

## NON-CAPITALIST, MARKET-BASED DEVELOPMENT? RENEWABLE ENERGY INFRASTRUCTURE IN CHINA

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Thus in ancient times a great flood arose, spilling its waters across the whole land; the people were forced to flee across hill and dale in terror, and nowhere could they find refuge. Then Emperor Yu of the house of Xia, taking pity upon their plight, set about to stem the flood, and opening up the rivers and channeling off the streams, dividing and deepening their beds to rescue the people from disaster; he led the waters east to the sea and all the world found peace and safety. Do you think that the people accomplished such a task by themselves? The mind of the emperor was fraught with care, and he himself took part in their labors, until his skin was calloused and brown and hair no longer grew on his body.

—from a letter written by Sima Xiangru about the great flood (c. 2300–2200 BCE), recorded by Chinese historian Sima Qian (94 BCE)<sup>1</sup>

If [Adam] Smith—who was sitting at the epicenter of the storm—did not see it coming, we may excuse. . . the Qing [Government] for not seeing it either. What they all missed, as many of our contemporaries still do, is the fundamental difference between capitalist and non-capitalist market-based development.

—Giovanni Arrighi, *Adam Smith in Beijing* (2007)<sup>2</sup>

The first major Chinese historiographic endeavor was written in 94 BCE by Sima Qian. In these *Records of the Grand Historian*, Sima Qian reflects on Da Yu, who had ruled some two-thousand years prior to Qian's time.<sup>3</sup> Da Yu's name and deeds survive in both Chinese folklore and the historical record, as do some of his approaches to statecraft. For instance, Sima Qian recounts the wide array of civil engineering projects Emperor Yu undertook in order to consolidate his rule over the central plains that had served as a heartland for Chinese civilization. Primary among these public works was Emperor Yu's efforts to bring an end to the floods that had beset these plains. By the time of the Han dynasty and Sima Qian's *Records*, Emperor Yu's ability to muster the labor and organization necessary to stem regular catastrophic flooding along the Yellow River had become exemplary, demonstrating virtuous governance and the

legitimacy of centralized decision making. Having himself traveled widely among the western Han frontier, Qian was also interested in historic and contemporaneous diplomatic relations between the Han court and the people living along its borderlands. He records communications several decades before him between Han envoys and elders of southwestern tribes *Ba* and *Shu*. The elders had been questioning the Han court: why did it seem more interested in establishing and developing relations with the western barbarians than in the social development of its own citizens? Qian recounts one response to this query:

In this world there must be extraordinary men before extraordinary deeds, and there must be extraordinary deeds before extraordinary results can be achieved . . . Therefore it is said, “The common folk are terrified at the start by anything extraordinary, but when it has reached completion, the whole world enjoys the benefits thereof.”<sup>4</sup>

In Sima Qian’s account, these words come from a letter written by court official Sima Xiangru (no relation) as a part of the latter’s attempt to respond to popular doubts about the then-Emperor Jing’s plan to contact “the western barbarians” through emphasizing important governmental functions of long-term planning and the court’s broader diplomatic vision.<sup>5</sup> Another part of this letter is reproduced above as an epigraph.

In the anecdote about the great flood and the tale of extraordinary results, the problems of a more modern state come into focus through the case of a large-scale public works project. First, we see the ambivalence of statecraft in balancing the tensions between regional and central, as well as individual and collective, interests in both Yu’s actions and Qian’s account. Second, Qian’s interest in Yu’s moment speaks to how addressing contemporary contradictions with an eye to historical instances yields greater clarity. On the one hand, we have Emperor Yu’s legendary abilities in controlling and ameliorating a protracted period of natural disaster through civil works projects on a massive scale. On the other hand, we have the memorialization of this project and its modeling and institutionalization in the Han court, where again infrastructure and public works appear as the consequence of the exceptional leadership and capabilities of the emperor to guide the work of the people. Taking on additional weight today against the

backdrop of China's ambitious Belt and Road Initiative, large-scale infrastructure has long operated as a mechanism for establishing a spectrum of diplomatic relations with other states. For instance, Sima Qian documents several chieftains in the Qiong and Zuo regions who desired to enter into relations with the Han after hearing of the gifts that "southern barbarians" received after developing diplomatic relations. In his letter, Sima Xiangru reminds the elders of *Ba* and *Shu* that they themselves used to be considered "barbarian" by the Xia dynasty.

Canal building featured heavily in these moments of diplomacy-cum-infrastructure. The Han Imperial court developed a system where the central government "sponsored military-agricultural colonies, known as the *tuntian* system, in Northwest China to ensure the safety of traders along the Silk Road."<sup>6</sup> Canals and irrigation underpinned the *tuntian* system, which has been described as "one of the most important state-promoted policies in ancient China."<sup>7</sup> Along with resettled farmers and soldiers, extensive canal development brought agriculture, Han culture, and relative abundance to arid, sparse regions, thus allowing the Han government to extend its influence to the western frontier.

The legitimacy gained by the central government through its flood amelioration and public work efforts is not without substance. A recent archaeological study in *Science* corroborates the basic geological facts of the Xia's river works:

The ~1920 BCE flood shares the main characteristics of the Great Flood described in ancient texts. Apart from its huge peak discharge, the secondary flooding on the lower plains may have been long-lasting, just as the Great Flood remained uncontrolled for 22 years until it was managed by dredging (rather than by blocking breaches in natural levees).<sup>8</sup>

Sima Qian's records accurately capture even the specific way in which Emperor Yu controlled the flood: by dredging the rivers ("deepening their beds"). Yunzhen Chen et al.'s 2012 article in *AMBIO*, "Socio-economic Impacts on Flooding: A 4000-Year History of the Yellow River, China," describes how the Yellow River, China's most historically significant river, has been especially turbulent in terms of both the number of times it has flooded (more than 1,000 times in 4,000 years) and the number of times it has changed course (once every twenty-five years).<sup>9</sup> Further, in much the same way we have in mind,

the authors establish a longer view that connects the turbulence of the river to technical and political-economic transformations within Chinese society, from the Xia dynasty to the twenty-first century. According to the authors, the dynasties following the Xia furthered their efforts to control the Yellow River, with a complete levee system emerging in 350 BCE. Contemporary Han accounts in *The Book of Han: The Gazetteer of Channels and Canals* from 83 CE remark that the distance between the levees on both banks could be as wide as twenty-five kilometers, which, combined with the development of irrigation systems, drew people to the floodplain for agriculture and contributed to a threefold boom in population during the Han dynasty.<sup>10</sup> Such infrastructural projects were part of ushering in a golden age of Chinese culture.

We offer one further example from ancient history to complete our initial point that Chinese governance has long revolved around large-scale hydroworks. The Han dynasty also began construction on the Grand Canal, which UNESCO's World Heritage Site documentation describes as "the largest and most extensive civil engineering endeavor prior to the Industrial Revolution."<sup>11</sup> The canal connects the Chinese interior and has been maintained and upgraded more or less continually in the subsequent 2,000 years, including major work by the Ming and the Qing (1368–1911) to facilitate exchange between southern regional rice harvesting and northern regional cotton planting and to bolster the national economy.<sup>12</sup> The current government, the People's Republic, has also undertaken renovations, and to this day the Grand Canal provides logistical and transportation capacities on a north–south axis (in contrast to all the other major Chinese rivers, which run east–west).

Thus, we can advance provisionally that the management of water through massive-scale infrastructure constitutes a major theme and problematic for central Chinese governments. This is not to lose sight of the specificity of contemporary problems of water management, including, of course, supplying potable water and irrigation for its population, hydroelectricity generation projects, and indeed the wide array of calamities that aquifers and waterways experience when absorbed even partially into the global logic of capitalist development. Instead, we wish to consider the massive-scale infrastructure project as a cultural form that expresses a Chinese historical dynamic between the state, the environment, and development.<sup>13</sup>

Global capitalism, which reorients this dynamic, arrives relatively recently in history, but it nonetheless first arrived in China after newly

invented British steamships finally defeated Qing coastal defenses and found a ready-made network of canals that allowed Britain access to the Chinese interior, fulfilling the then-250-year-old British dream of open Chinese markets. Marx accurately described this dynamic when he wrote that the cannons of capitalism blasted down “all Chinese walls,” but he did not identify the real historical situation. In the end, it was not “the cheap prices of commodities” that battered down Chinese walls, but British heavy artillery.<sup>14</sup>

Later Chinese integration into the twentieth-century global economy also centered along a waterway, this time the Pearl River, which became the center of Chinese commodity manufacturing for the world market. The Pearl River also served as the backdrop for Deng Xiaoping’s extremely influential 1992 Southern Tour, where the Communist Party crystallized the paths and principles that would shape contemporary China. Once again, China would not have appeared quite as attractive an investment destination without socialist infrastructural development in education, healthcare, transportation, energy, and so on. Contemporary climate crisis, even more of a newcomer than the British Empire or economic reform, looks like it will shape—to put it mildly—this historical dynamic still further.

