



China and Lithium Geopolitics in a Changing Global Market

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Abstract

The energy market is shifting from fossil fuels to renewables. This transition is creating new geopolitical dynamics. In the past, traditional energy geopolitics focused on the concentrated distribution of fossil fuel resources and the conflicts and dependencies that this created. In contrast, the ‘new’ renewable energy geopolitics emphasises the dispersed distribution or decentralisation of production capacity and the independence of states this generates. However, the market for lithium, which is essential to renewable energy storage through being a key component of lithium-ion (Li-ion) batteries, does not entirely fit theoretical conceptions of the renewable energy market’s dynamics. By focusing on China as a critical case, this article shows that lithium geopolitics has potentially created new (inter)dependencies and opportunities for conflicts, while also paradoxically enhancing state interdependence in renewable technology energy production. Thus, this hybrid form of energy geopolitics necessitates revising conventional energy security explanations to match these new market conditions.

Keywords Lithium geopolitics · Lithium-ion batteries · China · Electric vehicles · Lithium market

1 Introduction

Energy geopolitics is changing during the transition from fossil fuels to renewable energy. In the past, natural resources (e.g. coal, oil and gas) have been geographically concentrated and limited. Producer states have then felt empowered to use resources as a ‘weapon’ against consumer countries (e.g. the 1973 global oil crisis). Whether buyer states follow such conflict-oriented policies (Klare 2008) or accept interdependence with producers (Keohane 1984) reflects their past experiences and strategic priorities. However, the transition to renewable energy, in which environmental considerations are significant, is changing the energy

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market's shape. States can, in theory, produce their energy without relying on foreign sources as production becomes decentralised. Thus, for the first time in the global energy market, true “energy independence” seems more realistic for individual states. However, this argument could be challenged if we consider the storage of renewable energy, which may represent an exception due to the reliance on rechargeable lithium-ion (Li-ion) batteries. Lithium resources and the production of Li-ion batteries are concentrated in the hands of a few states, creating the potential for new conflicts and dependencies to emerge.

Lithium is essential to renewable energy as it is an important component in the production of rechargeable batteries. The significance of Li-ion batteries has increased in global automotive markets alongside the expansion of the market for electric vehicles (EVs). Moreover, “the Li-ion can be the battery of the first choice for energy storage” for a range of rechargeable consumer products (Diouf and Pode 2015, p. 375). Problematically, however, lithium production is concentrated in a limited number of places. South America has around 75% of the world's reserves, with Argentina, Chile and Bolivia representing the so-called ‘lithium triangle’ of producers. Thus, during the transition towards renewable energy market dynamics, old energy market realities concerning conflict and dependency still potentially exist. Centralised resources in a decentralised energy market are, therefore, a contradiction when viewed from existing theoretical perspectives. Such a new reality consequently requires an investigation of lithium geopolitics within renewable energy geopolitics to better understand this dynamic. The key research question is: *To what extent has the ‘old’ energy geopolitics politics of conflict versus interdependence transformed in the shift from fossil fuels to renewables and if so, are new dynamics around lithium geopolitics being created?*

China is an exceptional case to investigate lithium geopolitics. Chinese companies control half of global lithium production and over 70% of Li-ion battery manufacturing (Benchmark Mineral Intelligence 2020). Until recently, the United States (US) and Europe have not taken significant steps to stop such dominance (Kumagai 2021). No direct conflict has emerged between China and other big powers, or between China and the key producer states over access to lithium resources despite the trade war (Tu et al. 2020). As such, there are no conflict-oriented policies as was the case with oil production. Access to oil has historically caused confrontations between the US and supplier states [e.g. the First and Second Gulf Wars, the Carter Doctrine (Carter 1980)]. The main difference today is that what the US represents for oil producer countries is not the same as what China means to lithium-rich or lithium-dependent states. Australia is an exception here because of its geographical proximity to China and historical enmity-amity relations with China and Western powers, respectively. Moreover, China has largely sought interdependency in supplies with other countries but also created new interdependencies in technological development and supremacy (Zhang and James 2022; Soligen 2021). Such a contemporary focus on China reflects its growing market dominance, which could create new conflicts in the future as generating challenges to existing global rules (Jones 2020) under the debate of alternative order (Eun 2022). There is an evolution in geopolitics and international economic relations (Zeng 2022). Thus, during the

transformation into a new energy reality, the old concepts and debates concerning fossil fuels cannot be easily left behind.

This article is composed of three sections. The first one reviews energy geopolitics to determine its key concepts and theoretical assumptions, to show how the ‘old’ politics of conflict and dependency concerning fossil fuels has, theoretically, changed under the ‘new’ renewable energy market. It then discusses how lithium geopolitics may challenge these assumptions by reflecting elements of both traditional energy geopolitics and renewable energy dynamics, to establish the research framework. The second section then shows how this hybrid form of geopolitics plays out in practice, with an emphasis on China and the lithium market. Finally, the article discusses how future research on global lithium geopolitics may evolve.

2 Theorising the Transformation of Energy Geopolitics

2.1 Liberalism, Realism and the ‘Old’ Energy Geopolitics of Fossil Fuels

The geopolitical aspects of energy have traditionally been defined by various theories and priorities but relate primarily to the distribution of resources (Table 1). Realist theorists (Klare 2008) prioritise the danger of competition over resources, while Liberals tend to observe resource market dynamics in influencing energy geopolitics (Chester 2010). These assumptions on how inter-state relations work also shape the arguments on how the energy market is constructed and whether it has interdependence dynamics (Keohane 1984) or independence aims (Luft 2009). We can consider both of these perspectives sequentially with energy geopolitics generally and fossil fuels specifically.

