensional, multi-tiered and composite networks of connectivity, and ensuring diversified, independent, balanced, and sustainable development in these countries (NDRC, 2015). The BRI is designed to enhance the orderly and free flow of economic factors and the efficient allocation of resources. It is also intended to help create a regional framework of economic cooperation of beneficial for all.

The BRI features six economic corridors, as shown in Table 1. On land, it will focus on jointly building a new Eurasian land bridge and developing China-Mongolia-Russia, China-Central Asia-West Asia, and China-Indochina Peninsula economic corridors by taking advantage of international transport routes, relying on core cities along the belt and road and using key industrial parks as cooperation platforms. At sea, the BRI will focus on jointly building smooth, secure, and efficient transport routes connecting major sea-ports along the belt and road. The China-Pakistan Economic Corridor and the Bangladesh-China-India-Myanmar Economic Corridor are key routes of the initiative, necessitating even closer cooperation and greater progress (NDRC, 2015).

[Insert Table 1. here]

Table 1. Countries along the Corridors of the BRI

Energy cooperation is a core part of the BRI. In building connectivity networks, the BRI features several cooperation priorities, one of which is the connection of energy facilities, including cooperation in traditional energy such as oil and gas, as well as clean energy. China has signalled an intent to “promote cooperation in the connectivity of energy infrastructure; work in concert to ensure the security of oil and gas pipelines and other transport routes; build cross-border, power-supply networks and power-transmission routes, and cooperate in regional power grid upgrading and transformation” (NDRC, 2015).

Energy cooperation with countries along the BRI is a means to ensure China's energy security.

China's oil and gas supply is predominantly shipped through the Strait of Malacca and the South China Sea. The BRI will ease China's reliance on the Strait of Malacca, which accounts for over 60 per cent of its international trade and 90 per cent of its energy resources in the beginning of the 21st century (Jiang and Marro, 2015). This large volume is sourced through a geopolitically unstable region, heightening the importance for China to have a satisfactory import policy. Hence, an all-inclusive oil and gas distribution network via land and sea could, to a large extent, change the energy trade pattern in the Middle East, Central Asia, and Southeast Asia, thus improving China's energy transport security. Besides, route countries are not only vital to ensuring China's energy security, but are also key markets for its infrastructure companies.

A good example is energy cooperation in Gwadar, Pakistan, a port city just outside the Straits of Hormuz. A port, airport, pipeline, railway, and highway are all part of China's plan to invest US$46 billion to develop energy infrastructure according to the China-Pakistan Economic Corridor scheme agreement signed in April 2015. Shipping oil through Gwadar is expected to reduce the transit time by 85 per cent compared to that through the Strait of Malacca. In November 2015, state-owned Chinese Overseas Ports Holding Company Limited started a 43-year lease to operate the free-trade zone at the port of Gwadar in Pakistan (ICSANA, 2016).

Energy potential in the BRI countries, if unleashed, can significantly advance global sustainable growth. For example, a study suggest that the BRI region has a PV generation potential 449 PWh annually, which is 41.3 times the regional demand in 2016 and developing 3.7 per cent of the potential will meet the region's entire projected demand in 2030 (Chen et al., 2019). Liu and Hao (2018) find a long−run bidirectional causalities among carbon emissions, energy use, industry value added and GDP per capita in the BRI countries and suggests significant cooperation potential in growth and trade between China and the BRI countries. Zhang et al. (2020) find that the energy saving potential in the 56 BRI countries is around 9.95 billion tonnes of oil equivalent during the period of 1995 to 2015.

2.2 Benefits of energy cooperation under the BRI

The 65 core countries in the initial BRI plan can be divided into three groups. The first group is composed of energy exporters, mainly in the Southeast Asian, West Asian, and North African, and Central Asian regions, such as Russia, Mongolia, Kazakhstan, Saudi Arabia, Iran, Indonesia etc.

The second group includes energy importers, mainly in Central and Eastern Europe and South Asia regions, such as China, India, Poland, Czech Republic, etc. The third group is composed of the countries which are along the pipeline routes — mainly CIS countries such as Ukraine and Azerbaijan. Some countries take all three roles at the same time, as energy exporters, importers, and transit nations. For example, China now is the largest oil importer, the largest energy producer, and the greatest consumer of energy. It is also the largest carbon emitter, as well as the top investor in the installation and consumption of renewable energy. Therefore, one motivating factor for China in developing the BRI is to address its economic security challenges, especially with respect to energy security, which are concerns shared with most BRI countries. Large-scale overseas investment on energy projects, such as multinational pipelines (for oil and gas), terminals (for liquefied natural gas) and high-voltage power lines, has become a new normal in China's foreign policy practice.

