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REGULAR PAPER

A culture-led approach to understanding energy transitions in China: The correlative epistemology

Ping Huang | Linda Westman | Vanesa Castán Broto

Urban Institute, Interdisciplinary Centre of the Social Sciences (ICOSS), University of Sheffield, Sheffield, UK

Correspondence
Ping Huang
Email: p.huang@sheffield.ac.uk

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Abstract

Transformations of the energy system are unfolding in China at an unprecedented scale and pace. The dynamics of China's energy transitions impact global trends of energy decarbonisation. Transition theories within the Anglophone academic tradition have been used to examine this process, but they tend to misrepresent the social, cultural, and political structures that shape energy transitions in China. This paper proposes a move from an analysis of energy transitions "with Chinese characteristics" to alternative thinking on energy transitions truly rooted in Chinese epistemological and philosophical constructs. The correlative epistemology refers to a Chinese tradition of social studies that describes the cosmos as a structured order of relations (*guanxi*). This tradition sees *guanxi* as the fundamental constituent of Chinese society. Such a relational focus enables a culture-led reading of China's energy transitions, thus responding to calls for transition theories "from elsewhere." In particular, correlative interpretations of innovation and transition processes in China frame energy transitions within broader societal transformations, define the operation of transition governance, and reveal that pre-existing *guanxi* networks shape the activities of actors in transition processes.

KEYWORDS

China, correlative epistemology, energy transitions, *guanxi*, transition theory

1 | INTRODUCTION

In September 2020, Xi Jinping, President of the People's Republic of China (PRC), surprised an audience of world leaders at the virtual United Nations General Assembly by pledging that the country would become carbon neutral before 2060 (Mallapaty, 2020). The announcement anticipates a radical transformation of production and consumption in the country with the largest relative contribution to the global total GHG emissions (Janssens-Maenhout et al., 2019). This transformation will be diverse, depending on the varied trajectories of Chinese provinces and their impact on local economies and populations (Fang et al., 2019).

The Chinese energy transition will also have a global impact. China's global influence in energy transitions relates to the size of its renewable energy industry – which influences global supply chains everywhere – and a growing domestic market (REN21, 2019). China is the world's largest producer, consumer, and funder of renewable energy (Cao et al., 2018). China's commitment to carbon neutrality anticipates a ramp-up of renewable energy production and carbon intensity improvements (Mallapaty, 2020). Such a transition will require massive infrastructure changes in all sectors, not only energy (IEA, 2020).

The Chinese energy transition has become an object of great interest in academic research. China is an ancient civilisation that has maintained continuity for more than 5,000 years. The size, diversity, and complexity of the country make it difficult to either verify or falsify any interpretation of energy transition dynamics. As Bell puts it:

> A joke about China is that one can say anything about it without getting it right. Another joke is that one can say anything about it without getting it wrong. (2010, p. xiii)

Dominant innovation frameworks from an Anglophone tradition have analysed China's energy transitions, but they tend to generate homogeneous conclusions. Most successful cases of energy transitions are associated with the actions of entrepreneurs playing a leading role within a favourable selection environment, including appropriate infrastructure, limitless market demand, and supportive policies led by a strong central government (see for instance: Quitzow, 2015; Yu & Gibbs, 2018a, 2020). Blocking mechanisms for capitalising innovation explain most failed cases, often reporting weak connections between research entities and the industry, lack of efficient market mechanisms, or mismatches between innovation policies and industrial demands (see for instance: Binz et al., 2012; Lai et al., 2012; Huang et al., 2016; Zou et al., 2017). Crucial transition dynamics remain unexplained. In particular, these analyses rarely provide clear explanations about why transition processes are evident in some places in China but not in others.

We propose a correlative epistemology to address this gap. As a theory, correlative epistemology follows a long tradition of critical social research within Chinese scholarship. The correlative epistemology presents the cosmos (and Chinese society) as a structured order of relations: "*guanxi*" (Zhang, 1947). *Guanxi*, rather than entities, are the basic units of recognition (Rošker, 2017). Correlative interpretations of innovation and transition processes in China situate energy transitions within broader societal transformations, focusing on pre-existing *guanxi* networks that shape transition processes. These culture-based perspectives can deliver new insights on the energy transition in China beyond dominant innovation frameworks.

Our argument follows recent calls for developing spatial perspectives on energy transitions that engage with place-based frameworks for analysis. The following section situates this debate within current scholarship (Section 2) before focusing on China as a case that can generate alternative forms of knowing. The objective is to move from a transition "with Chinese characteristics" to new thinking on transitions that is truly rooted in Chinese epistemological and philosophical constructs. The argument unfolds in three parts, looking at the spatial dimensions of the energy transition in China (scale, pace, and depth) (Section 3), the limitations of current frameworks to explain the energy transition in China (Section 4), and the possibilities opened up by a culture-led approach (Section 5).

2 | PLACE-BASED PARTICULARITIES SHAPE ENERGY TRANSITIONS

Transition scholars have long been concerned with the limitations of current theorisations to capture place-based dynamics. Transitions frameworks such as the multilevel perspective (MLP) and technological innovations systems (TIS) conceptualise transition mechanisms in relation to structuration levels or systems functions without integrating spatial dimensions. Coenen et al. (2012) argue that transitions theory is often decontextualised, and this prevents a full analysis of the place-based conditions for successful transitions. According to Markard et al. (2012), dominant transition perspectives lack territorial sensitivity.

These criticisms have raised considerable interest in situated perspectives on energy transitions, analysing how geographical, material, cultural, and historical constituents of transitions vary across locations (Sarrica et al., 2016). Bridge et al. (2013) link energy transitions to the complexity of energy landscapes and the spatial embeddedness of energy activities. Empirical case studies demonstrate the situated nature of energy transitions (Castán Broto, 2019). Energy transitions take place within specific, place-based histories and political trajectories. The policy ambitions and visions that guide transitions are, likewise, embedded in specific socio-political contexts.

Transitions cannot be understood independently from the settings in which they emerge. The spatial turn in transition studies has inspired ample research on energy transitions at the urban and regional scales. This body of literature has identified specific aspects of place that influence energy transitions, ranging from the deployment of urban and regional policy, the operation of informal localised institutions, natural resources endowments, the specialisation of local industries and technologies, to the dynamics of local market formation (Hansen & Coenen, 2015).

Knowledge-making processes are also geographically situated, and hence theorisations of innovation and change need to recognise the geographies in which they emerge (Bridge, 2018). However, there has been a paucity of research examining the provenance of the reference frameworks used to study transitions. The majority of place-based theorisation of transitions follows an Anglophone tradition of transition studies (e.g., Castán Broto et al., 2020) with some influence of Francophone scholarship (e.g., Rutherford & Coutard, 2014). Current transitions thinking does not reflect the geographical plurality that the discipline aspires to. As interest turns to understand energy transitions in lower and middle-income countries, a suspicion arises about the heritage of transitions theories and the extent to which subaltern theorisations are being silenced in current debates. Bridge (2018) has called for theorisations of the dynamics of energy change "from elsewhere" to challenge universalist understandings of transitions and recognise the particularities of transitions within specific geographical contexts.