Both Liberalism and Realism have offered long-established theoretical explanations for energy geopolitics that have reflected the past dominance of fossil fuels in national energy mixes (Yergin 2005; Luft and Korin 2009). For Liberals, such geopolitics can be interpreted in terms of the market and the distribution of energy resources. Here, the main concern is whether energy sources are available or affordable to consumer states so that they can achieve energy security (Yao and Chang 2010). Diversifying energy sources allows such states to achieve this through cooperation with supplier states and transport states (Yergin 2005). As importers are primarily developed states it is, in theory, in their interests to help exporter and transit states, typically developing countries, in terms of infrastructure. This relationship, it is argued, leads to more social and political stability in these producer states. Thus, there is an emphasis on creating ‘interdependence’; a feature evident in relation to the fossil fuels market when it is based on mutual relationships between supplier and demander states. For example, Pakistan’s geo-strategic location provides an alternative route of fossil fuel the access to the energy-rich Persian Gulf region to the Chinese government (Javed and Ismail 2021).

Realists, in contrast, view energy geopolitics about state power and the distribution of energy resources (Klare 2008). Rather than seeking energy ‘interdependence’ they promote ‘independence’, often at the expense of other countries. Although Realist theory diverges in terms of how states pursue energy security, mainstream

arguments focus on competition within the anarchic international state system (Cheon and Urpelainen 2015). Due to such anarchy, states use their power to gain independent control of energy sources to avoid energy insecurity. Thus, for Realists, energy security becomes a national security issue related to foreign policy. These features, it is argued, are evident in the oil policies of leading states as neomercantilist strategies.

2.2 The ‘New’ Geopolitics of Renewable Energy

While these mainstream theoretical arguments have dominated past understandings of energy geopolitics, the current energy transformation, involving replacing fossil fuels with renewables, requires further theoretical interpretation. Here, rather than a focus on the distribution of resources, the ‘new’ geopolitics of renewable energy engages with the distribution of production capacity due to the nature of technological change (Table 1).

Technological advances and innovation are the main determinants of increasing state interdependence in the “new” energy geopolitics (Crikemans 2011; Paltsev 2016; Scholten and Bosman 2016). The central importance of technology comes from the geotechnical aspect of geopolitics composed of the interaction between technology and geography (Deudney 1997). The geopolitics of renewables are different from conventional energy geopolitics in terms of decentralisation of the energy market and the opportunities for states to secure energy independence because of this interaction (Hache 2018). Renewables can be produced anywhere with suitable conditions such as sufficient solar insolation or wind patterns, while oil and gas are only produced in limited regions, leading to multi-polarity in state energy independence. The location of oil and gas reserves has to an extent defined the policies of the big powers towards producer regions, i.e. independence or interdependence. However, a technological and technical innovation race is occurring for various energy sources that challenge this traditional relationship (Scholten et al. 2020).

The new energy geopolitics is, therefore, more symmetrical than before when considering the decentralisation of energy production but it also potentially reduces

Table 1 Theoretical arguments on fossil fuels, renewable energy and lithium geopolitics

Geopolitics	Empirical focus	Key arguments
Fossil fuels	Distribution of energy resources and transportation channels	States pursue either energy independence or interdependence
Renewable energy	Distribution of energy production capacity	Decentralized energy production provides states with energy independence but is also creating technological interdependency through mutual contribution
Lithium	Distribution of lithium resources and technology production	Geographically concentrated resource production means states pursue independence or interdependence but decentralised technological production leads to new interdependencies

state competition through renewables technological development (Newell 2019) and attendant increases in technological interdependency. Resource nationalism has been one of the most significant determiners of energy geopolitics since the 1973 oil crisis (Raphael and Stokes 2015). Competition in energy geopolitics was related to control over the market, with a distinct separation between consumers and producers. However, in the renewables market, centralization of clean energy investments for innovating, manufacturing and installing technologies “emerges from the synergistic interaction of mutually reinforcing activities undertaken by states pursuing capital accumulation” (Lachapelle et al. 2017, p. 324). The race towards renewables is, therefore, a race of mutual contribution between states rather than control over the market. Through time, the technological production capacity of states evolves through reciprocal interaction, whether it is intentional or not. In traditional energy geopolitics, however, national interests have created centralizations of power.

The energy transition, therefore, changes the debate on energy security from questioning “who controls what?” to “how vulnerable are energy systems?” (Cherp and Jewell 2011, p. 205). The geopolitical implications of the energy market are defined by this new context. While it once meant “a deterministic causal relationship between geography and international relations focused on the permanent rivalry, territorial expansion and military strategies of imperial powers”, it is now “the influence of geography on the power of states and international affairs more broadly, with less emphasis on determinism and more on the strategic importance of natural resources, their location, transportation routes, and chokepoints” which is significant (Overland 2019, p. 36). Such decentralised, multipolar, technology-led energy geopolitics, therefore, seems completely different to previous eras. However, critical questions emerge over how different this geopolitics actually is, particularly when considering lithium.

2.3 The Geopolitics of Lithium

Some of the characteristics of renewables geopolitics are evident when viewing the emerging lithium market. However, other aspects of the lithium market still exhibit features of the old politics of fossil fuels, leading to the creation of hybrid geopolitics (Table 1) that is causing states to pursue interdependence in resource access but, in parallel, interdependence in technological production in the form of lithium-ion (Li-ion) batteries. Moreover, this article hypothesises that such market dynamics have, to date, reduced the scope for inter-state conflict over access to resources and technological development. The race for market dominance in a global capitalist system pushes technological progress, which proceeds via mutual influences. Also, the lithium scarcity argument has only just become politically significant due to the recent rapid growth of the global EV market.