Rivers and river management provide just one element of these long-unfolding contradictions. As climate change continues to ravage communities around the world and upend extant development plans, renewable energy capacity in China stands out as a vital instance through which we can consider the dynamics of development, capitalism, the environment, and possible futures. To approach a more comprehensive understanding of these conditions, we draw heavily in this essay on the work of Giovanni Arrighi. Arrighi’s analysis of the world system, following Fernand Braudel, analyzes capital’s historical, spatial, and economic transformations. However, Arrighi offers only one (albeit compelling and predictive) image of the history of global capitalism. Had we engaged primarily with Robert Brenner’s work, which constructs an immanent account of capitalism’s historical path (as opposed to Arrighi’s primarily empirical approach), our conclusions would be different.<sup>15</sup> We would welcome a synthesis of the dynamics discussed here from a Brennerian perspective. As this article stands, we hope it opens more doors for inquiry than it closes. The final section of our essay will return wholeheartedly to Arrighi and the world system. For now, we proceed to establish what we know about China and renewable energy.

In 2018, as was generally the case in the prior five years, China was the single largest investor in renewable energy development, production, and capacity in the world. It accounts for about 32 percent of the global total investment (compared to about 28 percent by the 28 European Union countries together), and leads the world in total installed renewable capacity (hydro, wind, and solar).<sup>16</sup> In the tradition of central planning, the government has taken a primary role in setting emissions and energy-mix targets, subsidizing renewable energy research and development, and exacting fines and punishments on firms that fail to comply. Having met prior goals in many cases, the Chinese government revised its targets in 2019 for at least 35 percent renewable share of electricity consumption by 2030.<sup>17</sup> Consequently, the Energy Research Institute, part of the National Development and Reform Commission, calculated in 2019 that total Chinese carbon emissions will peak in 2022, ahead of the earlier target of 2030.<sup>18</sup> In 2018, Chinese carbon dioxide emissions per unit of GDP fell 4 percent, marking a decline of 45.8 percent from 2005 levels.<sup>19</sup> Further, in 2018, according to the China Electricity Council, renewable energy composed about 27 percent of all electricity sources, with hydropower composing more than 60 percent of renewable energy sources. Following global trends, hydropower production grew at a rate of 3.2 percent compared to 20.2 percent for wind and 50.8 percent for solar.<sup>20</sup> These accomplishments appear to be in line with official government goals to boost non-hydro renewable energy sources, as well as the long-term transition to renewable energy in total. As the development statistics make clear, China is moving from rushing waters to roaring winds and the light of the sun.

Alongside such empirical considerations, we are also interested in what infrastructure can mean for people whose property is held in common. Indeed, if we were to think of infrastructure not as a neutral term but as a politically and socially contested cultural form, the divergence between US infrastructure, say, and Chinese renewable energy projects will begin to make more sense as materially and functionally related forms of conveyance that must be interpreted differently on account of their socially mediated content. The way we tend to think of infrastructure in North America, as both invisible in plain sight and in desperate need of repair, produces cognitive discontinuities when applied to the development of renewable energy infrastructure in China. The liberal-modern frame for most Western discussions on infrastructure cannot hold true in the case of Chinese infrastructure projects: the path of private

land and public works applicable in the United States, for instance, has little to no bearing in China, especially since the land itself did not undergo any sort of privatization through still-recent settlement, as in the United States, or through enclosure, as in the United Kingdom. These differences conspire to make energy infrastructure in China unavoidably present in sight and in mind.<sup>21</sup> It is true that China has witnessed expulsions of smallholders during massive infrastructure projects, as every massive infrastructure project worldwide has necessitated. Nevertheless, the scale of these expulsions pales in comparison to the liquidation of the peasant class in Western Europe, for example, or the genocide of Indigenous people undertaken by the United States and Canada through their nation-building. Chinese expulsions also proceeded within a different juridical tradition, yielding different results for those expelled, as we will discuss below.

In the following sections, we address each of the three major renewable trends in Chinese energy production: hydropower, wind power, and solar power. Each area of energy generation speaks to a historical movement. Hydropower is an entrenched and slowly growing energy source; wind power has been steadily increasing capacity since the late twentieth century; and solar-power generation is the fastest growing energy capture technique. We consider such past, present, and future energy trends alongside climate crisis, state governance, and global economics. A final section reflects on the interlocking problematics associated with renewables infrastructure, climate crisis, and the world system.

### Hydropower and Climate Crisis

Given the prominence of rivers in Chinese historical consciousness and the importance that past Chinese governments placed on the rivers' control and development, it is fitting that the People's Republic has taken to hydroelectricity projects with enthusiasm. Hydroelectric plants are unique among energy sources in that they could theoretically both produce power and mitigate flooding. As we suggest in this section, the Chinese state has found some ways to make hydropower dam development less destructive than it has been elsewhere. However, on the global scale, given that capital tends to control the bulk of the cost, resources, and labor required by dam construction, the energy these dams ultimately produce tends to benefit capital accumulation. We can only speculate about China's move to develop

other energy sources: it may be in recognition of the material impacts of dams or due to the saturation of China's hydropower potential.

According to the International Hydropower Association, China accounts for 352 gigawatts (GW) out of the total global 1,308 GW hydroelectric capacity installed as of 2019, which is about as much as the next four nations together.<sup>22</sup> It was also the fastest growing national installer of hydroelectricity in the same year. Further, these figures do not reflect the hydroelectric plants that Chinese firms have installed overseas as part of its Belt and Road Initiative, which brings to mind the vital role of infrastructure in securing diplomatic goals and regional support during the Han dynasty. When one incorporates these trends, Chinese firms account for more than 70 percent of global hydropower construction in 2019, according to the National Energy Administration, and moreover Chinese companies have “invested more than 200 billion yuan in hydroelectricity projects in 40 Belt and Road countries and regions.”<sup>23</sup> Given China's formidable installed hydropower capacity, as well as its projects to install more hydropower capacity overseas, what does hydropower mean for global climate and global emissions?

Hydropower reservoirs emit a median of 18.5 grams of CO<sub>2</sub> per kilowatt hour, compared to 820 for coal, 490 for oil, 48 for solar photovoltaics (PV), 12 for offshore wind and nuclear, and 11 for onshore wind.<sup>24</sup> Therefore, from the perspective of CO<sub>2</sub> emission reduction alone—that is, from a purely technical standpoint—hydropower successfully reduces CO<sub>2</sub> emissions, and the replacement of coal and oil burning power plants by hydropower would theoretically greatly diminish CO<sub>2</sub> emissions. However, some evidence suggests that reservoirs created by hydroelectric dams produce a substantial volume of methane and other greenhouse gasses, perhaps contributing toward 1.5 percent of total global greenhouse gas emissions.<sup>25</sup> Moreover, the overall movement conditioning world-systemic hydropower build up and the concrete process of building a large hydropower dam raises the possibility that hydropower could lead to other carbon-intensive forms of economic activity, potentially lessening or negating its positive impact on carbon emissions.

Contemporary hydropower emerges as a phenomenon of the operations of global capitalism, not only through its financing by institutions such as the World Bank, but also in its role in building industrial capacity. In their landmark 2000 report, *Dams and Development: A New Framework for Decision-Making*, the World Commission on Dams notes that large landowners and “the industrial and mining sectors” predominantly reap the



benefits of large dam development, while the adverse effects of development fall disproportionately on “rural dwellers, subsistence farmers, Indigenous peoples, ethnic minorities, and women.”<sup>26</sup> Certainly, the questions of where dams are to be built, which ecosystems and lifeways they destroy, which people they displace, and what happens to these displaced people (an estimated eighty million people worldwide) appear as political questions, and it may be the case that government-industry coalitions could, theoretically, more or less equitably distribute the various benefits and harms of a dam.<sup>27</sup>

In the Chinese context, official government directives rely on land-based, rather than purely cash-based, strategies for resettling people displaced by large dams. Such strategies include “developing new and existing land for agricultural purposes and developing large-scale agriculture,” as well as income restoration schemes that include land adjustment and redistribution to newly resettled villagers; such approaches tend to offer employment “in state-operated, collective-owned enterprises,” low-yield land improvement projects, and other forms of post-settlement support.<sup>28</sup>