With its sizeable scholarly community, China offers opportunities to examine the application of dominant frameworks and to unearth alternative perspectives that emerge from deeply seated scholarship on critical social sciences. We present this argument in three steps: an outline of the spatial dimensions of China's energy transition considering available empirical evidence, a synthesis of the analysis of energy transitions with dominant theoretical frameworks, and the characterisation of an alternative response grounded on Chinese social sciences scholarship.

3 | MAPPING THE CONTOURS OF ENERGY TRANSITIONS IN CHINA: SCALE, PACE, AND DEPTH

This section outlines the spatiality and temporality of China's energy transitions looking at scale, pace, and depth. The scale of energy transitions refers to the material size and extent of change (Bridge et al., 2013). The pace of transitions addresses the temporal dimension of a transition, denoting how long it takes for concrete changes to occur (Sovacool, 2016). The depth of transitions examines the extent to which the energy system's fundamental structural changes demonstrate that the transition is embedded into the current energy system (Geels et al., 2017). The analysis of these three dimensions demonstrates the complexity of China's energy transitions and the need to apprehend the spatial variations that explain infrastructure deployment and organisation processes.

3.1 | Scale

Both the outcomes of China's energy transitions (e.g., production, generation, and consumption of renewables) and the changes in resource flows (e.g., finance, knowledge, and labour) provide an estimation of its scale.

At the end of 2018, almost a third of global renewable power capacity was located in China (727 GW of an estimated total of 2,378 GW) (REN21, 2019). According to these data, China is the top renewable producer in terms of installed capacity, including hydropower, bio-power, solar photovoltaics (solar PV), and wind power (Figure 1). In 2018, China consumed a quarter of the global renewable energy output (excluding hydropower) (Figure 2).

In terms of industrial capacity, China has become the world's largest producer of photovoltaic panels and wind turbines. In 2018, China accounted for 66% of global solar PV module production and 60% of cell production capacity (Andrews-Speed & Zhang, 2019). In 2018, the top 10 module manufacturers shipped an estimated total of 63 GW modules. Eight out of 10 top PV suppliers and half of the top 10 wind turbine manufacturers were located in China (Figure 3).

China is the leading investor in renewable energy technologies. In 2017, China's investment in renewables reached US$126.6 billion, accounting for the largest single share (45%) of investment worldwide, followed by Europe (15%) and the USA (14%) (REN21, 2018). REN21 data show that the renewable energy sector provided more than 10 million jobs worldwide, and 37% of the employment opportunities were in China. The number of patents filed for innovations in renewable energy technologies worldwide in 2016 was 10,460, 67% of them filed by China (Our World in Data, 2017).

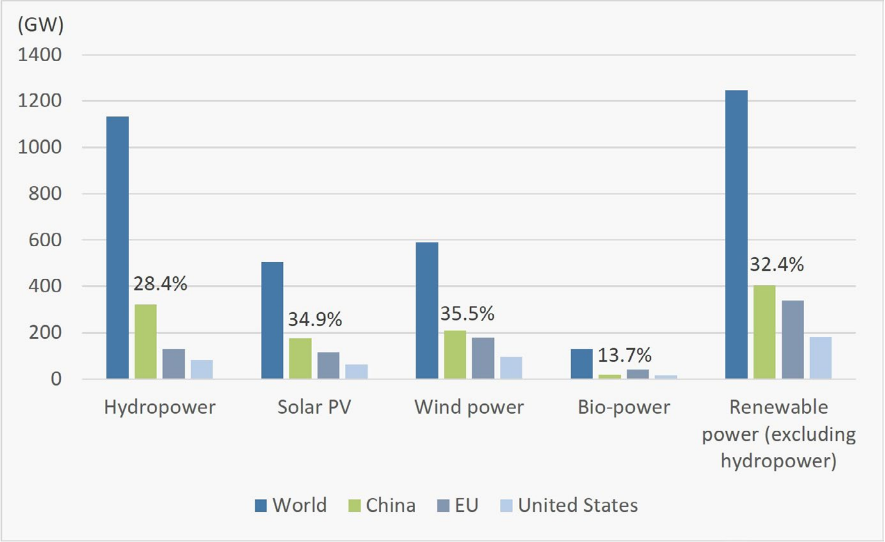

FIGURE 1 An overview of renewable power capacity by technology in 2018 (GW) and the share of China. *Source*: REN21, 2019

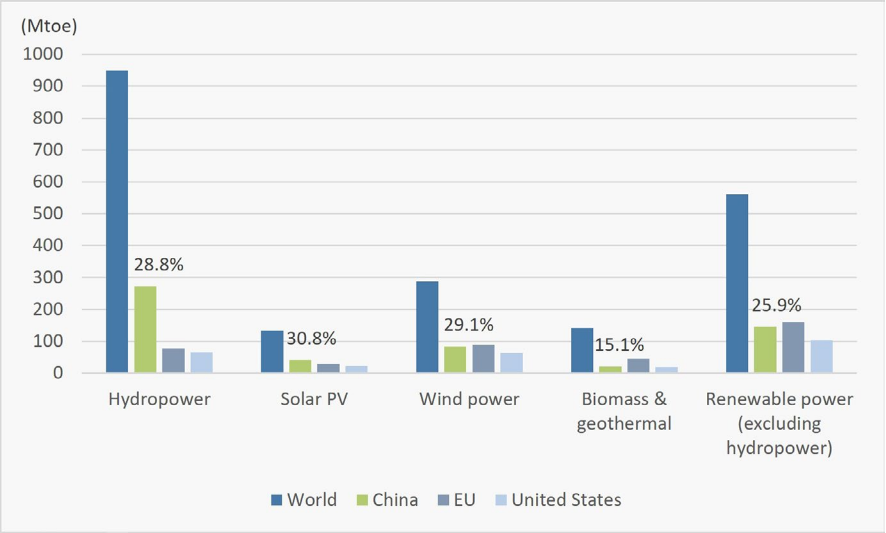

FIGURE 2 An overview of renewable energy consumption by technology in 2018 (Mtoe) and the share of China. *Source*: British Petroleum, 2019

3.2 | Pace

As shown in Figure 4, from 2010 to 2018, China's installed capacity of solar PV increased at a rate of 80% annually, which is more than double the world's annual growth rate. In 2018, global renewable energy consumption grew at a rate of 14%, while renewable energy consumption in China grew by 29% (British Petroleum, 2019). In the decade up to 2017 (Figure 5), the 10-year average growth rate of renewable energy consumption worldwide was 16%, compared to 41% in China. These figures suggest that transitions in China are unfolding at an unprecedented speed. Construction periods for renewable energy projects are often counted in days in China. China's speed has become a benchmark in innovation and infrastructure development (McKinsey & Company, 2015).