The geopolitics of lithium, which has recently stimulated a growing literature, has been defined according to several dynamics, namely whether it has a unique role in the energy market (Zicari and Fornillo 2017; Overland 2019), whether it has the potential to be geopolitically important in the future (European Commission 2018; Egbue and Long 2012), or how much it is different from fossil fuel geopolitics (Hunt

2015). Relative to other research, Kalanzsakos' studies (Kalantzakos 2019, 2020) provide a more comprehensive investigation, which examines the transition in critical minerals use and the geopolitical realignments related to them. These studies, however, attempt to observe the change in geopolitical conditions in parallel to the energy transition narrative. Lithium geopolitics, I argue, is unique compared to traditional and renewable energy geopolitics, for two reasons.

First, geographical concentration in lithium production means that consumer states must either pursue independence or interdependence to gain access to these resources. Here, in this argument, lithium is a vital strategic mineral, because most reserves are concentrated in South America or Australia, where there is no vertical integration (Kalantzakos 2020). What we then see in lithium production geopolitics is that there is a similar inter-state structure to conventional energy geopolitics, although they are not entirely the same. This unequal global distribution of lithium resources shapes consumer states' strategies, as in the traditional energy politics: achieving better and more productive renewable technology capacity creates a competitive race for market access to resources. From a Realist perspective, this situation supports market dominance over geopolitical dynamics, i.e. independence of supply. In contrast, Liberals would argue that consumer states should seek interdependence with producer states through economic or technological investments in infrastructure to better secure lithium supplies. Given that major conflicts over lithium supplies have not (yet) occurred in the same way over oil supplies, states it would appear are currently pursuing interdependence as a strategic approach.

Second, the centralising nature of lithium-dependent technological production means that producer states are becoming increasingly interdependent due to economic factors. As in renewables geopolitics, there is a centralization occurring in certain states around investment in lithium-dependent technologies such as Li-ion batteries for their innovation, manufacture and use in other technologies including EVs, supporting Lachapelle et al. (2017, p. 324) arguments regarding how states' pursuit of capital accumulation creates a "synergistic interaction" between mutually supporting activities. Such investments in Li-ion battery technologies, as discussed below, are increasingly concentrated in producer states in North America, Europe and East Asia, involving significant cooperation and interaction driven by the investments of multi-national corporations and state economic policy.

From these observations, hypotheses can be drawn on the nature of lithium geopolitics regarding the scope for inter-state conflict. Given that states have to date pursued interdependence in lithium supply, it can be hypothesised that conflict over resources has largely been reduced. In addition, while it is considered critical for battery technology (European Commission 2018), some believe that lithium politics will not take the place of "petropolitics", because this mineral is fully recyclable (Bos and Forget 2021). However, lithium is considered a rare element because it is "indispensable for the functioning of high-tech applications; highly geographically concentrated, often creating areas of contention in unstable parts of the world; and in growing demand" (Kalantzakos 2020, p. 1). Although recyclable, lithium reserves are finite and geographically concentrated, leading to potential shortages in the future (Egbue and Long 2012). This situation, we

further hypothesise, will compel states to pursue lithium security through gaining independent control of supplies via foreign policy actions; leading to inter-state conflicts similar to those over oil. Paradoxically, increasing interdependency in lithium-based technological production reduces the potential for conflict between states due to the economic benefits derived from cooperation. Such cooperation does not mean collaboration but reflects the policies of states oriented to race for capital increases within a neoliberal capitalist system. Conflict is avoided initially because of its economic and political outcomes. Moreover, conventional petrol and diesel cars still dominate the industry (Acea 2021), so lithium scarcity is not currently occurring. This situation has so far prevented lithium geopolitics from becoming a core debate in national security discussions. Both these arguments can be examined by using the case study of China.

3 The Lithium Market

3.1 Lithium's Role in Electric Vehicles and the Lithium Market

Transportation is one of the most significant contributors to greenhouse gas emissions (GHG) and global warming. Widespread improvements in EV technology can reduce the transport sector's negative impact on the environment (Egbue and Long 2012). There are several types of EV: lead-acid (LA) batteries, nickel-metal hydride (NiMH) batteries and Li-ion batteries. Although NiHM batteries had market predominance until the 2010s, there has been a subsequent transition towards Li-ion use (Majeau-Bettez et al. 2011), because Li-ion batteries are lighter and more energy-efficient. In 1992, when lithium batteries were introduced, they had only 10% more energy than NiMH batteries. In 2005, the average energy density of lithium batteries was 80% higher than that of NiMH batteries (Rodrigues and Padula 2017). This factor has supported the global market dominance of Li-ion batteries, which reached a 93% market share in 2020 (EIA 2021). However, this makes lithium one of the most strategic raw materials in the EV industry. As a result, lithium production has skyrocketed in a few years (Fig. 1). Li-ion batteries are environmentally acceptable, however, the availability, affordability and accessibility of their lithium components are becoming a contentious issue (Sovacool and Brown 2010).

Despite increasing supply, lithium prices have grown because of demand. Since lithium has become the central element in the current generation of batteries, spot prices for lithium increased, from \$6500 per metric ton in 2015 to \$17,000 per tonne in 2018 (Fig. 2). Lithium has also been taking an increasing market share due to global EV penetration (Fig. 3). Spot prices are also now recovering from the impacts of the COVID-19 pandemic (Tradingeconomics 2021).