With roots that go back to the plans of Sun Yat-Sen, a major figure in the founding of Republican China, the 22,500 megawatt (MW) Three Gorges Dam is the largest dam in China, and indeed in the world by installed capacity. Brooke Wilmsen’s longitudinal study of resettlement outcomes for villagers displaced by the Three Gorges Project (TGP), the only outside study of its kind in the Chinese context, reveals some of the effects of such policies: in 2011, displaced villagers reported two- to four-fold increases in income relative to pre-displacement levels, declining inequality, improvements from pre-displacement mud and wood housing to brick and concrete housing with electricity and indoor plumbing, and rising food security and social well-being since displacement.<sup>29</sup> Wilmsen does suggest that, due to the massive scale of the TGP, “its status as a nation-building project, and the international attention it received,” its resettlement outcomes may not necessarily reflect outcomes in other hydropower projects in China.<sup>30</sup>

It is true that the even provision of state benefits and policies across multiple jurisdictions in a continental-scale country that is still shaking off pervasive poverty in the long shadow of colonialism certainly remains a challenge. However, a 2013 study on the impacts of damming on the Lancang (Mekong) basin in Yunan, chosen for its lower profile and for the fact that the main community it impacted was the Lahu ethnic minority, shows similar results of increased incomes and government support.<sup>31</sup> The

authors note that these results, somewhat at odds with some previous studies done on settlement outcomes in China, could indicate that “resettlement policies for compensation may indeed be improving” compared with the waves of hydropower development from the 1990s on which those earlier studies had been built.<sup>32</sup>

A drawback in the Lancang basin case was that many of the displaced people turned toward wage labor to supplement their incomes, thus tying their livelihoods closer to market volatility and cutting them off from the relative stability of agricultural production. Further, many of the displaced lost their knowledge of local foodways, as the land they received for resettlement often did not support the same crops. Even a socially just government attempt to resolve the contradictions of development cannot prevent such loss, which lays bare the bargain at the root of infrastructural and economic development. Living practices and knowledges about specific plants and the relationships those plants have with humans and animals in particular ecosystems cannot be preserved once those ecosystems are destroyed. Though displaced people in China have access to increased incomes, better housing conditions, or new relationships to ecosystems, the rising waters of the reservoir submerge not only crucial animal habitats and fish migration routes, but also whole cultures and ways of life, especially those that maintained a relative degree of autonomy from the world market and a much smaller carbon footprint.<sup>33</sup>

In response to these and other concerns, including heavy water pollution and the possible disappearance of as many as half of Chinese rivers from 1990 to 2013, the Chinese government has dramatically scaled down the pace of its dam building and the total number of new dams in its 13th five-year plan (2016–2020). Hydropower growth has contracted significantly since 2013.<sup>34</sup> The latest plans emphasize ecological compensation schemes and vow to prioritize ecological health over runaway economic development under the goal of building an “ecological civilization.”<sup>35</sup> A 2018 report by the World Resources Institute, analyzing data gathered between 2001 and 2015, shows that worsening water stress in China has slowed down, while more areas are experiencing decreases in water stress.<sup>36</sup>

Internationally, the tendency within China toward slowing hydro growth does not quite hold. As alluded to above, Chinese overseas investment has grown to encompass some 70 percent of the global market for hydropower capacity, and, given the scale and saturation of Chinese ventures, some of

its projects have inevitably come under scrutiny for an array of ecological and social concerns. According to Stephanie Jensen-Cormier, International Rivers's former China Director, in the last three years, Chinese firms have taken "steps toward greater openness to engage, understand, and learn about the environmental and social concerns surrounding their projects," even leading to "tangible results in some cases."<sup>37</sup>

On the whole, the problems that remain in how Chinese hydropower projects engage with local communities affected by dams could be understood as externalizations: the move from domestic to international projects. Such developments might move the contradictions of development instead of resolving them. The major practical problem with Chinese hydroelectric projects overseas seems to stem from how Chinese companies often defer to governments and institutions in those countries instead of cultivating relationships with the people. This problem manifests in a number of ways, including large Chinese budgets for conservation or resettlement that nonetheless do not guarantee positive ecological outcomes. There can also be a lack of viable long-term impact tracking when firms leave impact assessments to governments without the resources to undertake them. Finally, there may also be a limited application of long-term "benefit-sharing" schemes with local communities.

Suggesting a more universal logic, these problems are not limited to or even more pronounced under Chinese financing. As the ample impact assessments in the 2000 World Commission on Dams report remind us, hydropower financing under the World Bank, the European Investment Bank, or other Western institutions did not lead to better or even commensurate environmental or social records.<sup>38</sup> Meanwhile as of 2019, 2.5 billion pounds of the total 2.6 billion pounds of UK Export Finance funds in recent years went to fossil fuel projects, and there appear to be no Western institutions investing as heavily in renewable energy development either domestically or in the Global South in the current moment.<sup>39</sup> Historically, under the directives of global capital, international banks do not support very costly large dam projects only, or even mainly, to produce power or control flooding. Countries receive international financing for dams on the condition that those loans will be paid back, either through the government selling the power it generates, or through the industrial or mining growth that the dam would stimulate. From this standpoint, hydropower participates in the circuits of capital, pulling ever more people, water, land, and other resources into the voracious metabolism of commodity manufacturing.<sup>40</sup> Even as hydropower projects bring electricity,

new houses, and proximity to transportation infrastructure to people, they also bring stresses on freshwater fish, animal habitats, and modes of life. Thus, looking at CO<sub>2</sub> emission rates for any specific hydropower plant could miss the forest of ever more factories, mines, and chemical pollution in watersheds, more regional carbon-dense development, and the environmental devastation that comes with greater integration into global capital, for the trees of curtailing CO<sub>2</sub> emissions relative to coal energy.

### Wind Power and Rising Hegemony

The flood of waters rising from China's past and its current massive infrastructural control of its rivers describes only one of the elemental flows that the People's Republic seeks to master. According to Joanna I. Lewis's 2013 study, *Green Innovation in China*, the People's Republic of China is the "largest wind-power market in the world."<sup>41</sup> This was not the case as recently as the turn of the twenty-first century. At that time, there were two major, non-state players, according to Lewis: Goldwind, "the first successful domestic turbine manufacturer," and General Electric, "the first multinational corporation to enter the wind energy business."<sup>42</sup> From the turn of the twenty-first century to the early 2010s, the Chinese state eclipsed two corporate leaders in wind energy. The path to China's massive wind energy boom is one marked by signposts of energy conservatism in the world system. According to a chronology Lewis compiles at the beginning of her book, China installed its first imported utility-scale wind turbine in 1986, yet it is not until over a decade later that the "First wind turbine manufactured by a Sino-foreign joint venture is installed in China" in the year 2000.<sup>43</sup> Between the mid-1980s oil glut, when markets were flooded with crude, and the turn of the twenty-first century, the world system tensed against the development of alternative energy sources to fossil fuels. Today, China has developed immense wind capacity and continues to do so at a scale unparalleled elsewhere in the world.<sup>44</sup> Its 13th Energy Technology Innovation Five-Year Plan specifically promotes wind power and aims for 210 GW of installed wind capacity by the end of 2020, as well as a total renewable energy capacity of 680 GW, and a 15 percent share of total renewable energy—goals it is on track to meet.<sup>45</sup>

According to Chinese Energy Portal, wind accounted for 4.72 percent of power production in 2017 and 5.23 percent in 2018. These numbers may seem incremental, but they represent a shift from 304,000 gigawatt hours (GWh)

in 2017 to 366,000 GWh in 2018, which indicates a growth in wind power production of 20.2 percent. In terms of renewables alone (excluding nuclear) wind made up 18.85 percent of power production in 2017 and 20.6 percent in 2018. Based on these figures of actual use, wind-generated power is still on the rise and has been for the past twenty years. The figures extend this story when we look to the generation capacity for wind power, meaning the total capacity of currently installed turbines to produce electricity. In this case, a ten MW turbine will produce ten MWh of electricity, if it runs continuously for one hour. In 2017, wind power capacity stood at 164,000 MW, which is 9.19 percent of China's total energy capacity. That figure rose in 2018 to 184,260 MW or 9.7 percent of total capacity, an increase, when measured in terms of MW gained, of 12.4 percent.<sup>46</sup> Looking at the installed generation capacity of renewables alone, wind accounted for nearly one quarter of total MW—ahead of solar power capacity, but less than half of hydro capacity. If wind turbines run steadily at full capacity for a year, they will produce upwards of 1.6 million gigawatt hours (GWh). Of course, this kind of calculation is based on hypothetically optimal conditions and the feasibility of storing or transporting the electric energy generated across vast distances. The point here is the development of new infrastructures and methods of energy governance have been central to the rise of wind power generation and are very likely to further efforts to sustain this rise. The required scale and possible challenges facing wind power generation could situate it as a renewable energy solution in need of a governing structure both for implementing novel energy distribution systems and for tracking the equity of this distribution. In other words, the entrenchment and expansion of wind power produces a high capacity for energy generation with little chance of the captured wind energy making it to those most in need of power.