3.3 | Depth

In China, energy transitions already manifest in the physical configurations of both rural and urban areas. Hundreds of wind turbines are erected in remote areas or coastal waters, and millions of ground-mounted solar panels cover large

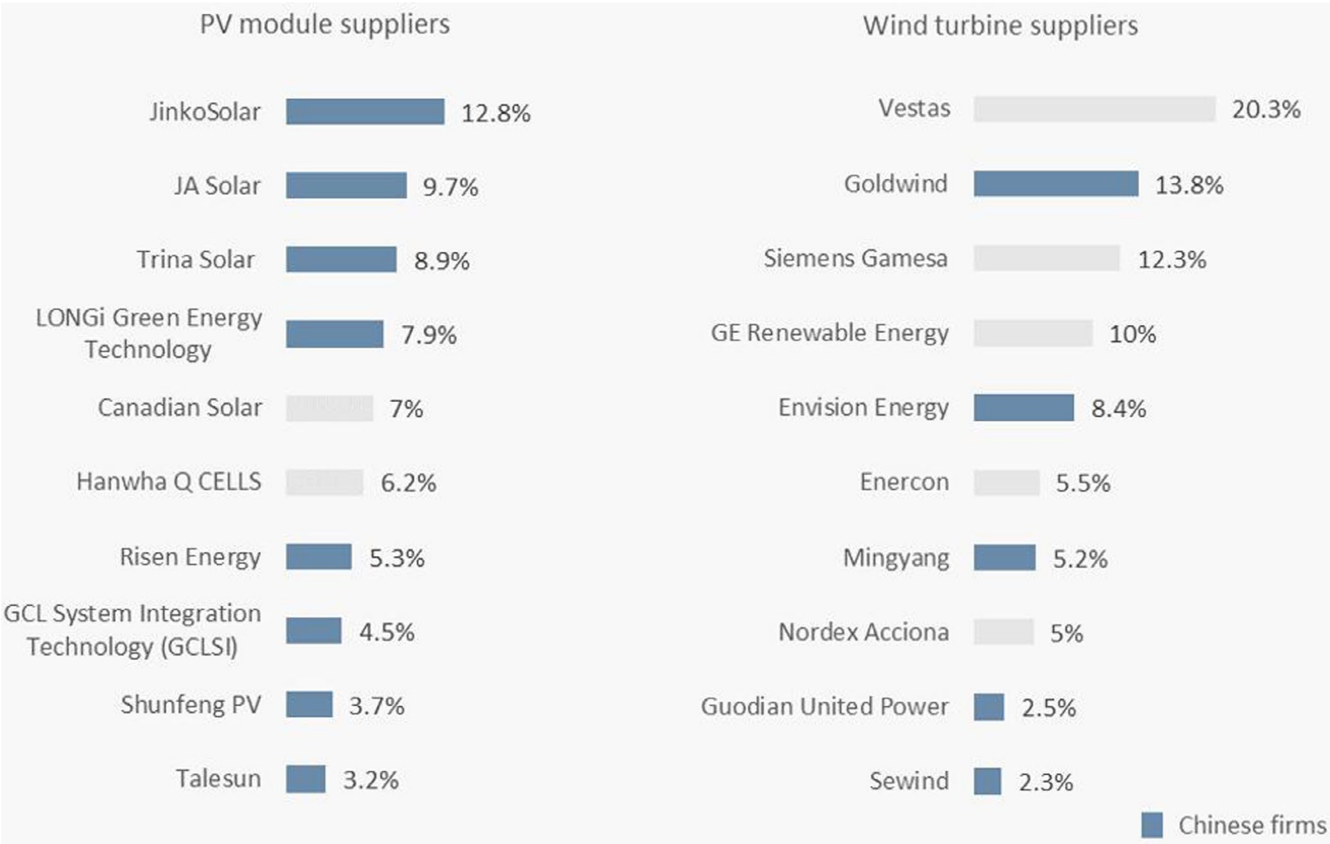

FIGURE 3 Market shares of the top 10 suppliers for solar PV modules and wind turbines, 2018.
Source: REN21, 2019

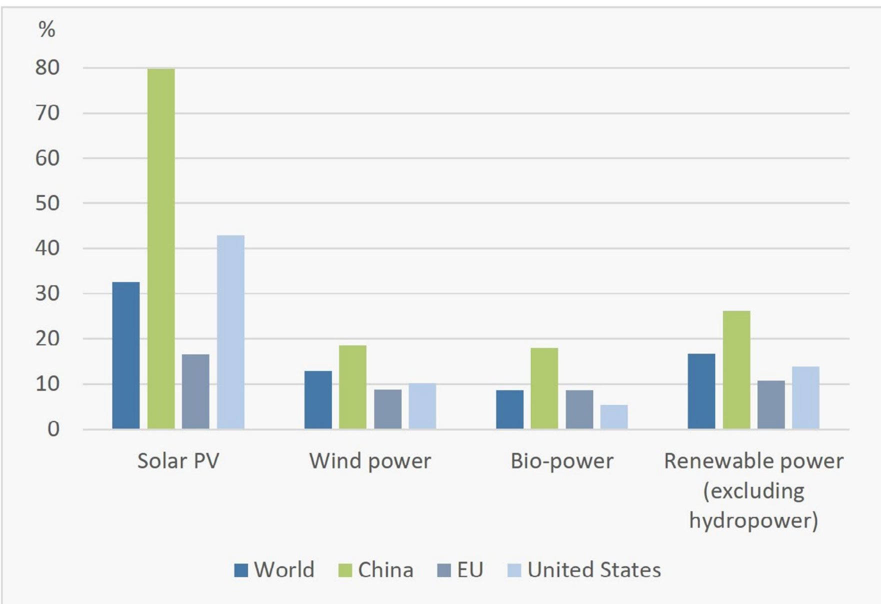

FIGURE 4 The annual growth rate of installed capacity of renewable energy (2010–2018), by technology and region.
Source: calculated from data released by REN21, 2019

areas. Charging facilities for electric vehicles proliferate and reshape urban infrastructure networks. Energy transitions are also embedded into the everyday life of Chinese people, who already show clear preferences for energy-efficient appliances, shared vehicles, and cycle lanes (Zhang et al., 2015).