There are three types of lithium products: lithium carbonate, hydroxide and chloride. Lithium carbonate is one of the lowest cost elements of a lithium-ion battery (Rodrigues and Padula 2017), so it is the world's most extensive lithium product in terms of output and trade volume (Martin et al. 2017). Lithium demand in 2018 was 270,000 metric tons of Lithium Carbonate Equivalent (LCE) and is expected to reach more than 1,000,000 metric tons of LCE by 2025 (Egan 2020). However, the

general lithium market is crucial in terms of supply competition and the strategic role of lithium. To date, lithium has become one of the most important materials in the global energy market during the energy transition and is known as "white petroleum" (Seefeldt 2020), which reflects its status as a strategic commodity rather than just a commodity. How the industry has moved away from oil to EVs can be traced via automotive industry demand (Fig. 4). Li-ion batteries are used by companies hosted in various states (e.g. the US, Japan, Germany) (Kulkarni 2020).

Around 75% of the world's known lithium reserves and over half of the world's lithium resources are located in the lithium triangle: Chile, Argentina and Bolivia. According to USGS (2021) and Statista (2021a), Argentina has 19 million tons, Bolivia has 21 million tons, Chile has 9.2 million tons, Australia has 4.7 million tons, and China has 1.5 million tons. However, the United States aims to improve its lithium reserves and production (S&P Global 2021). It is also worth mentioning that while batteries constituted 35% of lithium end-use products (e.g., ceramics and glass, lubricating greases, continuous casting mould flux powders, polymer production, air treatment) in 2015 (Martin et al. 2017), its share is now 71% (USGS 2021) and is expected to grow to 80% by 2025 (Bohlsen 2019).

However, investments in Li-ion batteries for EVs have reduced their costs by 80% since 2010 (Fig. 5). As the unit cost declines, renewable technologies are increasingly shaping a competitive business model, which can be described as a new form of the global energy market.

Technology not only reduces Li-ion battery costs but also helps to keep undersupply. Since Li-ion batteries can be recycled, lower economic, ecological, and social impacts can be achieved (Scheller et al. 2020). However, this technology also causes uncertainty, affecting market stability (Liu et al. 2020). This uncertainty is caused by

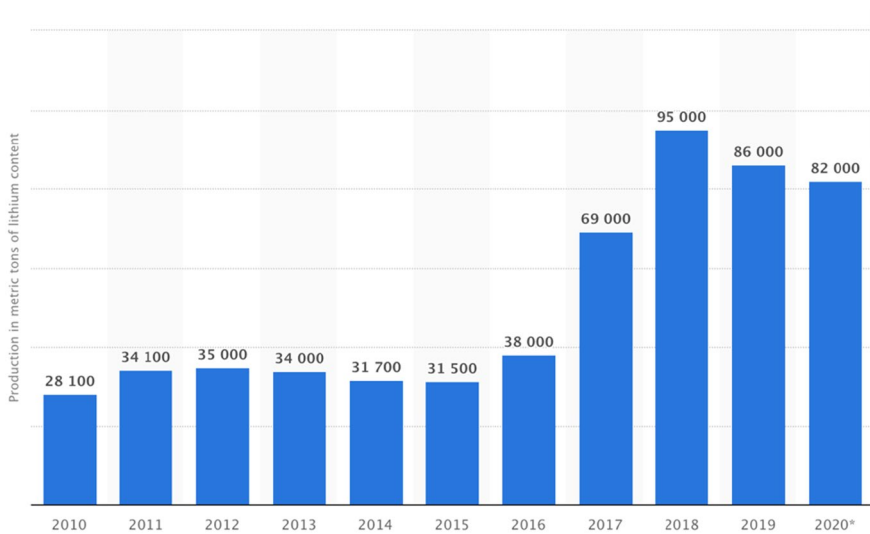


Fig. 1 Lithium mine production worldwide from 2010 to 2020 (in metric tons of lithium content) (Statista 2021a)

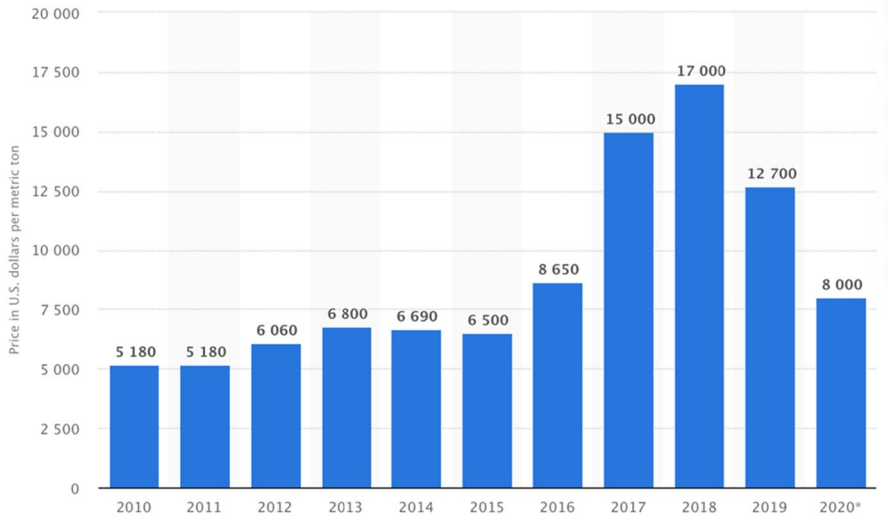


Fig. 2 Average lithium carbonate price from 2010 to 2020 (in US dollars per metric ton) (Statista 2021b)

the efficiency of recycling. The performance and durability of batteries made from recovered lithium might not reach the same quality level as those made from lithium raw materials (Sun et al. 2019). In Li-ion batteries, the recycling rate of lithium was less than 1% before 2015, while it reached 19% in 2018 (Liu et al. 2021). It is expected to reach 60% in the future (Ziemann et al. 2018).