The technical development of wind energy capture is not the whole story. Lewis tracks the emergence of China's global wind dominance to a unique legal context in which Chinese policy mandates forced localization without necessarily transferring intellectual property rights to Chinese firms, meaning that business has to take place within China's borders even though intellectual property rights are not necessarily held by Chinese firms. This mixture of restrictive and open policies has led to a situation where the influx of foreign firms has contributed to what Lewis describes as "a learning network within the Chinese wind industry."<sup>47</sup> This policy has resulted in increased capacity of both Chinese workers and infrastructure for the development of wind power

on a large scale. Holding dear to the material, while letting go of intellectual property, creates a situation where the right mix of production legacy and technical know-how create a hotbed for future wind projects.<sup>48</sup>

At first glance, the main technical problem that wind power generation faces is curtailment—a downturn in a generator’s output from its typical production levels considering available resources.<sup>49</sup> Another major obstacle stands in the way of wind power’s dominance: the lack of existing and sustaining electrical grid infrastructures. Without proper distribution and storage mechanisms, China will face what is known as wind rejection. Wind rejection happens when wind farms drop the total amount of electrical energy that could be generated, according to the wind resources. According to Yuning Zhang et al., this rejection happens “due to the limits of the electrical transmission lines or the potential safety problems in the electric power grid.”<sup>50</sup> Infrastructure is just as essential for wind power as are windy locations and the capacity to manufacture and maintain wind turbines.

In China, renewable energy resources are concentrated in the more sparsely populated northwest, while the bulk of energy demand tends to be concentrated thousands of kilometers away to the east. Consequently, power curtailment and rejection—i.e., wasted excess generated electricity that cannot find its destination demand—have been fundamental historical problems in terms of the development of renewable energy in China.

Lately, however, China has overcome some of the main impediments to further renewable development. Operational battery capacity almost doubled in 2018, increasing its 389 MW of capacity by 340 MW. These figures do not include energy storage in hydroelectric pumps, nor in the form of batteries in electric cars and buses, of which China accounts for 50 percent of the global market. For instance, energy storage in the batteries of municipal transportation vehicles in China is on the rise. Far to the south, programs developed in Chinese urban centers have had a big impact on battery development and steady power draw. Shenzhen has the world’s first all-electric public transit network, and Shanghai will have its fleet of electric buses running by 2020.<sup>51</sup> Shanghai’s Baoshan district has 240 buses in operation, sixty buses shy of the total number of US electric buses.<sup>52</sup> Some of these buses even have a range of 220 kilometers—an ecologically and technically viable use for excess wind energy. According to Brian Eckhouse, because buses run continuously, every 1,000 electric buses on the road saves somewhere around 500 barrels of diesel each day.<sup>53</sup> Chinese manufacturers are also exporting electric buses, as the Belt

and Road Initiative offers opportunities to produce the vehicles for Bulgaria, Denmark, Myanmar, and elsewhere.<sup>54</sup>

Unlike large-scale wind projects, the first wave of electrification in Inner Mongolia, China's most wind-rich region, proceeded on the basis of the development of "micro-wind turbines" or "household wind generators" that could provide electricity to hundreds of thousands of households that were too remote for grid connections. Beginning in the 1970s, government-supported research from local universities and research institutions developed 20 models of household wind generators. These models were designed for their eventual embedding in local contexts. Consequently, their designs focused on their ability to be built and maintained with basic tools, as well as adapted to local manufacturing, skill, and knowledge networks. The government distributed the wind turbines through sales and service centers it set up in every county. After receiving continuing government support through product demonstrations and redesigns from consultations over the following decades, the program registered 137,000 units in the region producing 18.5 MW of electricity as of 1997, before the current wave of renewable energy development. As of 2009, there were about 250,000 units (64 MW), with 40,000 produced yearly and increasing use in urban areas.<sup>55</sup> Jon Leary et al., in their 2012 appraisal, note the unmatched scale of the Inner Mongolian project, its success in cultivating local manufacture, and its flexibility in adapting to local contexts.<sup>56</sup>

As with hydroelectric power, large-scale wind generation requires a massive outlay and top-down organization of resources. Indeed, even the household-scale Mongolian project was only possible through stable government research, distribution, and support. The social relations of wind energy necessitate some degree of state intervention, though the specific elaboration of the state's role can take different forms. As in the example of early wind development in Inner Mongolia, wind power can be used for small-scale, modular energy generation unconnected to the grid. If we consider the epochal scale of renewable electricity generation required to replace fossil fuel generation and slow or halt climate change, some degree of central planning, distribution, and support is necessary as a part of the transition. Such planning appears able in part to address the historically determinate patterns of vastly uneven distribution of generation and power across the world. In the Global South, conditions of under-development and over-exploitation could be alleviated by a planning and enforcement

mechanism that develops national infrastructures and resource extraction conditions for the benefit of the people. Meanwhile in the Global North, the movement toward small-scale generation, which breaks apart established monopolies on energy and political power, could be much better suited to community needs.<sup>57</sup>

A national or, better yet, international strategy for energy transition and climate change preparation will need to address electric grids at the smallest scale. Writing about the U.S., Raymond Malewitz posits that “climate-change infrastructure compels local communities to participate in national and global energy and water networks through the rational management of their particular environmental resources.”<sup>58</sup> He situates the development of renewable energy infrastructures alongside climate change mitigation projects within specific regional ecosystems. Decarbonization requires engaged and open discussion about governance, centralization, and decentralization that address the regional and global at once.

The stakeholders are clear, but the mechanisms for producing just energy systems are not. As Nick Estes writes in “A Red Deal,” both “green economies and carbon-free, wind turbine, solar power, and electric bullet train utopias” and the return of Indigenous lands are possible and necessary to avert or lessen catastrophic climate change.<sup>59</sup> However we might collectively imagine such possibilities, they will be based on speculative suggestions. For instance, the return of Indigenous lands to Indigenous nations in the Americas could provide in part an important basis for a strategy of degrowth, halting the still-increasing consumption of fossil fuels in the most developed and carbon-intensive economies in the world.<sup>60</sup> Meanwhile, the large-scale installation of renewable energy capacity in the most impoverished regions of the world could provide the benefits of development—heat, light, power, shelter, water, and so on. An internationalist plan incorporating both of these paths could thus level the vast global disparities in income, opportunity, and living standards without significant carbon emissions.

Reducing energy intensity and increasing the share of renewable-generated energy were fundamental components of China’s 11th (2006–2011) and 12th (2011–2015) five-year plans. The 11th Five-Year Plan (2006–2010) for National Economic and Social Development emphasizes the need to build new major power transmission channels. This aim requires regional and provincial power grid construction, power transmission and distribution networks, urban and rural power grid innovation, an urban and rural power



distribution network, as well as power supply scope enlargement and power supply safety. The plan specifically calls for the all-out development of wind energy, including “30 more-than-100,000 KW large-scale wind power generation projects” in “Inner Mongolia, Hebei, Jiangsu and Gansu etc.”<sup>61</sup> The report frames these expansions of renewable energy infrastructure in terms of energy justice by calling for the construction of 50 green energy demonstration counties. It also outlines plans to optimize power grid extension, wind electric power generation, small hydropower stations, solar energy PV power generation, and so on, in order to “solve the problem of electricity utilization by the 3.5 million people without electricity.”<sup>62</sup> Similarly, the 12th Five-Year Plan (2011–2015) for Energy Development calls for an expansion of wind development in the north and offshore.<sup>63</sup>

The wind-rich areas of the green steppe, arid desert, and Hulunbuir grassland of Inner Mongolia present both technical and social barriers to wind power development. In their 2009 *Energy Policy* article “Onshore Wind Power Development in China,” Jingyi Han et al. track several societal problems inherent in Inner Mongolia wind-power development plans. These issues amounted to a shortage of communication between residents and developers. They point out that local governments lacked the influence to mandate where wind farms are established or how they are operated. On top of this governance problem, wind farm development restricted grassland that is typically used for grazing. It takes years for the grasses to return after the installation of wind farms, which often involves heavy machinery marring the landscape. Moreover, wind farms tend to be very large and located on publicly accessible land, which leads to security issues for wind turbine components.<sup>64</sup> To add to these issues, China is currently bolstering plans for a massive expansion of wind-power production in Mongolia ahead of the 2022 Olympic games.<sup>65</sup> Once again, renewable energy development has become the locus for statecraft and diplomacy.