Each group has its own specific understanding of energy security (Xu and Chung, 2016). Take the first group to start with. To energy exporters, relying on revenue from selling energy resources and products (such as Russia, Saudi Arabia, Kuwait, Indonesia, Kazakhstan, Turkmenistan, etc.) energy security means enough market capacity and favourable energy prices to cover their budget. To the energy importers such as China, India, the Czech Republic, Poland, Tajikistan etc., it means enough economic and environmental energy to sustain their national economy. To the countries through which energy transits (such as Ukraine, Georgia, etc.), it means fully enjoying returns from the energy crossing their land.

Although some energy exporters are rich in energy resources, they are faced with financial and technological constraints. Under the BRI framework, there are natural advantages of cooperation between energy exports and imports, such as investment facilitation in the joint exploration, development, and construction of energy pipelines and power facilities (Shi and Yao, 2019).

Past studies have highlighted several positive dimensions of BRI energy cooperation. One significant role that the BRI can perform is the mobilization of investment to alleviate financial resources shortages in many countries, especially developing countries. For example, the BRI is expected to help the ASEAN electricity market integration in the early stage and the ultimate effectiveness will depend on the ASEAN countries rather than China (Yao et al., 2019). Improvement to environmental performance is also reported in the literature. Tian et al. (2019) finds

China retains pollution-intensive and resource-intensive industries after the BRI, challenging the claim that the BRI will relocate pollution from China to other BRI countries. Another study (Zhang et al., 2018) showed more than 40 spanning countries eased their water shortage through virtual water trade surplus with China.

Han et al. (2018) suggest that the BRI can advance energy efficiency convergence between China and the BRI countries, indicating that the BRI can improve the environmental performance of the participating countries. More recently, Qi et al. (2019) found that among the BRI countries, low energy efficiency countries are catching up with higher efficiency countries, and the speed of convergence is higher in higher-income countries. However, it also suggests that weak innovation and research and development absorption capacity may undermine the convergence.

Energy input change is also found to be the most important factor that driving environmentally sensitive growth, or green growth in the BRI countries (Zhao et al., 2020).

3 Australia-China energy cooperation under the BRI: empirical justification

While energy cooperation under BRI should theoretically be beneficial to participate countries, not all countries that might benefit from BRI will join it. Australia is one such example. Australia and China's economies are highly complementary and their bilateral trade relationship is critical for both countries. As exhibited in the literature, energy cooperation under the BRI should be able to bring benefits for both Australia and China. In this section, we empirically demonstrate that the energy cooperation under the BRI can bring additional benefits.

3.1 The spillover effects of energy cooperation under the BRI

In order to investigate the impact of energy cooperation on the performance of energy companies along the Belt and Road, we selected publicly listed companies worldwide from 2010 to 2019 as the sample, including 1947 companies from 90 economies and construct the following regression set-up:

$$Performance_{i,j,t+1} = \alpha + \beta_1 Co_{j,t+1} + \delta X_{i,t} + A_i + B_t + \varepsilon_{i,t} \quad (1)$$

where *i*, *j*, and *t* represent company, country, and year, respectively. We use return on assets (*ROA*) to measure $Performance_{i,j,t+1}$. A_i and B_t are vectors of company and year dummy variables that account for company and year fixed effects. $X_{i,t}$ is a set of time-vary company-level control

variables, including the natural logarithm of the total assets (*Size*), the current minus the year of establishment (*Age*), the operating revenue growth rate (*Growth*), the ratio of the cash flow over the operating revenue (*Cash*), the ratio of the R&D expenses over the operating revenue (*R&D*), and the ratio of the costs of employees over the operating revenue (*Labor*). The $\varepsilon_{i,t}$ is the error term. Data on company characteristic data comes from BVD-Osiris database.

As we mentioned above, China conducts energy cooperation with countries along the Belt and Road through direct investment and the connectivity of energy infrastructure. Hence, we use two kind of indicators to measure the key variable-energy cooperation $Co_{j,t+1}$. The former is Chinese energy investment amount variable ($Invest\ Amount_{j,t}$). It is the natural logarithm of one plus the amount of Chinese energy investment in the country *j* in the year *t.* The latter is Chinese energy investment dummy variable ($Invest_{j,t}$), which equals one in the year *t* when there are Chines energy investment in the country *j* and zero otherwise. That is, $Invest_{j,t}$ = 1($Invest\ Amount_{j,t} > 0$). Data on Chinese energy cooperation with foreign countries comes from the Chinese Global Investment Tracker compiled by the American Enterprise Institute.