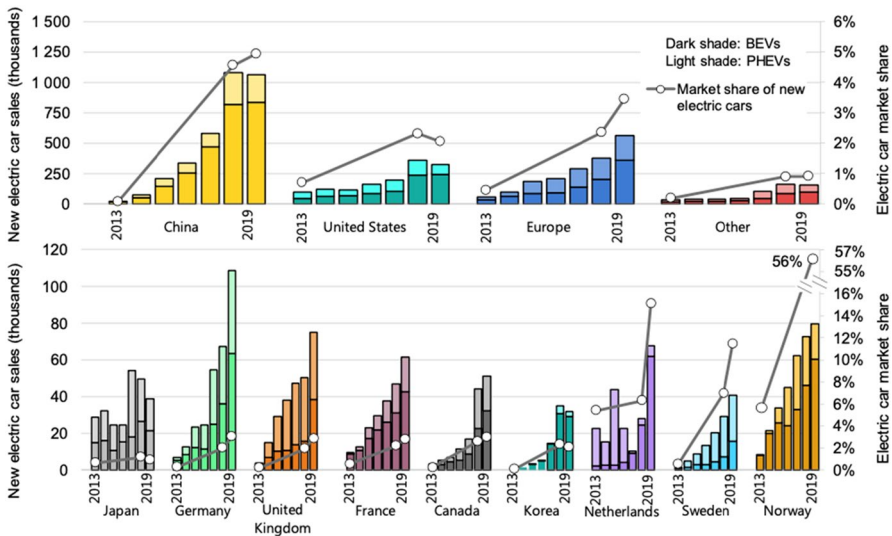


Fig. 3 Passenger electric car sales and market share in selected states and regions, 2013–19 (IEA 2020, p. 46)

Since economic, ecological, social and political aspects of lithium production are considered above, the environmental impacts should also be discussed. Several facts are undeniable: first, EVs are more environmentally friendly than cars that consume oil. Second, lithium is “the lightest of all metals” (USGS 2017, p. K1). However, water is necessary for lithium operations. Whether brine water or non-brine water is used does not matter but production can have an impact on water resources and the protection of wetlands (Heredia et al. 2020). It also harms the soil and causes air contamination. The mining of rare earth metals can also lead to the release of toxic byproducts. Moreover, since Li-ion battery recycling technology has not improved enough, Li-ion wastes can leak into the environment (IER 2020). In general, green energy is not as green as it is portrayed in contemporary discourses.

3.2 China’s Policies and Ambition for Li-Ion Batteries

Back in 2010, China dominated the global mining of raw rare earth materials, with 97.7% of production (China Power Csis 2021). Such dominance pushed other countries to increase their production so they could reduce China’s market share. As a result, it decreased to 62.9% in 2019 (China Power Csis 2021). The risks of global dependence then pushed the Chinese government to reduce export quotas of these elements by 40% in 2010, which also triggered an increase in prices (Hensel 2011). Such a decision motivated the EU, Japan and the US to file complaints with the World Trade Organisation (WTO), demanding consultation with China to moderate its restrictions.

The Chinese government guides resource investment and pricing to achieve supply security (Economy and Levi 2014). It adopts sustainable and comprehensive policies for guiding the Chinese government on strategic materials, thereby lithium and Li-ion batteries. The emphasis on rare earth minerals, environmental protection and energy efficiency has existed in three of the latest 5-year plans of 2011–2015 (CNPC 2011), 2016–2020 and 2021–2026 (CSET 2020). Low-carbon development has also been supported by various mechanisms such as the China Investment

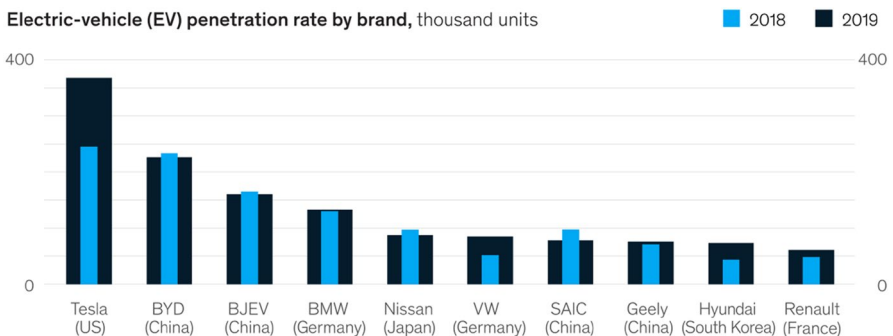


Fig. 4 EV penetration rate by brand and country origin 2018 and 2019 (thousand units) (McKinsey 2020)