The production of wind turbines requires raw materials, factories, machines for assembly, fleets of vehicles for transport, and laborers every step of the way. As with hydroelectric dams, but to a lesser degree, wind turbines require advanced planning, proper location, and the right materials and know-how. The project begun in the 1970s for dispersed household power generation, as well as the current expansion of both wind power generation and the use of municipal fixes, such as the electric bus fleets of Shenzhen, produce two poles of state approaches to energy. Technological

development meets community need in both cases. Alongside small- and large-scale power generation comes an increased knowledge capacity. Both the 1970s rural power generation project and the electrification of public transport are significant steps away from fossil fuels, but climate change has different energy requirements than living well during the Holocene. What we think we see here are the seeds of degrowth of the carbon economy and the expansion of renewables at the same time: a kind of promise of a dialectical reversal of currently existing combined and uneven development. The unconscious waste of people and of resources under global capital, even in China, could be better acknowledged and addressed by a careful mix of central and decentralized planning that takes combined and uneven development as inevitable yet liberating. Flipping the differentials and redistributing energy could mean a marriage of town and country. Wind power generation, electrified transportation, and community-determined needs satisfaction form three important pillars for spatial reorganization in the name of energy justice. The Belt and Road Initiative certainly seeks a developmentalist path, but, so far, it also embraces clean technology alongside fossil fuels. What does this mean for property reform in China's north, in Inner Mongolia? That remains to be seen.

### Solar Power and Communism

In 2017, the United Nations Development Program and Panda Green Energy Group built a 248-acre solar power plant in Dàtóng, China. The site is one of one hundred planned panda-shaped solar farms that will line the route of the Belt and Road Initiative. According to *Reuters*, Panda Green Energy Group has already connected one of the plants to the grid in the Shanxi province.<sup>66</sup> The plants are said to have a direct impact on cutting China's reliance on coal: "Utilization of one panda solar power [*sic*] plant will save the equivalent of a total 1.06 million tons of coal and cut emissions of greenhouse gases by 2.74 million tons in 25 years," according to the company.<sup>67</sup> This timeline presents solar energy as a useful wedge against future emissions, but if such developments do too little, too late, we do not mean to suggest they should not be pursued. Rather, low-carbon energy solutions, no matter how scaled-up, have imprints of their own and cannot be pursued as the sole strategy for an environmentally and socially just energy transition. Once again,

governance and ownership are crucial factors in the future of solar energy in China and for the world-energy system.

There is something to be said here for the massification of the panda imagery alongside the prefectural city Dàtóng, named for the Confucian term *dàtóng* 大同 meaning “‘great universality’ (and sometimes ‘great harmony’ or ‘great unity’).”<sup>68</sup> The confluence of this Belt and Road Initiative solar project and the fortuitous meaning of the concept for which its location is named make for a curious lesson in energy as a social relation. For as Andrew Pendakis explains, “In *dàtóng*, no action is free from the burden of mattering... From this perspective, prosperity is not an obstacle to but proof of moral rectitude.”<sup>69</sup> We hear the echoes of Sima Qian’s records of state-driven development in the Xia and Han dynasties here, not to mention Deng Xiaoping’s pronouncement on his 1992 Southern Tour: “development is the strongest theory.”<sup>70</sup> Sima Qian likewise points to the way that ancient Chinese states fostered prosperity and stability through right action. In an era of fossil-fueled climate crisis, no action is free from the burden of carbon-intensive energy. This observation becomes all the more important as it applies to larger and more impactful forms of governance. China’s role as a state amplifies a sense of right action for energy, and its role as a world leader through initiatives such as the Belt and Road Initiative increases this burden.

Panda-shaped solar arrays are not exactly what David Schwartzman had in mind when he wrote his 1996 article “Solar Communism” for *Science & Society*.<sup>71</sup> Drawing on work in ecological economics from Elmar Altvater and John Dryzek, Schwartzman rehashes thermodynamics in order to posit that a globally deployed solar capture of energy could avoid the pitfalls assumed by thermodynamics and generate a socially viable satisfaction of human needs. Schwartzman argues that the adage “from each according to their abilities, to each according to their needs” ought to be expanded to include more-than-human nature as well.<sup>72</sup> For him, a “future global economy energized by the direct collection of solar radiation, at high conversion efficiencies, would be, to use that old Hegelian-Marxist metaphor, a negation of the negation of preindustrial energetics powered by recent/current solar flux via photosynthesis; this highly inefficient process having been first negated by industrial society powered by fossil fuels that released stored solar energy trapped millions of years ago.”<sup>73</sup> This dialectical reversal, the negation of the negation, is not precisely what we find in the development of Chinese solar power in the present.

Before discussing the current possibilities and limits of solar power, we work through Schwarzman's argument and the conceptual dynamics of solar power generation.

Schwartzman's proposal relies on an "initial 'parasitic' phase" that may simply be unavailable to us today, in which transition would rely "on fossil fuels and nuclear power," though he also posits that accessing solar energy must not include any "net transfers of carbon dioxide, methane or other greenhouse gases to the atmosphere/ocean system (e.g., by deforestation, flooding from big hydropower projects)."<sup>74</sup> He continues his critique of the environmental and physical costs of energy sourcing by articulating that the same argument applies to "recycling, cleaning up and/or restoring the biosphere, and mining/refining mineral ores with increasingly scarce concentrated sources," because fossil fuels as well as nuclear and geothermal power assault the biosphere through incremental heat and pollution.<sup>75</sup> For instance, nuclear power relies on water cooling that significantly adjusts the temperature of a body of water. Meanwhile, its waste presents challenges for proper storage and monitoring. Moreover, nuclear power has historically been highly reliant on fossil fuels.<sup>76</sup>

In one sense, the argument Schwartzman makes is one bound to paper—the calculation of solar capture entropy-proofing soars above and beyond fossil fuels, nuclear power, and even other renewables. From a physical perspective, solar cells just work. They do not require moving parts, as windmills do, nor do they require the water cycle in the way hydropower generation does. So long as light strikes the surface of a solar cell, the electrons will react, moving from their places through the circuit. The electron reaction plays itself out in each solar cell: as unproductive electrons bounce around without being captured, a small portion complete the movement through the porous cell from positive to negative charge.

In another sense, Schwartzman outlines the cultural dynamics of energy systems. Building an energy regime that requires high energy inputs to locate, extract, refine, transport, and even produce energy creates its own energy-intensive social relations: fieldwork teams, riggers, refinery workers and maintainers, pipeline and railway builders and operators, combustion engine engineers and producers offer a limited set of examples. A solar regime still needs extraction teams, producers, and installers. It still needs a distribution and storage strategy (a smart grid and storage solutions, such as the batteries found in electronic vehicles). Though solar regimes

are leaps and bounds less complicated than the fossil regime, they still require governance. Schwartzman sees in solar communism a long-term solution to both entropy and the social relations of fossil capitalism. It is not yet settled at present whether the Chinese model of solar development will come to differ from those pioneered in the West.

To be communist about energy does not mean foregoing being a materialist about modes of energy capture. Jasper Bernes makes this point clear in his blog post for *Commune*, “Between the Devil and the Green New Deal.” He writes, “The renewable-energy supply chain is a complicated hopscotch around the periodic table and around the world. To make a high-capacity solar panel, one might need copper (atomic number 29) from Chile, indium (49) from Australia, gallium (31) from China, and selenium (34) from Germany.”<sup>77</sup> The primary material associated with solar energy capture is cobalt (27), a by-product of copper mining, and along with Chile we add the Democratic Republic of the Congo as the country where most of the world’s cobalt originates. The large-scale extractive practices for renewable energy technology involve, unfortunately, violent conflict, intensive mining practices, and, at times, child labor. However, it is not the fault of renewable energy technologies that they require minerals and mining to be made, nor is it the fault of mining and minerals that European and US neocolonialist control—through the European Union, the Organization of American States, *Françafrique*, the International Monetary Fund (IMF), and “foreign aid” from a caravan of NGOs—crush the attempts of the Global South to nationalize resources and determine their conditions of extraction. We most clearly see this in the 2019 US-supported coup against Bolivia’s Indigenous president Evo Morales, who had attempted to renegotiate the terms through which foreign firms could access the country’s lithium reserves.<sup>78</sup>

The conflict, exploitation, and pollution surrounding the production and installation of solar panels differs in kind from that surrounding fossil fuels: the former is localized and open to regulation, and while the latter shares these qualities at the site of extraction, the transportation, refinement, sale, and consumption (i.e., burning) of fossil fuels produce dispersed and often untraceable impacts that are felt unevenly in terms of air quality, CO<sub>2</sub> concentration, and residual pollution. The aim here is not to argue that the human and environmental costs of solar cell production need to be morally weighed, but rather to understand each energy resource as having inherent and contingent social impacts. Solar panel construction,

it strikes us, involves distinctly human, though difficult, problems, by which we mean social problems that unfold at the scale of human beings.<sup>79</sup>

What would it take for a solar electricity regime to emerge? According to Dustin Mulvaney in his 2019 book *Solar Power*, the successful scaling up of solar energy will have begun once it is typically measured in terawatts (TW), which is not the case at present despite the fact that over “99.9 percent of photovoltaic modules and concentrated solar power plants ever built were installed after 2008.”<sup>80</sup> Part of this rise in solar power production includes identifying locations suitable for capture. Previously undesirable landscapes for development, such as deserts, will become new sights of land-use conflict, according to Mulvaney, including China’s Gobi Desert.<sup>81</sup> He notes that the “net social and environmental benefits of solar power are well documented and generally uncontested,” yet as with all large-scale energy capture projects, solar entails “solar energy landscapes, production of silica and various metals from mines, processing in smelters, blast furnaces, glass factories, chemical plants (with their effluents), and manufacturing facilities.”<sup>82</sup>

Mulvaney looks to the technical hurdles, rather than the social ones. We want to emphasize that for a renewables regime to emerge, and for it to be one that is fundamentally just and equitable, the world-energy system—its supply chains and infrastructures—must be understood as a cultural form.