In addition, we are more concerned about whether energy cooperation under the BRI is more effective and promote the performance of energy companies more. Therefore, following a difference-in-difference approach, we add the interactive item of $BRI_{j,t}$ and $Co_{j,t}$ based the equation (1).

$$Performance_{i,j,t+1} = \beta_1 BRI_{j,t+1} * Co_{j,t+1} + \beta_2 Co_{j,t+1} + \beta_3 BRI_{j,t+1} + \delta X_{i,t} + A_i + B_t + \varepsilon_{i,t} \quad (2)$$

where $BRI_{j,t}$ is a dummy variable that equal one if country *j* is under the cooperative framework of BRI after 2013 and zero otherwise.

To reduce the influence of extreme values, we winsorize all continuous variables at the 1 per cent level. Table 21 reports descriptive statistics of company characteristics and energy cooperation indictors. There are Chinese energy investments in 56.5 per cent observations.

[Insert Table 2. here]

Table 2. Company Characteristics and Energy Cooperation Indictors

As shown in Table 3, there are significantly positive impact of Chinese energy investment on energy companies. If China makes energy investment in a country, the ROA of energy companies

in this country will increase by 0.96 on average. For every one percentage point increase in Chinese energy investment amount, the ROA of energy companies in the corresponding country will increase by 0.2 on average. From the regression (3), we find that the key variable of interest, the interaction term between energy investment and BRI, is significant and positive. This suggests that energy investment under the BRI framework has further enhanced the performance of energy companies, highlighting the natural advantage of energy cooperation under the BRI framework.

[Insert Table 3. here]

Table 3. The Impact of Chinese Energy Investment and the BRI

3.2 Australia-China bilateral energy cooperation: a reality check

As shown in Figure 1 and Figure 2, after China became a member of the World Trade Organization in 2001, the trade volume between China and Australia began to grow rapidly, especially in the energy sector. Australian exports of ores and mineral fuels, mainly coal, took off. Iron ore has now been Australia's main export to China for many years. Against the backdrop of the Paris Agreement and environmental concerns, coal, which was up to 2018 Australia's second-largest export commodity to China, started to face challenges from the overall restrictions imposed on coal consumption and the impact of volatile coal industrial policy on production.

[Insert Figure 1. here]

Figure 1. Bilateral trade between Australia and China

[Insert Figure 2. here]

Figure 2. China's energy import from Australia

Liquefied natural gas (LNG) replaced coal as Australia's second-largest export commodity in 2018. China began to import LNG in 2006, bringing Australia into China's energy landscape. Now LNG is one of Australia's main export commodities, second only to iron ore (Liu et al., 2020). Australia has surpassed Qatar to become the world's largest exporter of LNG in 2018 and the largest

supplier of LNG to China, which comprises 46 per cent of China's imports as of November 2018 and 33 per cent of Australian total export.[3] The LNG market in China remains broad and continues to expand rapidly. In 2017, LNG in China accounted for 8 per cent of the total energy supply, far below 23 per cent of the world (BP, 2019). The trade volume and proportion of LNG between the two countries is expected to increase further. Despite the declining export of iron ores and coal, China is Australia's largest two-way trading partner in goods and services (valued at US$145.4 billion in 2018) and Australia's largest resources and energy market, with imports from Australia worth more than US$57.7 billion in 2018, more than a quarter of Australia's total exports of goods to all countries (UN Comtrade International Trade Statistics Database, 2020).

It is worth noting that bilateral energy trade between Australia and China showed significant decline in 2015 and 2016 instead of continuous growth, even after both countries signed the China-Australia Free Trade Agreement (ChAFTA) in 2015. This was mainly due to the downturn in international commodities, the decline in demand for iron ore in China, and the decline in political relations between China and Australia. Bilateral trade between the two countries quickly resumed in the following years. In the long-term, bilateral trade between Australia and China has shown a continuous upward trend, notwithstanding a short-term decline in the trade volume and adjustments in the trade structure.

In fact, China has been Australia's largest trading partner since late 2007 and Australia's largest export market since 2009 (Australian Embassy China, 2020), presently accounting for over 30 per cent of its total exports. This has sparked vigorous domestic debate in Australia whether Australia is overly economically dependent on China, where energy trade dominates (Mao, 2020). Hence, multi-channel energy cooperation will benefit the long-term energy cooperation between the two countries.

Apart from trade, Chinese investment in Australia has substantially increased over the last decade, and overwhelmingly concentrates on Australia's natural resources, including iron ore and LNG, driven mainly by China's rising domestic demand. Consolidating production and supply chains and acquisition of overseas resources are considered to be key measures for ensuring China's energy and resource security and its economic growth. However, after the global financial crisis in

[3] We would like to thank He Quanlin and Li Haoyang, masters from School of International Studies of Renmin University of China, for their data in the report on China's international energy cooperation (2018).