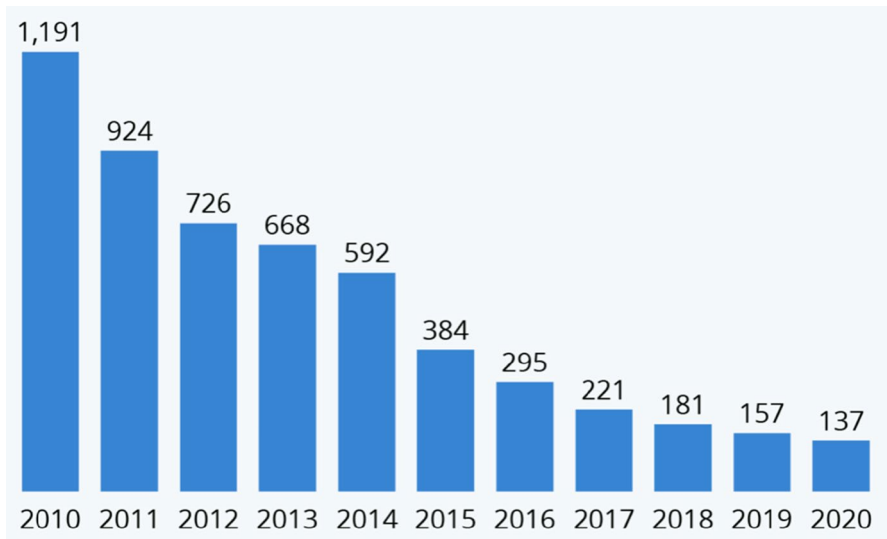


Fig. 5 Volume-weighted average of Li-ion battery price (in USD) (Bloomberg 2020)

Corporation, which was founded in 2007 to support Chinese enterprises' initiatives for the acquisition of unexplored deposits and exploration projects in any part of the world. In addition, other policy includes the report of the 19th National Congress of the Communist Party of China (Xinhua 2017), which declared a new historical direction for China's development transition as high-quality development rather than high-speed growth. In addition, a "New Energy Vehicle (NEV) industry development plan" (Xinhua 2020) will run from 2021 to 2035 along with the "Made in China 2025" strategy (SCPRC 2015) to promote high-end manufacturing, production of electric cars and clean energy technology. The pledge made in the Paris Climate Agreement 2015 and achieving high-quality development with greener energy sources have pushed China towards excessive dependence on imports and thereby increase the supply risk of lithium (Ziemann et al. 2018). China's foreign dependence reached 86% in 2015 (Hao et al. 2017). It also led to ambitious policies relating to state-owned lithium companies.

Although China is the fifth-largest lithium producer country globally, Chinese companies control half of global lithium production and over 70% of Li-ion battery production (Benchmark Mineral Intelligence 2020). China's Tianqi Lithium, listed on the Shenzhen Stock Exchange, became the second-largest shareholder in Sociedad Química y Minera (SQM), a Chilean mining company, in 2018. It also holds a 51 per cent stake in the world's biggest hard-rock lithium mine at Greenbushes in Western Australia (Kalantzakos 2019). It is a vertical operation as it is owned by China's biggest lithium producer Jiangxi Ganfeng Lithium. Ganfeng Lithium Co. also procured a 51 per cent share of Lithium Americas Corp's project in northern Argentina in 2020. These two companies held 30% of the global market share (Heredia et al. 2020). Chinese companies have also invested in Bolivian lithium reserves (Seefeldt 2020). In addition to these states, Ireland, Canada and Zimbabwe

host Chinese state-owned lithium mining companies (i.e., Ganfeng Lithium, Tianqi Lithium, CATL and SRG) (Zhou et al. 2020). One hundred and forty-eight of the world's 200 Li-ion battery mega factories, either in production or planned, are located in China, whereas Europe (21) and North America (11) had only 32 mega factories scheduled in 2021 (Benchmark 2021a). Despite foreign dependency, China seems to dominate the market by aggressively buying lithium-related assets globally (S&P Global 2021). This strategy is seen in Table 2, which shows purchase deals completed or pending.

Chinese market dominance is also evident in the context of the US–China trade wars. The Chinese government decided to cut subsidies to EV production by half in the summer of 2019 and eliminate subsidies for vehicles with ranges under 250 km, which has subsequently brought down EV sales. These twin policy decisions could quickly reduce lithium prices because of China's market dominance (Fig. 3). The Chinese Government's policies and companies' decisions toward Chinese dominance in the global lithium and Li-ion batteries market also find a match in society. Private electric car sales are projected to reach 66 million by 2030 (with a 37% sales market share); this will expand spending on Li-ion batteries (Hsieh et al. 2020). In China, over half of the lithium demand is for batteries, and battery lifespan is being extended (Guo et al. 2021). Domestic demand is being created, which generates pressure for more supply-oriented policies.

However, such an ambitious policy creates international responses both directly and indirectly. Until 2017, the US had not mined rare earth minerals domestically and imported most supplies from China. It then made rare earth elements part of a trade war with China. The US did not want foreign sources controlling its strategic mineral commodities (DOS 2019), so felt it necessary to intervene (FCAB 2021). The US produced 9% of Li-ion batteries in 2019 (Benchmark Mineral Intelligence 2020). The European Commission (2017) is also aware of lithium's criticality for battery technology. The "Horizon 2020" project was implemented as a financial instrument for sustainable growth (European Commission 2013), and the "EU Raw Materials 2050 Vision and Technology and Innovation Roadmap" was released to ensure reliable access to raw materials, including lithium (VERAM 2016). Under the current circumstances (see Fig. 6), China leads the Li-ion battery cell capacity in the world, but other big powers aim to reduce China's control capability in the market. There has not been a direct confrontation as in past petropolitics, rather there is competition led by private–public partnerships within lithium-rich states (Berg 2021).