Thinking in technical terms alone, we can see how solar arrays could be put to use by the state. In 2007, China planned to increase solar power capacity to 1,800 MW by 2020. Already by 2009, China was set to quintuple its projected output with a new projection of 10 GW.<sup>83</sup> The 12th Five-Year Plan (2010–2014) projected 21 GW and called for the establishment of 1,000 solar-energy model villages.<sup>84</sup> “In 2015, China had a total deployed solar capacity of 43 GW compared to more than 94 GW in the EU. [In 2018] China’s total deployed capacity of 175 GW dwarfed the EU’s 115 GW.”<sup>85</sup> Josh Gabbatis puts it another way: “The installed capacity of solar panels in China in 2018 amounted to more than a third of the global total, with the country accounting for half the world’s solar additions that year.”<sup>86</sup> To top this off, China is very close to achieving cost parity between fossil fuel and solar generated energy.<sup>87</sup>

Opening up our understanding of solar energy, we can see that PV panels hold a profound usefulness for areas that the electrical grid has not yet reached. The capacity for localization of solar energy capture in particularly sunny remote regions should not be overlooked as sources of carbon-zero energy, which require little to no maintenance. Yet here we run aground on

the struggles facing actually existing communism in a capitalist world: how to satisfy human needs through communist means in a capitalist world? We would rephrase such considerations in terms of energy: how to produce a renewable, distributed, social energy grid in a fossil-fueled world? How to resituate the Chinese development and production of solar arrays such that we can see the commodity chains behind each panel and determine how to devise ecologically and socially just ways of sourcing the required materials? No matter the answer, development continues apace.

On June 17, 2019, the Gansu province solar array located in Dunhuang—located nearly 2,000 kilometers away from the Dàtóng solar panda—China’s first 100-megawatt molten salt solar thermal power plant operated at full capacity for 20 hours.<sup>88</sup> Unlike solar panels, the array redirects and concentrates light with 12,000 mirrors towards a receiver that in turn powers a heat engine and heats molten salt. The heat stored in the salt allows the plant to produce energy at any time of day. Such solar heating has become ubiquitous in China for home water use, first appearing in the 1970s. Meanwhile, the Chinese Export-Import Bank is financing a large solar field in Jujuy, Argentina just to the north of Salta, in the Cauchari field.<sup>89</sup> We would insist that such technological developments alone cannot produce a carbon-neutral or carbon-negative social order. Instead, it is only in how such technologies are put to use and distributed that we will start to see something like what Schwartzman was thinking of when he described solar communism.<sup>90</sup>

### Belt and Road: Infrastructure, Climate Crisis, and the World System

After surveying five centuries of the blood-soaked trajectory of historical capitalist accumulation in his last major work, *Adam Smith in Beijing* (2007), Giovanni Arrighi arrives at the contemporary moment and declares, “the European path of capitalist development” has reached a dead end.<sup>91</sup> For Arrighi, the collapse of the legitimacy of US authority worldwide following its invasion of Iraq condenses the historical logics shaping the rise and fall of the European capitalist empires. What is more, the overextension of the U.S. in Iraq continues through moments of profound under-extension at home, highlighted, for instance, in its negligent response to the ravages of Hurricane Katrina on its own citizens in August 2005. Tellingly, in this second example of US priorities, the crisis in New Orleans was not a direct result of the storm but occurred rather because of the failure of both the

levies to hold back excess water and the US emergency response to treat the moment as a crisis. Here, material and social infrastructures were undercut on US soil, even as the state flexed its military power in Iraq.

This sort of malfeasance, surfacing again during the COVID-19 pandemic, is not new. Since the Genoese bourgeoisie profited from wars made by Iberian states, financial and militaristic interests have motivated inter-state relations along the European capitalist development path. As the Genoese bankers lost their influence, Dutch and British accumulation destroyed and rebuilt the world-capitalist system forged by the Genoese-backed Iberians through conquest and genocide. The Dutch and British developed the Genoese fusion of commerce and militarism into a global system of imperialism through which they expanded trade further and enforced favorable trading relations through war, resulting in the subjugation and impoverishment of much of the world.<sup>92</sup>

Militarism, finance, the endless accumulation of territory and the historical expression of these interests through imperialism have thus always characterized capitalist expansion in the Western interstate system. In Arrighi's words:

The commercialization of war and an incessant armament race have characterized the Western path of capitalist development from its earliest beginnings in the Italian city-states to its final culmination in the failed US world state. So-called "military Keynesianism" . . . is no more a novelty of the twentieth century than finance capital and the transnational business enterprise.<sup>93</sup>

Even the epochal inventions of the Industrial Revolution, such as steam engine improvements, the iron railroad, and the iron ship, were possible only because of the scale of Britain's economic and material demands occasioned by its war with Napoleonic France over succession to Dutch hegemony. Indeed, in this light, the industrialization of "the sectors that really mattered—i.e., the capital goods industries"—was incidental to the industrialization of arms production.<sup>94</sup> For Arrighi, although the War on Terror proved profitable for certain interests in the short run, as the U.S. injected ever-increasing amounts of money into defense spending (a trend with no sign of reversing), a more lasting consequence was the decreasing ability of the U.S. either to rally broad international support for its military interventions or to govern and develop Iraq in the years following the 2003 invasion.



The US-driven cycle of militarism, commerce, imperialism, and the endless accumulation of capital, in this view, reached its high-water mark during the early stages of the Cold War. The U.S. succeeded for a time in steadily enriching its bloc of allies and client states before the US-developed productive capacities of states like Germany and Japan confronted the U.S. as competitors and upset the economic balance, resulting in the U.S. abandoning the Bretton Woods world currency system in a bid to rescue American manufacturing competitiveness.<sup>95</sup> In the same period (i.e., the post-1970s waning of US hegemony and increasing chaos in the interstate system), Arrighi takes stock of the unprecedented growth of the Chinese economy, especially since the 1980s. In the closing chapters, Arrighi considers the possibility that the re-emergence of a world-historically important national economy could restore a millennia-long East Asian interstate system—suppressed for a century by the arrival of Western capital and cannons—that functioned quite differently from the Western interstate system.

A few fundamental differences separate the historical “market-based” East Asian interstate system from the European capitalist system for Arrighi. First, the China-centered interstate system of trade and diplomacy that operated mostly continuously between Japan, China, Korea, Vietnam, Laos, Thailand, and Cambodia, and that fully stabilized beginning in at least the Ming dynasty (1368 CE), was remarkably peaceful compared to the European system. Its historical emergence and functioning did not depend on a symbiosis between national economies, arms manufacturing, and frequent military conflict.<sup>96</sup> Second, the historical East Asian interstate system did not develop through endless territorial expansion, with the Qing expanding only to transform “a hard-to-defend frontier into a pacified periphery and a buffer against raiders and conquerors from Inner Asia,” and all territorial expansion ceased around 1760 after these aims were established.<sup>97</sup> Lastly, less important for Arrighi but implicit in the prior two terms and important for our purpose of projecting future paths of development, the China-centered interstate system was predominantly non-interventionist. The Chinese government did not demand that emperors in Vietnam, Japan, or Ryuku recognize the political authority of the Chinese emperor in their own territories. Instead, the states related to each other mostly through a complex and shared system of trade, cultural exchange, diplomacy, and ritual, with the interstate system itself granting and reinforcing legitimacy to the self-determination of each constituent state. Following a thread traceable from Sima Qian’s writing on the Han emperor’s

gift-giving to southwestern elders to open diplomatic relations, the Qing government also “interfered as little as possible in the native people’s internal affairs” in its tributaries in central Asia.<sup>98</sup> In general, “relations with China did not involve much loss of independence, as these states were largely free to run their domestic affairs as they saw fit and could also conduct foreign policy independently from China,” with Korea retaining de facto independence for two millennia despite Chinese suzerainty prior to 1911.<sup>99</sup>