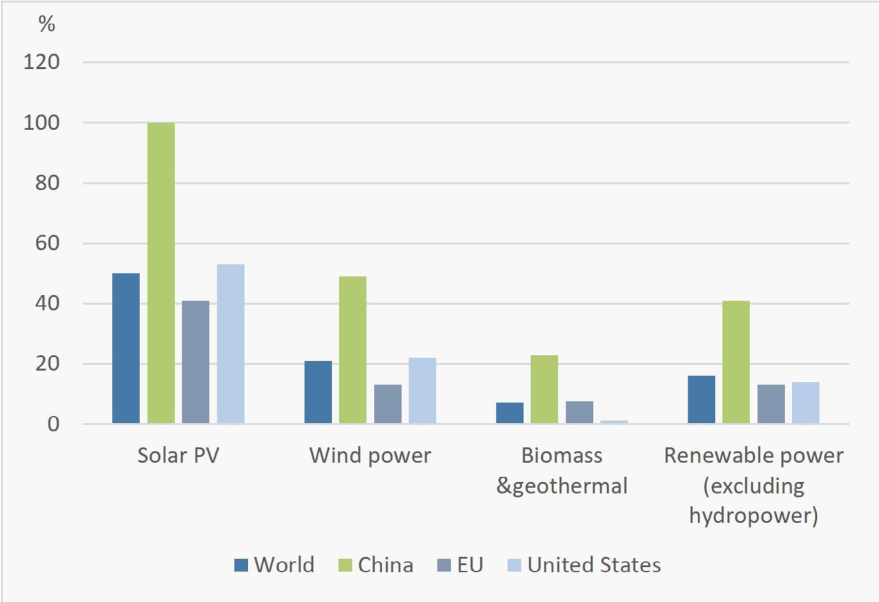

FIGURE 5 Ten-year average growth rate of renewable energy consumption (2007-2017), by technology and region
Source: National Energy Administration, 2019

Nevertheless, structural change has not accompanied the scale and pace of change. In 2018, the global average share of renewables (excluding hydropower) in primary energy consumption was merely 4%.[1] In China, the share was just above the average level worldwide. As a comparison, in Sweden, the share of renewables (excluding hydropower) in primary energy consumption increased from 6% in 2009 to 12% in 2018. A reason behind the limited structural change in China is that the installed capacity of renewable energy has not fully translated into electricity generation. Figure 6 provides an overview of wind curtailment in China from 2010 to 2018. To put the numbers in perspective, the wind power capacity abandoned in the year of 2016 alone is enough to supply the annual electricity consumption of Bangladesh (Qi et al., 2019). The situation is similar for solar PV (State Council, 2019).

China is characterised by significant regional disparities that add additional complexity to the deepening of transitions. Curtailment is a problem in northern regions that produce abundant renewable energy but have limited demand because their local economies are less developed. In 2018, the share of renewables (excluding hydropower) in gross electricity consumption was 22.3% in Ningxia province but merely 3.5% in Guangdong province (National Energy Administration, 2019). Interprovincial transmission could address curtailment, but the country lacks long-distance transmission lines (Zhao et al., 2016).

Regions in China differ considerably in terms of resource endowments, development stages, industry specialisation, and governance capacities. The central government addresses regional disparities through policy experimentation, injecting local knowledge and experiences into national policy formulation (Heilmann, 2008). This approach supports pilot schemes to advance energy transitions, such as the "Low-carbon City Initiative," the "New Energy Demonstration City Program," and the "National Ecological Civilization Experimental Zones." These pilots, however, are not sufficient to address the mismatch between central government policy rhetoric and policy enforcement at the local level (Cai & Aoyama, 2018).

Analysis of the depth of transitions reveals the complexity of the unfolding dynamics, in terms of not only regional differences but also the effectiveness of transition policies in a highly fragmented institutional system. Large-scale changes may lead to large-scale waste of resources, while the pace of abandonment might be as rapid as the pace of innovation. Explaining the geographical variability of energy transitions in China and how it influences transitions at the national and international level is an imperative for transitions research.

4 | CURRENT UNDERSTANDINGS OF ENERGY TRANSITIONS IN CHINA

As argued above, current analyses of energy transitions in China have a limited ability to explain ongoing processes of change. This includes dynamics of stability and change, the ambiguous role played by different actors, and the dynamics of participation open within the country.

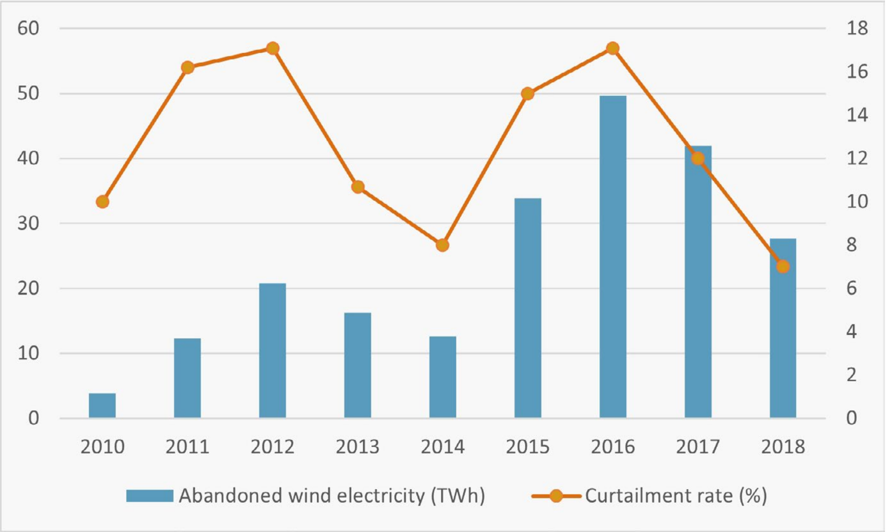

FIGURE 6 Wind curtailment in China (2010–2018)
Source: National Energy Administration of China

4.1 | Rethinking stability and change

In transition frameworks, the deep structures of society are often conceptualised as *landscapes* or *regimes* (Markard et al., 2012). A landscape is viewed as an exogenous environment (e.g., cultural patterns or demographic trends) that lies beyond the direct influence of actors (Geels, 2005). Sociotechnical regimes consist of interconnected elements between technology and social and material structures (e.g., regulative frameworks, markets, technologies, material artefacts) that constantly reinforce each other to create a fluid form of resistance to change (Geels, 2005). In transition theories, both concepts assume institutionalised temporal stability (Markard et al., 2012). However, when looking at the economic and socio-political backdrop of China's energy transitions, stability and consistency are not the dominant tones. Sociotechnical systems in China do not look stable because they are in fact in continuous flux.

China has undergone both rapid and deep transformations within a period of just 70 years since the establishment of the People's Republic of China in 1949. Political systems, institutions, the material arrangements of cities, infrastructure systems, and society's demographic composition have experienced dramatic changes.

Politically, China underwent turmoil during the Maoist Era (1949–1978). The decade-long Great Proletarian Cultural Revolution (1966–1976) paralysed the state system almost entirely. Deng Xiaoping opened a new era in 1978, the Reform Era, moving away from the Cultural Revolution and embracing economic development. Today, China is again undergoing political and institutional reforms. China's energy bureaucracy, for instance, has gone through profound changes in the past decades, with several rounds of fragmentation and centralisation (Cai & Aoyama, 2018).

Industrialisation, marketisation, and globalisation shaped the decades after the Reform Era. The transition from a planned to a market economy in the 1970s reorganised labour markets (Meng, 2000), the financial sector (Laurenceson & Chai, 2003), the operations of state-owned enterprises (Tylecote & Cai, 2004), and fiscal policy (Wong, 2007). China's GDP increased from US$149.5 billion in 1978 to US$14.3 trillion in 2019 (World Bank, 2020).