4 Interpreting Lithium Geopolitics in China

As the case study shows, China is an exemplar of this new hybrid geopolitics related to lithium, both in lithium supply and lithium-based technological development and production. First, the geographical concentration of lithium supply and its limited availability has led to China adopting a strategic approach based on interdependency. As in the oil market, the lithium market relies on strategic locations and natural resources. Thus, it does not have a localised character as with renewables. The

Table 2 Lithium deals by China-based companies, 2012–2021

Buyer	Year	Properties acquired	Target country	Target company	Deal value (\$M)
Zihn Mining Group Co. Ltd	2021	Tres Quebradas	Argentina	Neo Lithium Corp	765.0
Contemporary Amperex Technology Co. Ltd	2021	Manono	DRC	Manono project	240.0
Ganfeng Lithium Co. Ltd	2021	Mariana	Argentina	Mariana project	13.2
Contemporary Amperex Technology Co. Ltd	2021	Caucheri East, Pastos Grandes	Argentina	Millennial Lithium Corp	298.2
Ganfeng Lithium Co. Ltd	2021	Sonora and Zinnwald	Mexico and Germany	Bacanora Lithium PLC	259.3
Chengdu Tianqi Industry Group Co. Ltd	2018	Salar de Atacama and Mt Holland—Lithium	Chile and Australia	Sociedad Quimica y Minera de Chile SA	4,066.2
Jiangxi Ganfeng Lithium Co. Ltd	2016	Mavis	Canada	International Lithium Corp	0.2
Jilin Jien Nickel Industry Co. Ltd	2016	Quebec	Canada	Quebec lithium mine	23.6
Jiangxi Ganfeng Lithium Co. Ltd	2016	Mount Marion	Australia	Reed Industrial Minerals Pty. Ltd	27.2
Jiangxi Ganfeng Lithium Co. Ltd	2015	Mount Marion	Australia	Reed Industrial Minerals Pty. Ltd	19.5
Chengdu Tianqi Industry Group Co. Ltd	2012	Greenbushes	Australia	Greenbushes Lithium	803.3

(S&P Global 2021)

product is more widely ‘available’ in South America but as China attempts to mitigate climate change and meet its Paris Climate Agreement pledge, it has sought an increasingly secure supply through investments, mainly in South America. Chinese companies are now actively acquiring lithium mining companies in this region (Table 2). However, China is also a country with global ambitions and a rivalry with the only superpower, the US. Thus, global interdependency has to date been a strategic tool of China in the lithium market but the question of “what if lithium becomes more difficult to access?” cannot be answered easily.

Secondly, interdependencies are also visible in China’s Li-ion battery production. As with renewables production, there is as Lachapelle et al. (2017, p. 324) would term a “synergistic interaction” that has developed from mutually economically beneficial manufacturing activities that have resulted from Western countries and corporations in which they are based, undertaking Li-ion battery production in China, in the pursuit of capital accumulation. Due to its economies of scale, China is now the leading manufacturer of such batteries, controlling over 70% of global production (Benchmark Mineral Intelligence 2020), but achieves this market dominance partly through domestic investment and partly via foreign direct investment: Samsung (South Korea) (KEDGlobal 2021); Panasonic (Japan) (The Economist 2021); and Apple and Tesla (US) (Global Times 2021) all source Li-ion batteries from China and hence share technological development. As in

renewables geopolitics, mutual interdependence leads to reciprocal interaction and the growth of technological production capacity in all states.

These factors have to date shaped the potential for conflict over lithium. It was hypothesised in Sect. 2.3 that interdependency would reduce the scope for conflict, which is indeed evident. Although there is centralisation of technological capacity in the decentralised energy production market, one side's technological achievements help the others to improve themselves, as seen in the production capacity of Li-ion batteries. As has happened in renewables geopolitics, such technological interdependency does not lead to direct confrontation economically and politically. For example, the solar panel trade dispute between China and the EU and the US has not gone to the trade war stage (Chen 2015). In lithium geopolitics, however, even this type of dispute has not been observed because of the direct influence and participation of actors from these states, who can be affected negatively economically or politically by any conflict. There is a little economic incentive for Western countries to engage in conflict with China over battery technology since the current market benefits both their multi-national electronics and EV producers and domestic consumers of such products.

But access to lithium and a reduced supply globally is still causing tensions. In Sect. 2.3, we also hypothesised that shortages of supply could increase future conflicts as states seek independence. As described above, the US has already made access to rare earth metals the subject of trade wars with China. The EU has also identified lithium as a key mineral for future industrial policy. It is still unknown whether world politics will move into a new Cold War or fragmented world politics determined by various superpowers or multilateral power dynamics. However, it is known that the national interests of big powers are not moving towards collaboration in the lithium market. Such national interest orientation is not leading to conflict-oriented policies to access lithium resources at the international level for now as this race includes private–public partnerships. It is not the same as the Iraq War of 2003

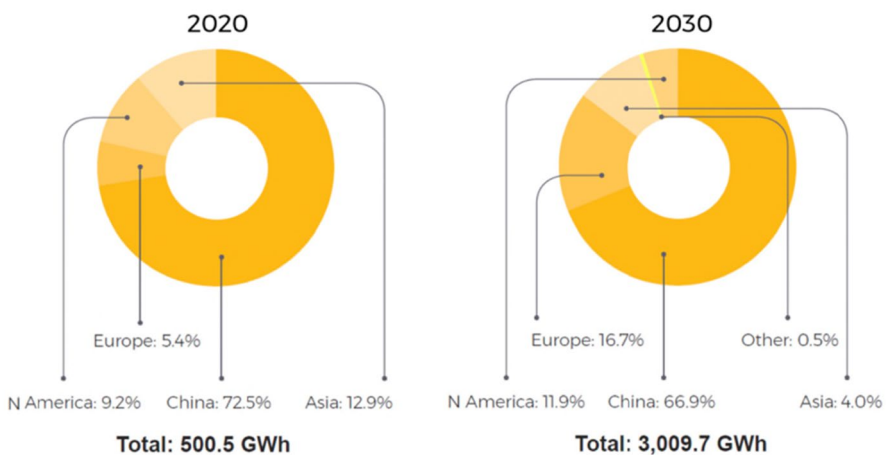


Fig. 6 Lithium-ion battery cell capacity in 2020 and planned for 2030 (Benchmark Mineral Intelligence (2021b), as cited in Moores (2021))