The Western path of capitalist development has torn the communities, livelihoods, and wealth of the world apart in its plunder for profit. Could the restoration and improvement of a non-interventionist, relatively peaceable (with no system-wide wars) interstate system that has been a historical center of world economic activity restore balance to the current epochal wealth and power gap between the West and its subjugated post-colonies, as Adam Smith predicted 250 years ago?<sup>100</sup> This is a central question for Arrighi, and for us. While climate change, driven predominantly by British and US industrialization and their interwoven systems of imperial control (the US military is a bigger polluter than as many as 140 countries, even some industrialized nations such as Denmark and Sweden), already catastrophically upends stability, livelihoods, health, and food and water supplies across the world, the U.S. and the U.K.—the largest historical benefactors of greenhouse gas emissions—appear the least willing to address the problem.<sup>101</sup>

In the closing lines of *Adam Smith in Beijing*, Arrighi, noting the then-inchoate Chinese attempts to provide avenues of financing to developing countries outside of the IMF and World Bank framework, posits the establishment of an interstate system centered around mutually beneficial relationships among nations of the Global South, a Bandung 2 so to speak. A renewed Bandung, based on shared economic rather than political-ideological commitments, could “mobilize and use the global market as an instrument of equalization of South–North power relations.”<sup>102</sup> The main barrier to this possibility, Arrighi anticipates, is the mounting environmental costs that would limit China, India, and the rest of the South from developing along the cheap, fast, genocidal, and reckless energy-intensive Western path. “The fact remains that not even a quarter of China’s and India’s population can adopt the American way of producing and consuming without choking themselves and everybody else to death,” Arrighi writes.<sup>103</sup> If China wishes to pursue continued growth, therefore, it must orient the global market toward an ecologically sustainable development path. Everything depends on whether China can

revive its “traditions of self-centered market-based development, accumulation *without* dispossession, mobilization of human rather than non-human resources, and government through mass participation in shaping policies,” in other words, its traditions of domestic, labor-intensive development (evidenced by its millennia-long history of infrastructure projects), non-expansion, non-interference (in its classical interstate system), and the mass line.<sup>104</sup>

If China succeeds in this endeavor, it could “contribute decisively to the emergence of a commonwealth of civilizations truly respectful of cultural differences;” if it does not, China would likely invite a new round of global chaos as Western interests reassert their “crumbling global dominance” and continue to guide the world along the European path of immiseration and endless accumulation.<sup>105</sup> Samir Amin, in his 2013 overview of Chinese development and possible limits, perceives a similar world-historical juncture where the only way forward is through the reconstruction of “a polycentric international system, respectful of all national sovereignties. . . capable of supporting the independent initiatives of the peoples of the South.”<sup>106</sup> As Arrighi finished *Adam Smith in Beijing* in 2007, as Amin finished “China 2013,” and indeed as we write in 2019, the fates of China and a Bandung 2 still remain undetermined.

In the twelve years since *Adam Smith in Beijing*, the dynamics and contradictions of Chinese economic ascent have deepened. Greenhouse gas emissions, average annual temperatures, species extinctions, and sea level rises have only increased further. The China hawks within the U.S. seem to have solidified a strategy of containment, beginning with the Obama administration’s non-accidental exclusion of the largest non-US pacific economy in its Trans Pacific Partnership trade pact, and continued through long-term economic decoupling, most spectacularly announced by the Trump administration’s levying tariffs on all Chinese exports to the U.S. However, as temperatures and emissions continue to rise, so too has China continued to develop its non-carbon-based energy capacities, with all of their imperfections and contradictions, at world-leading scales, as we have detailed above. While the U.S. has closed the door on full Chinese integration into the US-led global order, China has continued to provide large-scale financing, now fully announced and institutionalized as the Belt and Road Initiative, to developing countries in the hopes of creating a new world system without enforcing political or economic prescriptions in the manner of traditional international banks.<sup>107</sup>

Many Western commentators, including former National Security Advisor John Bolton, have expressed concerns that the Belt and Road Initiative's loans constitute a "debt-trap" whereby China could use national indebtedness to force subjugation.<sup>108</sup> However, there is very little evidence to support this claim, with only one confirmed case of asset seizure—of a port in Sri Lanka—in a portfolio of more than \$200 billion worth of loans.<sup>109</sup> In fact, it seems more likely that China will cancel debts than parlay them into political control, with at least \$50 billion already renegotiated, cancelled, and deferred.<sup>110</sup> Furthermore, according to John Mathews and Xin Huang's 2018 study of Chinese Belt and Road funding, about 55 percent of total energy project funds went toward renewable projects, a 35 percent increase in a decade.<sup>111</sup> A future study could compare the ecological and social results of Chinese funded projects to non-Chinese funded projects; this would help us to consider whether it is possible for different kinds of financing to yield radically different results within or possibly apart from the world capitalist system.

Together, the data suggest a Chinese attempt to help other developing countries along a relatively sustainable development path. The question of whether the massive scale of Chinese investment in renewable energy domestically and abroad will be enough to forestall catastrophic climate change, however, remains unresolved. For now, the possibility of reorienting the world system to further South–South cooperation, supporting the projects of self-determination and sovereignty of oppressed people subjugated and impoverished by centuries of the Western development path, remains open. For it to stay open, however, Chinese interstate diplomacy and financing must continue to avoid the pitfalls of expansion, intervention, militarism—in short, the endless accumulation of territory and capital—that has driven the communities of the world to the brink of social and ecological collapse.

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## NOTES

- 1 Sima Qian, *Records of the Grand Historian: Han Dynasty II Revised Edition*, trans. Burton Watson (New York: Columbia University Press, 1961, revised 1993), 290.
- 2 Giovanni Arrighi, *Adam Smith in Beijing: Lineages of the 21st Century* (London and New York: Verso, 2007), 329.
- 3 Da Yu (c. 2123–2025 BCE) was the first emperor of the Xia dynasty (2070–1600 BCE), the first traditional central dynasty in written Chinese history.
- 4 Qian, *Records*, 290.
- 5 The emperor's plan was unpopular with the regions nearest to the barbarians because of the strain the labor and costs of the road-building project imposed on the local economy.
- 6 Lei Luo et al., "Uncovering the Ancient Canal-Based Tuntian Agricultural Landscape at China's Northwestern Frontiers," *Journal of Cultural Heritage* 23 (2017): 79–88.
- 7 Ibid., 80.
- 8 Qinglong Wu et al., "Outburst Flood at 1920 BCE Supports Historicity of China's Great Flood and the Xia Dynasty," *Science* 353, no. 6299 (2016): 579–582.
- 9 Yunzhen Chen et al., "Socio-economic Impacts on Flooding: A 4000-Year History of the Yellow River, China," *AMBIO* 41, no. 7 (2012): 682–698.
- 10 Ibid.
- 11 UNESCO, "Decision: 38 COM 8B.23," *Report of the Decisions Adopted by the World Heritage Committee at its 38th Session* (2014), 194.
- 12 In fact, such was the Grand Canal's importance even into the late nineteenth-century that its fall into disrepair under a declining Qing dynasty whose treasuries had been cleared out by the Opium Wars exacerbated severe droughts to bring about cataclysmic famines.
- 13 On fossil fuel infrastructure as a cultural form see Brent Ryan Bellamy, "The Inertia of Energy: Pipelines and Temporal Politics" in *Time, Globalization and Human Experience*, eds. Paul Huebener, Susie O'Brien, Tony Porter, Liam Stockdale, and Yanqiu Rachel Zhou (New York: Routledge, 2016), 145–159.
- 14 "The cheap prices of commodities are the heavy artillery with which it batters down all Chinese walls, with which it forces the barbarians intensely obstinate hatred of foreigners to capitulate." Karl Marx and Friedrich Engels, *The Communist Manifesto* (Oxford: Oxford University Press, 1998), 7. As a matter of fact, Western, primarily British, commodities proved wholly uncompetitive, with opium being "the West's only feasible entree into the Chinese market," according to Joseph Esherick. The Qing government's attempt to control the opium trade and limit the spread of opium addiction among the populace precipitated the Opium Wars, through which the British enforced by war its right to sell Indian produced opium to China, in the process drawing massive amounts of tribute from India and directing all profits of the trade back to Britain. Joseph Esherick, quoted in Arrighi, *Adam Smith in Beijing*, 338.
- 15 See Robert Brenner, "The Origins of Capitalist Development: A Critique of Neo-Smithian Marxism," *New Left Review* 104 (July/August 1977): 25–92.
- 16 David Roberts, "The Global Transition to Clean Energy, Explained in 12 Charts," *Vox*, last modified June 2019,