2008 and the emergence of a "new normal" growth model, China's demand of energy and resources has slowed down. Although the levels of investment from Hong Kong SAR (fifth largest foreign investor) and from China (ninth largest foreign investor) in Australia have grown significantly over the last decade, China's direct investment in Australia has experienced a decline for two consecutive years, from AU$85.0 billion in 2016 to AU$64.0 billion in 2017 and AU$63.6 billion in 2018 (Dfat, 2020).[4]

Most investment has flowed into resources, but is gradually moving towards agriculture, tourism, and infrastructure with a shrinking demand for energy and resources in China. Coincidentally, Chinese investment into Australia also shifted away from coal and LNG in the past few years. As show in Table 2, Chinese total investment in energy/resource sector of Australia amounted to AU$1,585 million AUD in 2018 and AU$231 million in 2019, with 85 per cent decline in 2019. However, different sectors show quite different trend. For example, Chinese investment in mining decreased by 90 per cent while that in conventional energy and renewable energy in 2018 increased by 295 per cent and 217 per cent, respectively compared with the total in 2017. Whereas in 2019, Chinese investment into energy and renewables showed more of a decline compared to that in mining (KPMG and University of Sydney, 2019;2020).

[Insert Table 4. here]

Table 4. Chinese Investment in Australia by Industry in 2018 and 2019

As part of this new trend, large strategic investments in resources, energy and infrastructure have given way to smaller investments, primarily by private investors, into projects that are tactical and directly linked to Chinese consumer market demand. Mining investment has likewise shifted towards lower deal sizes. The only large deal in 2018 is the acquisition of a majority stake in a mining asset in Laos owned by MMG Australia. There were no major Chinese investments in 2018 in areas such as energy (oil and gas), infrastructure and renewable energy in Australia.

Moreover, such investment has been subject to closer scrutiny by the Australian government based on national interest, resource security, resource pricing, corporate social responsibility, environmental regulation, and local culture protection. In recent years, the political tensions between Australia and China have paralleled with a significant decline of Chinese investment in Australia.

[4]

Although there is no overarching consensus, economic, political, and social factors are widely discussed in explaining the challenges of the Chinese energy investment in Australia. The substantial investment in the energy and mining sector by Chinese investors, with the majority of Chinese state-owned enterprises (SOEs), has raised concerns about weakening local energy suppliers' bargaining power. Immature investment arrangements can also cause failure. Take the case of Rio Tinto, for example, where Chinalco tried to reach a complex joint venture arrangement with convertible bond proposals, making it miss the optimum window of opportunity in making a straightforward equity deal (Yao et al., 2010).

The market-based nature of Chinese SOEs is viewed with suspicion and the support from state-owned banks they receive leads to anxiety, raising the doubt that they are investment decisions of the Chinese government instead of firms and making the sensitive deals even more difficult. The other concern is that more Chinese interference in Australian policymaking could been seen though the mining industry. The more powerful influence energy/resource sector has exerted on politics (the so-called resource-politics) maybe lead to the backfire on Chinese investment. What's worse, some states seek to influence the federal trade and investment policy with China, embarking on infrastructure reform and seeking to shape policy in areas such as migration that have clear Commonwealth jurisdiction, which will strengthen the political concern (Jayasuriya and Cannon, 2015).

The intention to ensure supply security by pursuing upstream investment also leads to the backfire towards Chinese resource investment in Australia (Beeson et al., 2011). An anti-China sentiment on the rise in Australia has also started to impact on Chinese energy investment. Moreover, there is an increasing tendency for economic issues to be politicised. Both society and political circles are increasingly divided into 'doves' and 'hawks' in terms of their positioning on China, which is the foundation for Australia's nuanced position (Bisley, 2018).

4 Suggestions on Australia-China Energy Cooperation under the BRI

Based on the natural advantage of energy cooperation under the BRI framework, we further analyse the potential of Australia-China cooperation in energy. A framework (Table 5) with two dimensions is proposed: a country dimension and a fuel-type dimension. On the first dimension,

three types of countries are focused on: Australia (A), China (B) and Third Countries (C); on the second dimension, energy is divided into three groups: fossil fuels (1), low-carbon fuels (2) and infrastructure (3) which includes physical infrastructure and institutions. The analysis is done based on the framework, staring with the country dimension.