(Stokes 2007). On one hand, the direct interference of big powers is decreasing, while proxy wars are increasing. On the other hand, the global narrative of environmentalism shapes free-market orientations. The economic interests of governments (i.e. both suppliers and consumers) are the primary factor rather than political confrontations in lithium geopolitics. This is the time of transition from geopolitics to geoeconomics, which displaces the method of the military with the method of commerce (Luttwak 1990). Co-development and co-production exist in the political-economic race of inter-state relations. As a result of this, technological interdependency has prevented conflict so far. Thus, there is a difference between lithium politics and petropolitics. Another related factor is the changing global dynamics in the period of the post-unipolar world system, which was led by the US. To simplify it, US troops started to withdraw from one of the lithium-rich states (i.e., Afghanistan) in August 2021, which is incompatible with historical experience. Chinese investments are expected to increase in the region (Bloomberg 2021). Chinese dominance has been achieved with interdependency in economic and technological spheres.

Conflicts may also yet emerge in lithium technology production. Global sales of EVs are expected to climb from 1.7 million in 2020 to 26 million in 2030 (Kumagai 2021). In addition, the US and Europe have recently taken steps for increasing domestic production of Li-ion batteries and their recycling, which indirectly helps China's robustness. However, such a trend also reflects potential future conflicts at the sovereignty level. As a result, China's Li-ion battery share is expected to decrease. It could undermine China's position but how current geopolitics transforms into a new era will be the primary determiner. Thus, multipolar, decentralised and technology-led renewable geopolitics (Overland 2019) does not work in the lithium sphere, although lithium geopolitics could become one of the most critical sub-sets of renewables geopolitics (Diouf and Pode 2015). Lithium resources are finite and limited, unlike the renewables. Such a context creates a more competitive race for lithium production.

Is China resilient? The US-China trade war has shown us, yes. The Government's policies have been able to change the situation in the market. However, resilience should not only be interpreted as resistance. It also includes keeping stability in the political-economic market and having sustainable policies, which China has achieved so far. The tricky part is based on external actors' future policies (e.g., the US and Europe). The game-changer role of China pushes others to use incentives and technology-oriented policies for now. Compared to the US experiences in the global oil market, China is a game-changer in the lithium market despite the lack of domestic production.

5 Conclusions

The key question identified in the introduction related to the extent to which the 'old' energy politics of conflict and interdependence had transformed in the transition towards renewables within lithium geopolitics. This research has found that lithium geopolitics comprises elements of both conventional energy and

renewables geopolitics but is not the same. On one hand, controlling the market or not being controlled by any other actors is critical in the oil market. On the other hand, reducing the vulnerability of energy systems with the improvement of technology is characteristic of the renewables market. It is still difficult to see similar interactions in the lithium market as in fossil fuels or renewables because of the interdependencies created in lithium production and lithium-based technologies such as Li-ion batteries. However, competition in the lithium market could become integrated with international political dynamics related to big powers' foreign policy orientations. Lithium politics is still not similar to petropolitics, but there is a growing market and the possibility of changing dynamics in international politics.

China reflects these market dynamics, as the strongest actor, while following two main strategies: sourcing lithium from supplier states through developing interdependencies and also leading Li-ion battery technological development, which creates interdependency with other countries. China has become a dominant power in the market; however, controlling the market both economically and politically has not been achieved yet. Other big powers are dependent on China's power, but supply and technological interdependency has prevented conflict until now. The debate on the "commercial peace" theory is better to be further discussed (Moon 2021).

This article could also inform further research into lithium geopolitics. First, the positions of lithium producer states require a better understanding. While interdependence with China and industrialised states is a feature of lithium geopolitics, such asymmetrical relations could be creating new dependencies for producers themselves. Second, comparative research is required into the lithium strategies of the US, EU and other leading industrialised states, to understand how they are changing in response to China's market dominance. Although continued interdependence would be optimal for all states in avoiding conflict, critical questions arise over whether limited future access to supplies will create incentives for independence strategies and bring states into confrontation, as with oil supplies in the past. Finally, further work is necessary in theorising lithium geopolitics, particularly regarding the internal factors shaping state lithium strategies and their implications for foreign and industrial policy. A critical question here relates to how lithium is influencing national security and in turn the implications for the world order.

Declarations

Conflict of interest The author declares that there is no conflict of interest.

Ethical Statement Hereby, I, Dr. Suleyman Orhun Altiparmak, consciously assure that for the manuscript the following is fulfilled: (1) This material is the author's own original work, which has not been previously published elsewhere. (2) The article is not currently being considered for publication elsewhere. (3) The article reflects the author's own research and analysis in a truthful and complete manner. (4) The article properly credits the meaningful contributions of co-authors and co-researchers. (5) The results are appropriately placed in the context of prior and existing research. (6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference. The violation of the Ethical Statement rules may result in severe consequences. I agree

with the above statements and declare that this submission follows the policies in the Guide for Authors and in the Ethical Statement.

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