Infrastructural systems, presented in the transitions literature as a semi-durable dimension of regimes (or even more stable "landscapes"), are also evolving rapidly. Investment into railroads, roads, buildings, piping, and other forms of material structures has increased over the past decades (Han & Xiang, 2013). Improvements in infrastructures have enabled both rapid urbanisation and massive internal migration. The National Bureau of Statistics of China estimated that in 2019, 61% of the population lived in urban areas and 39% in rural areas. Only 16 years before, in 2003, that figure was reversed, with 39% of the population living in urban areas and 61% in rural areas.

China has undergone a demographic transition since the 1970s (Feng, 2011). On the one hand, China has seen a rapid decline in its mortality, as life expectancy climbed in 2019 to an average of 76 years. On the other hand, China's fertility decline below the replacement level – a hotly debated issue – points towards a permanent change in the life of Chinese populations. While this decline has often been attributed to China's coercive one-child policy, other analyses point towards a complex array of causes in line with neighbouring countries with less coercive policies. These include the economic boom, the rapid increase in female literacy and health, the incorporation of women into labour markets, and broader changes in culture and social expectations (Wang et al., 2018).

Economic growth has also meant significant changes in patterns of consumption and disposable capital. Between 2015 and 2019, average household consumption grew 46% up to 27,563 RMB per household (National Bureau of Statistics, 2020). This growth was even more pronounced in rural areas, where average household consumption grew a staggering 62% between 2015 and 2019, while in urban areas the growth was 35%. Consumption habits and lifestyles, related to eating, mobility, or household practices, changed following rising income levels, demographic shifts, urbanisation, and growing interconnectivity (Hu & Peng, 2015; Loo & Li, 2012; Schipper & Ng, 2004).

Transformations of political institutions, the economic system, the population distribution, and infrastructure configurations form a dynamic backdrop of energy transitions in China. As demonstrated by Tyfield,

> Contemporary China presents a case of such a rapidly and profoundly changing society, both intra-nationally and internationally, that it is hard, even if one attempts it, to formulate a "stable" landscape that may be unproblematically treated as exogenous. (2014, p. 587)

In this context, characterising the landscape or the regime is an arduous task. The growing body of literature on China's energy transitions reflects this difficulty, with ambiguous, inconsistent, or even contradictory interpretations of the landscape and the incumbent regime. Institutions undergoing fundamental changes, such as the cadre performance evaluation system, are described as part of the landscape (e.g., Yu and Gibbs (2018b) on solar water heating in urban China). Similarly, fundamental reforms of the energy system are routinely analysed as exogenous forces, part of the landscape (e.g., Yuan et al. (2012) on electric power). Across the literature, a similar factor is often presented as part of different analytical levels. For instance, the Renewable Energy Law, promulgated in 2005, was considered a landscape element in some studies (Yu & Gibbs, 2018b; Yuan et al., 2012), but as part of the regime changes in others (Xu, 2020). Similarly, the incumbent infrastructure was identified as a regime factor in some studies (Liu & Shiroyama, 2013; Yu & Gibbs, 2018a, 2020; Zhao et al., 2016), but as part of the landscape in others (Yuan et al., 2012). This lack of alignment between empirical observation and analytical categories suggests that frameworks such as the multilevel perspective are limited in analyses of energy transitions resulting from multi-layered processes of radical change.

4.2 | Understanding actors' logics of action

The diffusion of innovation through society is conceptualised in the transitions literature as resulting from processes of coevolution between society and technology (Geels, 2005; Kemp et al., 2007). Coevolution requires generating diversity (innovation) through open-ended and uncertain processes, adapting selection environments (the alignment of society with novelty), and reducing diversity through differential replication (Safarzyńska et al., 2012). Diffusion of innovation is propelled by learning, the consolidation of industries, and the formation of actor networks and social institutions around new technologies. This way of conceptualising society poses difficulties when understanding processes of change in China, where a "free market" does not exist. The assumption that entrepreneurs drive novelty and foster the evolution of skill sets and routines is therefore not appropriate.

In transition studies, coalition-building between actor groups is considered a condition to expand processes of change. This perspective assumes interaction between the public, private, and academic sphere or across distinct social groups (e.g., public authorities, supply chains, users) (Geels, 2005). This idea is especially influential in theories of reflexive governance (Voss et al., 2006), later developed in the transition management literature (Frantzeskaki et al., 2018; Kemp et al., 2007). These perspectives assume that actors have distinct logics for action and enjoy relative independence in relation to their attributed functions. Universities and research institutes, for instance, become the main actors for knowledge production, while banks, venture capital suppliers, and insurance firms channel financial resources. However, in China, the boundaries between the state, markets, and research innovators are not demarcated. Zheng and Huang (2018) use the term "market in state" to describe the unique political economy of China, in which "a substantial part of the market and market mechanisms is firmly embedded and confined within institutional mechanisms of the state" (p. 139).

Many key players in China's energy transitions are state-owned enterprises (SOEs), operating under political guidelines developed by the Communist Party of China (Tsang & Kolk, 2010). In 2016, among industrial enterprises above the designated size,[2] SOEs accounted for 30% of the total number of firms, 58% of the total assets, and 40% of the total profits (Wu, 2018). SOEs can substantially influence the development trajectories of the innovation system. In the new energy vehicle industry, for instance, key enterprises are wholly or partly owned by the government (Liu & Kokko, 2013). SOEs occupy a central position in network building, resource allocation, and market exploration. They also compete among themselves, as well as enable competition among regulatory agencies. They both enable the role of the public sector on innovation and question the division of functions and attributions across the state and the market. Innovation clusters, circular economy hubs, and incubators likewise tend to be government-funded and heavily guided by public policy (Barbieri et al., 2012).

The most influential universities and academic centres in China operate under political guidelines (Sleeboom-Faulkner, 2007). In 2018, there were 2,663 higher education institutions (HEIs), of which about 750 were privately owned (Ministry of Education, 2019). In 1995, the Ministry of Education initiated "Project 211" to enhance the research capacities of high-level universities in China. Approximately 100 research-oriented universities were included in the project, all public universities. The largest public research institute is the Chinese Academy of Sciences (CAS), which has over 100 branch institutes nationwide and hosts more than 85 percent of China's large-scale science facilities (Zhang et al., 2019). Directly supervised by the State Council, CAS engages in basic and applied research that addresses specific national needs and challenges. In China's national innovation system, public research institutes and universities play an essential role in a state-tutored process of knowledge production and diffusion (Liu et al., 2017).

The financial system in China, particularly the banking sector, is also, to a great extent, controlled by the government. A key feature of China's banking system is the dominance of the "Big Five" – the five largest state-owned banks (Dong et al., 2014). In 2018, the total assets of the "Big Five" reached 105 trillion RMB, accounting for 37% of Chinese banking assets, and their deposit balance and loan balance accounted for 44% and 38% of the sector-wide total, respectively (Ifeng, 2019). State ownership of financial institutions enables political intervention in the allocation of financial resources. For example, banks' lending practices follow political priorities (Dong et al., 2014), including government-led initiatives of energy transitions.