[Insert Table 5. here]

Table 5. Potential Energy Cooperation between Australia and China

In Australia, the potential for energy cooperation includes:

In the fossil fuel area, investment goes into resources and export projects for coal and natural gas, as well as power plant upgrading (A1). Australia is the world's largest LNG exporter while China is the world largest gas importer and on the road to be the largest LNG importer as well. Given the synergy in resources, it is in Australia and China's interests to establish a stable, healthy, and long-term relationship based on energy and resource demand and supply. In as early as 2006, such an aim was included in a six-point agreement between then-Chinese Premier Wen Jiabao and then-Australian Prime Minister John Howard. Furthermore, shifting from resource trade to resource investment is a key factor in deepening the bilateral economic relationship. Chinese Premier Li Keqiang had also called in 2011 for both sides to go beyond "a simple buyer–seller relationship" and to "make innovation in new and cooperative ways", indicating some openness on the Chinese government's part to encourage more investment into Australian resources, at least at that point in time. Spillover of tensions between the two countries into the economic realm are altering the lay of the land.

In the electricity sector, Australia's electricity is mainly generated by ageing, inefficient, coal-fired power plants, many of which will not to be replaced within this decade (Climate Council, 2014). Despite mounting pressure to reduce emissions, Australia is still planning to introduce new power plants, albeit with stricter emission and efficiency standards. The closing-down of one of the ageing powers plants, Hazewood, has caused national concern about potential blackouts and price spikes. Australia is said to contemplate closing nine old coal-fired power plants with a combined capacity of 5.4 GW (Uhlmann, 2017).

More importantly, Australia is open to international investors on clean coal technology. Since

Chinese thermal power plants are more efficient than most of the Australian ones, China could supply thermal power equipment to the latter. China is the world's leader in coal-generation efficiency and emissions control: its ultra-supercritical generation units perform 11 per cent better than the top plants in Japan and Europe. While higher efficiency in coal-fired power plants often means employing modern technologies, a report shows that China has invented new technology to upgrade existing subcritical coal-fired power plants without dismantling the infrastructure already there (Callick, 2017). On the Australian side, due to the closing down of aging coal mines without proper replacement, the country is facing higher electricity prices. As long as coal-fired power plants are still active in Australia, Chinese investors can provide Australia with investment and technology. There could also be joint R&D in thermal power technology and equipment (B2) between the two countries in thermal power generation to make generation cleaner in both countries. On March 27 2018, China and Australia launched the carbon dioxide capture and storage technology project, a joint research project on climate change, in Brisbane, which will further strengthen their cooperation on technology and environmental protection and energy. However, cooperation in CCT could drag China into controversial debates on coal-fired power plants in Australia.

China and Australia may also have opportunities to cooperate in building Australia's infrastructure. Despite being the largest LNG exporter, Australia's domestic market claims face gas shortage (Grafton et al., 2018) and thus brings about a few opportunities for cooperation. On the supply side, both countries can discuss the possibility of reviewing LNG contracts to release more supply for Australian domestic markets. They could also jointly develop gas pipelines, and even LNG regasification terminals (A3). The high price in Australia is a result of fragmented markets, which could be solved by pipeline development. Australia, despite being on the way to become the world's largest LNG exporter, still needs regasification terminals to send LNG from Australian producers and international markets to its domestic consumers. Since Australian cities are mostly sitting along coastal areas, such terminals are more cost-effective than pipeline connections.

Investment from China into Australia does not necessarily need to flow into traditional resources such as coal or natural gas. Clean energy, for example, is an important area that both sides are keen to highlight. Australia is the sunniest and one of the windiest countries in the world (Climate Council, 2014). And there is a significant temporal synergy between wind and solar in Tasmania, south-eastern and North Australia (about 40 per cent within a distance of 93 per cent). In

fact, in view of the potential energy crisis caused by the closure of old power plants, the number of photovoltaic installations in Australia has exploded in recent years. In 2018, 3.7757GW of photovoltaic power was installed, and one-fifth of households had their photovoltaic systems. However, given Australia's huge electricity consumption, PV generation, 729.2 GWh, accounted for only 0.3 per cent of the electricity generation in 2017-18. Nearly 70 per cent of the electricity generation is still provided by coal and coal by-products (Australian Bureau of Statistics, 2019).

Since China has mature technology and expertise in developing and deploying low-carbon energies such as nuclear, wind and solar power, and since Australia is rich in these resources, cooperation between them (A2) is not only complementary but also helpful for both to transit to a green economy. Furthermore, Australia and China have significant potential in the future development of hydrogen. Australia is aiming to be one of the op 3 hydrogen exporters (COAG Energy Council, 2019) in the Asian market, while China will be the largest hydrogen user and an importer by 2030 (IEA, 2019). This complexity in the future provides enormous opportunities for bilateral energy cooperation.