The government can also create market demand for emerging technologies. SOEs are usually pioneering users of low-carbon technologies. In China, low-carbon initiatives spread within the public sector (e.g., in public facilities such as hospitals and schools) before expanding to the broader society. For instance, in Shenzhen, electric vehicles were first used in public transportation (Huang & Li, 2020). In 2017, Shenzhen had electrified 100% of its public buses and 63% of the taxi fleet, thus establishing a niche market for electric vehicles (Huang & Li, 2020). Similarly, local governments prioritised installing solar water heaters in public buildings such as museums, stadiums, and universities, supporting the development of the industry (Yu & Huang, 2020).

The public sector plays a substantial but also ambiguous role in shaping the energy regime and is entangled in promoting, creating, and benefiting from markets in multiple ways. Scholars often encounter difficulties in distinguishing incumbents and challengers as conceptualised in transition frameworks. A typical example is the role of the State Grid Corporation of China (SGCC), the largest incumbent utility company in China. Although SGCC is usually considered a regime actor (see, for instance: Zhao et al., 2016), it has initiated many radical innovations to promote decarbonisation of the energy system (Mah et al., 2017). Because the logics of action for different actors do not fit assumptions of state and market distinctions, transition scholars often resort to alternative conceptualisations, such as the incumbent-led model (Mah et al., 2017). This demonstrates a cognitive lock-in of transition scholars in dealing with the limitations of current transition frameworks in explaining the uniqueness of China's energy transitions. Current theorisations of actors' logics encounter two difficulties: the misrepresentation of state limits, as confined to a well-defined public realm, and the underestimation of the will of the state, a will constructed through hybridisation across actors in energy transitions.

4.3 | Recognising fragmented authoritarianism and latent forms of societal participation

In the transitions literature, China's transition is often explained as a unidirectional process of industrial innovation at scale, under hierarchical rule from a powerful central government (Eaton & Kostka, 2014). Despite this conventional narrative of command-and-control, emerging evidence suggests that innovation is a multiplex process, that central government influence thrives in uncontrolled experimental projects of social and technical innovation (Lo & Castán Broto, 2019), and that multiple actors – private and collective – influence change (Korsnes, 2014).

In transition studies, the regulatory environment is often presented as a durable backdrop against which transitions occur. In China, the function and implementation of regulations in social processes are ambiguous. Although China's one-party political system has ensured the continuity and long-term certainty of environmental policies, scholars have long argued that legislation is not always implemented at the local level (Van Rooij, 2006). As noted by Zheng (2006), in the West, the enactment of a policy is the end of business, while in China, a policy *per se* only means the beginning of business. China's environmental governance is hence increasingly featured as fragmented authoritarianism: "command-without-control" prevails in policy implementation at the local level (Wang et al., 2018). Transition governance in China is simultaneously hierarchical and fragmented (Cai & Aoyama, 2018). This empirical analysis is at odds with theories of transition that celebrate coordination and alignment as symptoms of success in transition governance.

Inclusivity and participation are critical components of transformative capacity in sustainability transitions (Wittmayer & Schäpke, 2014). In a non-democratic environment, public participation implies radically different forms of interaction than those assumed in this literature. In China, multiple social interests contribute to the formulation and revision of policy objectives and public programmes, but through obscure processes that follow different scripts and logics than those deployed in a Western context (Westman & Castán Broto, 2019).

The role of civil society in China is deeply ambiguous. NGOs in China are often unable to fulfil roles identified in Western society, such as political advocacy, promotion of human rights, and awareness-raising (Zhan & Tang, 2013). If NGOs and community organisations play a role in mediating transition dynamics in China, their rationales and modes of action are radically different. Similarly, the conventional definition of deliberative policy processes does not fit the processes observed within China's political system. While deliberation does occur, it operates at a micro-level or through informal dynamics that may be impossible to capture using the open policy dialogue approach (Frantzeskaki et al., 2018).

A different set of mechanisms exists through which society participates in the legitimation of public objectives (Huang et al., 2020). Societal participation takes on a different form in the Chinese context because it is embedded in different state–society relations. De Jong observes:

> When the role and functioning of the state is viewed as an analogy of the way the family operates, we may conclude that the state society relations are quite different from those developed in Western political and legal philosophy. Rather than protecting individual citizens from state interference in their private sphere, there is the conception of the state acting as a head of the nation leading the various segments of society to a path following the common good as the main yardstick. (2012, p. 18)

De Jong (2012) suggests that Confucian values, including the importance of the family, respect for authority, and an inclination towards preserving stability, permeate praxis, psychology, and logics of decision-making and organising government in China. Public policy, from this perspective, reflects the common good, even though the common good has not been formulated through an observable process of stakeholder participation or deliberation. The links between citizen demands and political objectives are hence hardly reflected in analyses of energy transitions. However, Confucian values do not explain the dynamics of energy transitions described above and combining this explanation with existing transition theories is unsatisfactory. We propose an alternative theory of transitions building on social sciences traditions from China.

5 | A CULTURE-LED THINKING ON ENERGY TRANSITIONS IN CHINA

5.1 | The societal dynamics in China: A correlative epistemology

Explanations of transitions in China are confounded because they fail to consider epistemologies and theories grounded in Chinese worldviews. Instead, we propose the correlative epistemology as a starting point to understand transition dynamics in China. The assumption is that a precise grasp of energy transition dynamics must engage with society's deep structures, including the epistemological assumptions used to interpret those dynamics.

Ideas of relationality are gaining purchase among transition scholars (Castán Broto, 2019). Binz et al. (2014) note that TISs operate through spatial relationships, networks, and relational processes that foster learning and support diffusion. Murphy (2015) focuses on the political dynamics of transition as a form of relational place-making. Truffer and Coenen (2012) call for a relational understanding of actors' resource base, understanding both local nodes and global networks. A relational perspective is also a good starting point to understand transitions and innovation in China. However, a Chinese relational perspective is ontologically different from the relational perspective in a Western sense.

Chinese epistemology is correlative[3] (Rošker, 2014). Granet (1934) first described a concrete mode of Chinese thought as "correlative thinking." Based on the correlative epistemology, Chinese philosophers developed a correlative cosmology (Schwartz, 1973). As noted by Chinese philosopher Zhang Dongsun (1947), the reality of the cosmos can be viewed as a structured order of relations. *Guanxi* (relation) constitutes the cornerstone of Chinese philosophies, particularly Confucianism (Liang, 2004). According to Zhang, the universe is a complex network consisting of innumerable, interdependent relations connected and separated in diverse ways and distributed in uncountable levels (Rošker, 2017). The Chinese correlative cosmology implies that no entity is independent: all entities exist in relational connections (Rošker, 2009). The correlative cosmos can only be known within those relations.