The development of renewable energy will create demand for grid extension, particularly in a decentralised scenario, because many of Australia's renewable resources are located far from electricity load centres (Climate Council, 2014). In this case, Chinese investment and even high-voltage transmission technology (A3) would help Australia transport the clean electricity.

In the Chinese market, except for the joint R&D in thermal power that has been discussed, Australia could use investment in China's coal and LNG projects (B2) to integrate China's energy supply chain. Australia's wide experience in electricity markets could also be useful (B3) for China's nascent electricity market reform.

While there is an opportunity for Australia and China to engage directly within the BRI framework, this is not the only avenue for cooperation. The two countries could also look towards cooperating in developing the market in third countries. For example, their firms can jointly invest in coal and LNG facilities (C1) and infrastructure (C3) to facilitate the export of Australian resources and the sale of Chinese equipment and engineering services. The two countries could also join hands in reshaping the much-needed global energy governance (C3) (Andrews-Speed and Shi, 2016). Both countries are members of a few important global and regional clubs, such as G20 and APEC, with the capability needed to set a new agenda for global debates in energy governance. In a joint

statement issued after the third RCEP leaders' meeting in Bangkok, the 15 member countries concluded all text negotiations and all market access negotiations. They committed to ensuring the signing of the agreement in 2020, which will set up a new platform for energy cooperation between China and Australia.[5] By doing so, Australia can develop beyond a resource economy with an extended supply chain which may hedge the Australian economy from commodity price fluctuations.

As for China, its significant share in the world total energy sector and its growing overseas interests make the country vulnerable to international energy market changes. Over the last 15 years, China has become the world's largest net importer of oil, a major gas importer, and a significant player in seaborne coal markets (BP, 2015). The overseas investments by its energy companies exceed US$200 billion (Humphreys, 2015), and China is the world's largest exporter of wind and solar energy equipment (Kong, 2011). Therefore, it has a growing interest in joining and reforming global energy governance to protect its interests.

5 Conclusion and Policy Implications

Recent years of economic slow-down have threatened the traditional model of economic relationship between China and Australia (in which resources, energy trade and investment play a key role), and have brought about the risk of unsustainability. This unsustainability is particular serious, given China's recent announced commitment to achieve carbon neutrality by 2060. Both Australia and China have acknowledged the above-mentioned risks and are thus determined to find out ways to avoid them by adopting different hedging strategies accordingly. The Chinese government made the decision to invest overseas in the hope of integrating its productivity and adjusting its supply chains. At the same time, the Australian government is attempting to diversify its services and other exports from China.

We find that energy cooperation under the BRI, especially Chinese energy investments, enhances the performance of energy companies, highlighting the natural advantage of energy cooperation under the BRI framework. However, Chinese energy investment in Australia faces mounting challenges. The Australian community has concerns such as weakening the bargaining power of local energy suppliers, the investment decisions SOEs backed from state-owned banks,

[5] Lin, H., and Wang, J. (2019). Major progress was announced in a joint statement issued by RCEP leaders, Retrieved from http://www.xinhuanet.com/2019-11/05/c_1125192213.htm

resource-politics. An anti-China sentiment on the rise in Australia has also started to impact Chinese energy investment. Moreover, there is an increasing tendency for economic issues to be politicised.

Our analysis suggests that BRI provides potential and new forms of energy cooperation between China and Australia. Our analysis also suggests potential areas under the BRI framework that both countries might have common interests. For example, the gas supply crisis in Australia provides a good chance for both countries to review their LNG contracts and jointly develop gas transportation infrastructure, including pipelines and regasification terminals. More importantly, China and Australia can deepen their relationship by not only enhancing their current trade and cooperation, but also by exploring market opportunities together in trade and infrastructure in third countries.

In the case when both countries resume cooperation, there are still changes to be made to realize the potential benefits. Chinese firms should learn how to operate in Australia with cooperation and input from local partners and with responsibility and environmental governance. The Australian community needs to deepen its understanding of the increasing activities of Chinese investors. Amid the increasing trade and political tensions, the two countries need continued, level-headed discussion and debate about the potential cooperation areas at all levels.