The correlative perspective is a means to understand social and political change. *Guanxi* acts as the fundamental constituent of Chinese society. Individuals' very existence is demonstrated foremost, not by any individual *per se*, but by the *guanxi* network he or she is embedded in, defined by complex ethical standards that primarily originate from Confucian thought (Hu, 1919). From a macro perspective, Confucian thinker Liang Shuming (1949) called the Chinese society an ethic-based society, which, as defined by Liang, is inherently *guanxi*-based. Similarly, sociologist Fei Xiaotong (1985) conceptualised the Chinese *guanxi*-based social structure as "*chaxu geju*" (a differential mode of association). Conceptually, "*chaxu geju*" constitutes two dimensions. In Chinese, the meaning of "*Cha*" denotes the horizontal dimension, which can be understood as a multi-layered egocentric network, in a way similar to the ripples that appear in a lake when casting a pebble into it (Figure 7, left). The inner circles represent stronger ties, and the outer circles weaker ties, extending from family members to classmates, colleagues, teachers, students, friends, and acquaintances (Peng, 2004). Integral to this social structure is also a vertical dimension ("*Xu*") that represents the hierarchical social order originated from the Confucian ethical values and principles (Herrmann-Pillath, 2016).

Chinese correlative epistemology differs substantially from the Western interpretations of relations and networks. One epistemology is one of causality rooted in the "Philosophy of Substance" (Vandermeersch, 2017). In causal thinking, relations are understood based on entities (Di, 2020). The substance of entities defines relations, and the primary object of recognition and comprehension is the substance of entities. In transition studies, for instance, the relational perspective denotes the formation of a networked space through the causal agency of actors, in which the substance of each node is the determinant factor of the overall network (Murphy, 2015). As shown in Figure 7 (right), in the Western network, nodes (individuals) and the relations they form are clearly distinguishable. Sub-groups defined by specific categories emerge within the network within clear borders (Herrmann-Pillath, 2016).

Chinese philosophy does not follow the paradigm of causality (Zhang, 1947). The Chinese relational network cannot be broken down to each node (individual) in the network (Di, 2020). Therein, *guanxi* can be viewed as a pre-determined and pre-existing element ubiquitous in Chinese society. The logic of actor activities cannot escape the operation of *guanxi*. Every individual is embedded in this complex, structured, and hierarchical *guanxi* network.

5.2 | Towards the correlative interpretations of energy transitions in China

The correlativeness of Chinese society ensures continuity and coherence in the relationships between the state, society, family, and individuals. Di (2020) describes Chinese society as "a society of continuum" consisting of numerous, scalable circles of relations. In such a society, change takes place as ripples through overlapping and non-bounded webs of relations. Change occurs simultaneously in multiple dimensions, and thus, the energy transitions cannot be confined within any single system, nor any specific "level." How can the correlative epistemology offer a more holistic and nuanced interpretation of energy transitions in China? Here we propose some analytical threads.

First and foremost, the energy transitions need to be situated within broader processes of change that are continually unfolding in China. Because multiple systems reconfigurations occur simultaneously, energy transitions in China merely take

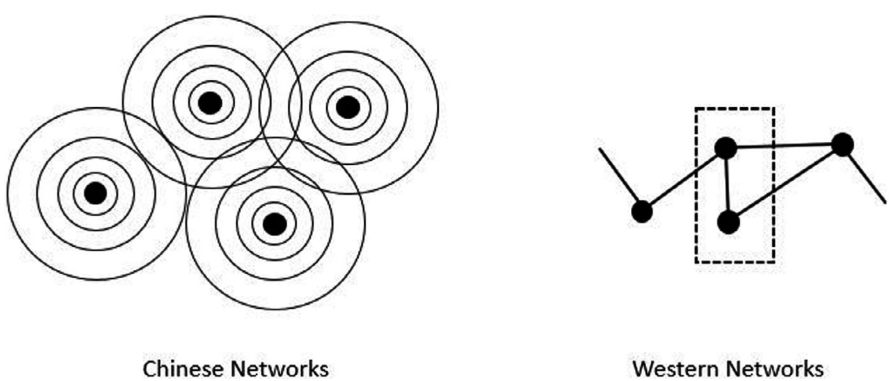

FIGURE 7 The structure of Chinese and Western social networks
Source: Adapted from Herrmann-Pillath (2016)

place alongside, and frequently as part of, the country's ongoing transformations. Analytically it becomes impossible, if not misleading, to identify any so-called exogenous landscape factors. Instead, correlative thinking explains how every element of an imagined landscape or regime is interconnected with elements within and beyond the observed system. China has a long tradition of strategic planning in national governance that sketches the country's development priorities and long-term visions. The construction of "transition arenas" can never be understood apart from China's overarching political and social goals that represent the country's national priorities. A useful strategy of analysis is to identify what kinds of transformations are unfolding at the time of analysis and what is the position or role of the energy sector in these transformations.

Likewise, analysis on transition governance in China needs to follow a correlative logic, with sensitivity to the role of the state. Despite the fragmented energy bureaucracy, the state's will penetrates multiple domains of energy transitions, exercising tangible and intangible influence, but always through complex mechanisms within *guanxi* networks. A correlative perspective transcends the dichotomy of incumbent versus challenger in transition studies, because in a "market in state" (Zheng & Huang, 2018), the state's will extends beyond any incumbent or business interest. The correlative epistemology features the dynamic and dialectical relationship between niche (challenger) and regime (incumbent), mediated by the will of the state. A correlative analysis of energy transitions envisages an open transition arena ready for different layers of interactions to unfold. The object of analysis is *guanxi*, particularly the complex relations between organisational players in the transition arena.

A correlative approach to niche formation compels the analyst to follow *guanxi*. Existing structures of *guanxi* condition the logics of action for different actors, as well as their mindsets and common goals. *Guanxi* means that "who you are" (in terms of relations) might matter more than "what you are" (substance), and this also shapes energy transitions profoundly. In transition theories, network building is considered a central and internal process for niche formation and an essential mechanism for up-scaling and co-evolution (Schot & Geels, 2008). A pioneer seeks other actors of interest to establish an innovation network. Resources are distributed within this network, and every actor is assigned a distinct function, such as investor, supplier, researcher, or user (see, for instance: Geels, 2002) (Figure 8, left). In a society structured by pre-determined social networks, a more suitable transition strategy is to find existing *guanxi* networks (relations such as family members, relatives, friends, and colleagues) and mobilise them to channel resources such as knowledge, capital, labour, and legitimacy (Figure 8, right). This is not an uncommon scenario in China's energy transitions, particularly during the early phase of niche formation. For instance, the start-up capital for establishing the currently largest electric vehicle manufacturer in China, Build Your Dreams (BYD), was borrowed by the founder Wang Chuanfu from his cousin (Chinanews, 2009). Similarly, the entrepreneurial team of solar water heater firm Sangle, one of the leading solar water heater firms in China, was formed primarily by the founder's former colleagues from the Energy Research Institute of the Shandong Academy of Sciences (Dazhong Com, 2008).