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Table 1. Countries along the Corridors of the BRI

Corridor	Countries along the Corridor
New Eurasian Land Bridge	China-Kazakhstan; Russia; Belarus; Poland-Czech Republic-Holland (All these new rail routes offer rail-to-rail freight transport, and are also known as the 2nd Eurasia Land Bridge)
China-Mongolia-Russia Corridor	China, Mongolia and Russia (High-speed rail and road links; this route has been open for freight trains)
China-Central Asia-West Asia Corridor	China-Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan and Turkmenistan)-West Asia (Iran and Turkey)
China-Indochina Peninsula Corridor	China and the five countries in the Indochina Peninsula: Greater Mekong Sub-regional ASEAN countries (Cambodia, Laos, Myanmar, Thailand, Vietnam)
China-Pakistan Corridor	China-Pakistan
Bangladesh-China-India-Myanmar Corridor	Bangladesh-China-India-Myanmar

Note: The BRI features six economic corridors. On land, it will focus on jointly building a new Eurasian land bridge and developing China-Mongolia-Russia, China-Central Asia-West Asia, and China-Indochina Peninsula economic corridors by taking advantage of international transport routes, relying on core cities along the belt and road and using key economic industrial parks as cooperation platforms. At sea, the Initiative will focus on jointly building smooth, secure, and efficient transport routes connecting major sea-ports along the belt and road. The China-Pakistan Economic Corridor and the Bangladesh-China-India-Myanmar Economic Corridor are key routes of the initiative, necessitating even closer cooperation and greater progress (NDRC, 2015).

Table 2. Company Characteristics and Energy Cooperation Indictors

Variable	*N*	Mean	Std. dev.	Min	Max
ROA	16765	-4.927	19.4382	-83.08	39.26
Invest	16793	0.565	0.4958	0	1
Invest Amount	16793	4.0098	3.6576	0	9.9423
BRI	16793	0.238	0.4259	0	1
Size	16580	11.5987	3.1813	2.7081	18.205
Growth	12663	41.8296	221.1491	-99.9837	1811.3953
Labor	9989	11.3706	16.4505	0	79.51
R&D	14380	0.5079	2.1943	0	17.07
Cash	16351	13.0944	19.1586	0	80.42
Age	16666	21.7835	20.8859	0	146

Table 3. The Impact of Chinese Energy Investment and the BRI

	(1)	(2)	(3)	(4)
	ROA	ROA	ROA	ROA
Invest	0.9592*		0.1435	
	(0.5288)		(0.686)	
Invest Amount		0.2072***		0.1265
		(0.077)		(0.0992)
BRI			-0.44	-0.4283
			(0.8982)	(0.8894)
Invest * BRI			1.8568*	
			(1.0085)	
Invest Amount * BRI				0.2037
				(0.152)
Control variables	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Company	Yes	Yes	Yes	Yes
N	7366	7366	7366	7366

Notes: Standard errors are in parentheses. ***, ** and * indicate significance at the 1, 5 and 10 % levels, respectively. For the sake of brevity, the estimates for control variables (Size, Age, Growth, Cash, R&D, Labor) are not reported.

Table 2. Chinese Investment in Australia by Industry in 2018 and 2019

	2018			2019		
Industry	Value	Percentage	Change	Value	Percentage	Change
Healthcare	3436	42%	111%	0	0%	-100%
Commercial Real Estate	3027	37%	-31%	1479	43%	-51%
Energy (oil and gas)	726	9%	295%	0	0%	-100%
Mining	464	5%	-90%	208	6%	-55%
Renewable Energy	395	5%	217%	23	1%	-94%
Infrastructure	100	1%	-79%	0	0%	-100%
Food & Agribusiness	85	1%	-92%	1528	44%	1699%
Services	11	0%	-96%	195	6%	1675%
Total	8244	100%		3433	100%	

Source: The KPMG/Sydney University database

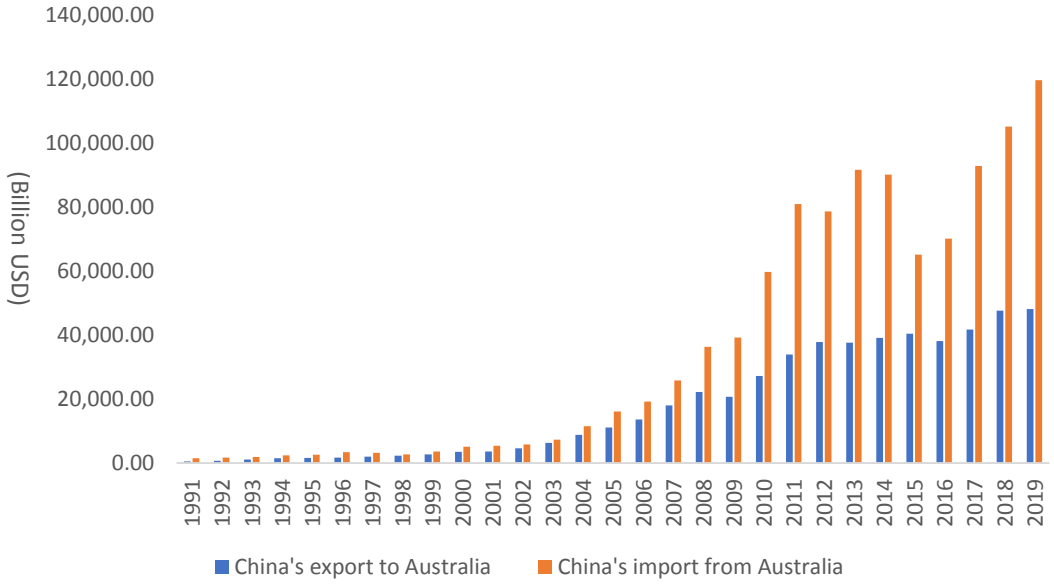
Notes: The column Value, Percentage and Change represent the Chinese investment amount (AUD million) in Australia in the corresponding industry, a percentage of the total for the year, the yearly change rates in %, separately.