The successful development of a niche depends on utilising or reorganising the existing network to reorient resources rather than on creating or constructing a new network. Because niches grow within and are supported by existing *guanxi* networks, a key research strategy is to map the operation of *guanxi* networks in niche formation and scale-up. Until now, transition scholars have only developed a cursory understanding of *guanxi*, largely confined to its facilitating role in innovation diffusion and adoption. For instance, Yu and Gibbs (2018a, 2020) describe how interpersonal networks facilitated the diffusion of solar water heaters in Dezhou. The technology diffused very quickly between acquaintances (pre-existing social networks). Similarly, Huang et al. (2018) observe in Rizhao how local business people used personal networks and acquaintances for market expansion. Nevertheless, correlativeness is rarely considered a key mechanism in transition processes. A notable exception is Sheng's (2019) in-depth work on the role of *guanxi* in local green transitions in China. In Baoding, the development of the solar industry in the Baoding High-tech Park originated from a deep conversation between two friends, a local official Ma (the then director of the high-tech park) and a solar entrepreneur Miao. The pre-existing mutual trust between Ma and Miao ensured effective cooperation in solar implementation, and they actively utilised their *guanxi* networks to mobilise key resources (land, capital, human labour, and knowledge) that nurtured the niche formation and scale-up. Sheng's research pays special attention to the correlativeness of the Chinese society and demonstrates the significance of *guanxi* in realising local green transitions in China.

Despite China's insertion in the global economy, *guanxi* networks and "*chaxu geju*" still structure Chinese society (Di, 2020). Ignoring the inherent correlative features of Chinese society generates misunderstandings and misleading interpretations, because the factors that determine critical trajectories are overshadowed by analyses that seek to identify processes of change following models that simply do not fit empirical observations. Transition scholars struggle to frame China's case as a sociotechnical transition "with Chinese characteristics" (e.g., the regime-led transition model proposed by Mah et al. (2017)). We suggest moving away from "patching up" existing transition frameworks that are inadequate to explain China to instead thinking from *within* the Chinese society and Chinese culture. In particular, the correlative epistemology will help explain the geographical diversity of energy transitions in China.

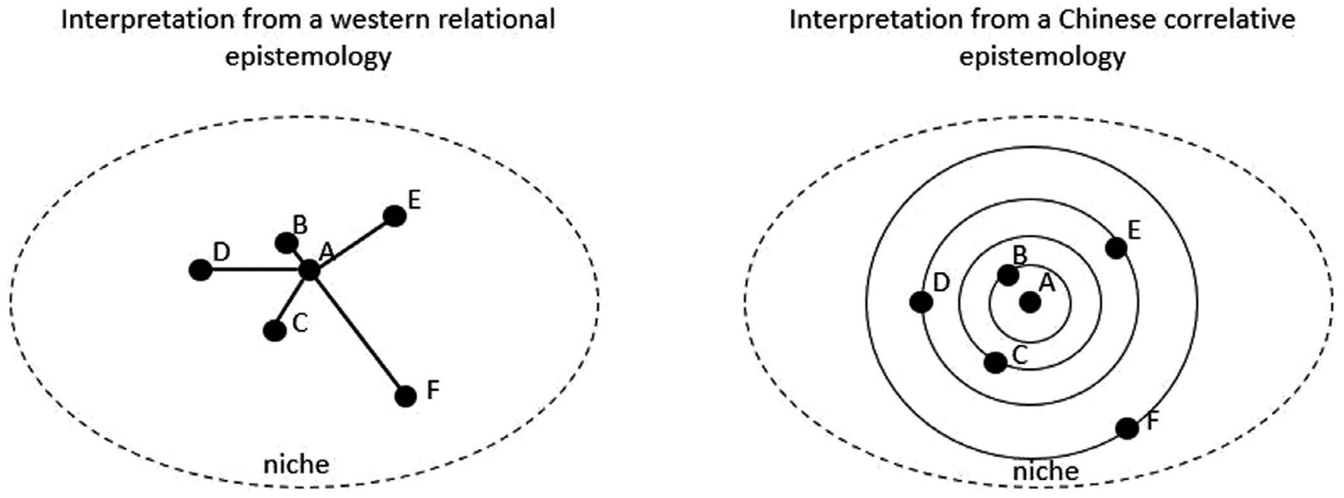

FIGURE 8 A comparison of the Western and Chinese interpretations of networking in a technological niche

6 | CONCLUSION

The global energy system is undergoing a systematic restructuring towards more sustainable, efficient, and secure energy. Changes are unfolding in China at an unprecedented scale and pace, with rapid mobilisation of massive financial resources and personnel into the energy sector. China constitutes a key piece of the global renewable energy mosaic, and what happens in China will be globally relevant and influential.

Current understandings of energy transitions in China remain mired by the mismatch between assumptions of transition frameworks and empirical realities, including the relative instability of landscapes and regimes, the ambiguous and pervasive role of the public sector across social domains, the blurring of public–private boundaries, and the coexistence of forms of authoritarianism with relatively invisible processes of societal participation. These observations challenge the applicability of transition governance approaches that emphasise democratic and inclusive policy-making.

Transitions in China can only be understood from within a specific Chinese perspective, embedded in Chinese thought history. The correlative epistemology is deeply rooted in the Chinese traditional philosophies, through which the universe is viewed as a structured order of relations. Relations (*guanxi*), instead of individuals, are the fundamental constituents of Chinese society. In a *guanxi*-based society, transition actors do not build innovation networks but instead mobilise resources within existing networks. This mechanism differs fundamentally from the assumptions of innovation networking and niche formation that shape conventional frameworks to understand energy transitions. This approach can open the door to understanding the geographical diversity of transition processes in China.

Geographical inquiry can follow the lead from other fields – especially in sociology and political science – that have already researched Chinese *guanxi* culture. Interviews (Wank, 1996) and questionnaire surveys (Chen et al., 2015) provide rich data on *guanxi* networks. Adopting a correlative approach is a challenging task but a rewarding one. In the case of energy transitions in China, examining *guanxi* networks might help to answer the question of why transitions gain momentum in some places but not in others.

Transition theories "from elsewhere" (as Bridge (2018) suggested) help question the basic assumptions behind the frameworks that explain energy transitions. For example, the correlative epistemology throws doubts on the tenets of systems thinking that ground transition theories. The inherent interconnections of *guanxi* networks grounded in cultural assumptions appear to question a systems view of groups of interrelated components arranged to meet a specific purpose. *Guanxi* networks are both arbitrary and determining. Do they constitute a sociotechnical system? This is the kind of question that we hope to explore in future work. In conclusion, engaging with a theoretical framework "from elsewhere" is a strategy to obtain better explanations of energy transitions within their geographical contexts and revisit the fundamental tenets of dominant transition theories.

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DATA AVAILABILITY STATEMENT

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ORCID

Ping Huang https://orcid.org/0000-0002-7573-715X
Linda Westman https://orcid.org/0000-0003-4599-4996
Vanesa Castán Broto https://orcid.org/0000-0002-3175-9859

ENDNOTES

[1] Source: calculated from British Petroleum (2019).

[2] According to the National Bureau of Statistics of China, industrial enterprises above the designated size refer to industrial enterprises whose main business income is above 20 million RMB.

[3] We avoid using the more common term "relational epistemology" to highlight the ontological difference between China's relational epistemology and relational epistemology in a Western sense.

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