Table 5. Potential Energy Cooperation between Australia and China

	In Australia (A)	In China (B)	Third countries (C)
Fossil fuels (1)	Investment in resources and export projects; and power plant upgrading	Export of LNG and coal, Joint R&D in thermal power	LNG regasification terminals
Low carbon energy (2)	Wind farms, solar power, Hydrogen		
Infrastructure (3)	Grid extension, Gas pipeline, LNG regasification terminals	Australian services in electricity markets	Transnational grid for reasons such as exporting Australia resources, global energy governance

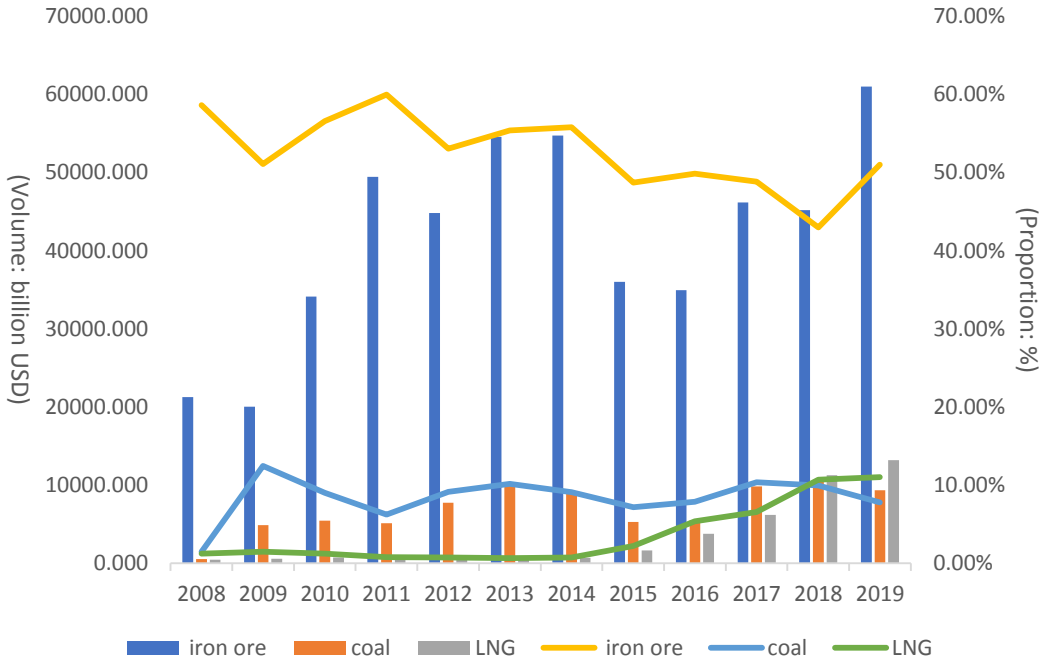
Notes: Based the natural advantage of energy cooperation under the BRI framework, a framework with two dimensions, a country dimension and a fuel-type dimension, is proposed, which analyzes the potential of Australia-China cooperation in energy. On the first dimension, three types of countries are focused on: Australia (A), China (B) and Third Countries (C); on the second dimension, energy is divided into three groups: fossil fuels (1), low-carbon fuels (2) and infrastructure (3) which includes physical infrastructure and institutions. The analysis is done based on the framework, staring with the country dimension.

Figure 1. Bilateral trade between Australia and China



Source: CEIC database

Figure 2. China's energy import from Australia



Source: CEIC database

Notes: The left column is China's energy goods import volume from Australia. The right one is the proportion of China's energy goods import on total import from Australia.

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