- <https://www.vox.com/energy-and-environment/2019/6/18/18681591/renewable-energy-china-solar-pv-jobs>.
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- 18 David Stanway, "China CO<sub>2</sub> Emissions to Peak in 2022, ahead of Schedule: Government Researcher," *Reuters*, September 5, 2019, <https://www.reuters.com/article/us-china-carbon/china-co2-emissions-to-peak-in-2022-ahead-of-schedule-government-researcher-idUSKCNrVQ1Ko>.
- 19 Xinhua, "China Beats Annual Target for Cutting Carbon Emissions in 2018," *people.cn*, last modified November 27, 2019, <http://en.people.cn/n3/2019/1127/c90000-9636110.html>.
- 20 "2018 and Other Energy Statistics," China Energy Portal, last modified January 25, 2019, <https://chinaenergyportal.org/en/2018-electricity-other-energy-statistics>.
- 21 For an overview of thinking critically about infrastructure in the United States see Michael Rubenstein, Bruce Robbins, and Sophia Beal, "Infrastructuralism: An Introduction," *Modern Fiction Studies* 61, no. 4 (2015): 575-86.
- 22 International Hydropower Association, "China" and "2020 Hydropower Status Report," May 18, 2020, <https://www.hydropower.org/statusreport>.
- 23 中国电力新闻网, "中国水电企业已占海外70%以上水电建设市场," *National Energy Agency*, last modified January 23, 2019, [http://www.nea.gov.cn/2019-01/23/c\\_137767698.htm](http://www.nea.gov.cn/2019-01/23/c_137767698.htm); Hongyu Bianji, "Chinese Enterprises Represent 70 Percent of Global Hydropower Market," *Peoples Daily Online*, last modified January 22, 2019, <http://en.people.cn/n3/2019/0122/c90000-9540389.html>.
- 24 This is according to the greenhouse gas reservoir metric (i.e., the G-res tool) developed by the International Hydropower Association to quantify lifetime carbon densities of hydropower plants. International Hydropower Association, "The G-res Tool," last accessed July 6, 2020, <https://g-res.hydropower.org>.
- 25 Bridget R. Deemer et al., "Greenhouse Gas Emissions from Reservoir Water Surfaces: A New Global Synthesis," *BioScience* 66, no. 11 (November 2016): 949-964.
- 26 World Commission on Dams, *Dams and Development: A New Framework for Decision-Making* (London: Earthscan, 2000), 124-5.
- 27 In the case of the Gariep Dam and Vanderkloof Dam in South Africa, for instance, white farmers who were displaced felt fairly compensated, while black farmers were ineligible for compensation. World Commission on Dams, *Dams and Development*, 124.
- 28 Guoqing Shi, Jian Zhou, and Qingnian Yu, "Resettlement in China," *Impacts of Large Dams: A Global Assessment*

- (Berlin: Springer, 2012), 219-242.
- 29 Brooke Wilmsen, "Is Land-Based Resettlement Still Appropriate for Rural People in China? A Longitudinal Study of Displacement at the Three Gorges Dam: Land-Based Resettlement in Rural China," *Development and Change* 49, no. 1 (January 2018): 170-198. See also Brooke Wilmsen, "Damming China's Rivers to Expand Its Cities: The Urban Livelihoods of Rural People Displaced by the Three Gorges Dam," *Urban Geography* 39, no. 3 (March 2018): 345-366.
- 30 Wilmsen, "Is Land-Based Resettlement Still Appropriate for Rural People in China?," 192.
- 31 Brendan A. Galipeau, Mark Ingman, and Brynan Tilt, "Dam-Induced Displacement and Agricultural Livelihoods in China's Mekong Basin," *Human Ecology* 41 (2013), 437-446.
- 32 Galipeau, Ingman, and Tilt, "Dam-Induced Displacement," 443. Like Shi et al. and Wilmsen, the authors point to a 2006 law, "Regulations for Resettlement for Large and Medium Hydropower and Water Conservation Projects," promoting land-based resettlement strategies, as a turning point for government resettlement policy.
- 33 In most cases, people predominantly relying on small-scale agriculture and selling their produce to towns who were displaced by dam projects were not exactly free from the world market prior to displacement, but they still retained an agricultural/subsistence safety net. After displacement, many took wage labor jobs, some locally at the dam, and some in cities more closely linked to the world market. However, because land cannot be privately sold or transferred in China, most migrants still retain an agricultural and social base to which they could return. It is also important not to romanticize poverty and subsistence living.
- 34 Wenjuan Dong and Qi Ye, "Utility of Renewable Energy in China's Low-Carbon Transition," *Brookings*, last modified May 18, 2018, <https://www.brookings.edu/2018/05/18/utility-of-renewable-energy-in-chinas-low-carbon-transition>.
- 35 Dimitri de Boer, "Eco-Priority in Development Outcome," *China Daily*, last modified November 4, 2017, [http://www.chinadaily.com.cn/opinion/2017-11/04/content\\_34103811.htm](http://www.chinadaily.com.cn/opinion/2017-11/04/content_34103811.htm).
- 36 Jiao Wang, "Drop by Drop, Better Management Makes Dents in China's Water Stress," *World Resources Institute*, last modified April 26, 2018, <https://www.wri.org/blog/2018/04/drop-drop-better-management-makes-dents-chinas-water-stress>.
- 37 Stephanie Jensen-Cormier, "Lessons from My Three Years Engaging with China's Hydropower Giants," *Panda Paw, Dragon Claw*, last modified April 5, 2019, <https://pandapawdragonclaw.blog/2019/04/05/lessons-from-my-three-years-engaging-with-chinas-hydropower-giants>.
- 38 Consider also the 1982 massacre of 400 Indigenous people in Guatemala by the US-backed government to pave the way for the Chixoy Hydroelectric Dam funded by the World Bank and Inter-American Development Bank, part of a \$2 billion rise in Guatemalan indebtedness over 10 years. Or consider the 2016 murder in Honduras of Indigenous environmentalist Berta Cáceres, following the 2013 murder of her comrade Tomas Garcia, orchestrated by a US-trained former intelligence officer to eliminate future delays on a dam financed by the Central American Bank for Economic Integration, FMO Netherlands, and Finnfund. Or the Kandadji Dam in Niger, primarily funded by the World Bank, a project which not only lacked the land to resettle all displaced people (some 30,000 have not been resettled), but also left resettled people without running water in 2016.

- 39 Jillian Ambrose, "Government Funding Fossil Fuel-Burning Plants Abroad," *The Guardian*, 10 June 2019, <https://www.theguardian.com/environment/2019/jun/10/government-funding-fossil-fuel-burning-plants-abroad>.
- 40 It is possible that the proliferation of low-interest loans and loan forgiveness under Chinese financial direction would further complicate this dynamic. We will discuss this in our conclusion.
- 41 Joanna I. Lewis, *Green Innovation in China: China's Wind Power Industry and the Global Transition to a Low-Carbon Economy* (New York: Columbia University Press, 2013), xi.
- 42 Lewis, *Green Innovation in China*, xix.
- 43 Ibid.
- 44 According to Wind Energy International, as of 2019, China accounts for more than two-thirds of total global installed wind power capacity, more than two times that of the United States, the second largest wind market. Additionally, China led the world in new installations in 2018, about three times that of new installations in the U.S., at a rate far greater than installation rates in Europe, which have stalled in recent years. See "Wind Power Capacity Worldwide Reaches 597 GW, 50.1 GW added in 2018," *World Wind Energy Association*, June 4, 2019, <https://wwindea.org/blog/2019/02/25/wind-power-capacity-worldwide-reaches-600-gw-539-gw-added-in-2018>.
- 45 International Energy Association, "China 13th Renewable Energy Development Five-Year Plan (2016–2020)," last modified June 1, 2018, <https://www.iea.org/policiesandmeasures/pams/china/name-161254-en.php>.
- 46 See "2018 Electricity & Other Energy Statistics," *China Energy Portal* | 中国能源门户, last modified January 25, 2019, <https://chinaenergyportal.org/2018-electricity-other-energy-statistics>.
- 47 Lewis, *Green Innovation in China*, 3.
- 48 Lewis, *ibid.*, also notes that the system of intellectual property in China is impossible to quantify in relation to the West because China is "inherently different from other market economies."
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- 50 Yuning Zhang et al., "Wind Energy Rejection in China: Current Status, Reasons and Perspectives," *Renewable and Sustainable Energy Reviews* 66 (December 2016): 322–344.
- 51 Zigor Aldama, "Powered by the State, China Takes Charge of Electric Buses, with Shenzhen Taking the Lead," *South China Morning Post*, last modified January 18, 2019, <https://www.scmp.com/magazines/post-magazine/long-reads/article/2182466/powered-state-china-takes-charge-electric-buses>.
- 52 Current estimates place Chinese electric buses alone at over 420,000. See Brian Eckhouse, "The U.S. Has a Fleet of 300 Electric Buses. China Has 421,000," *Bloomberg.com*, May 15, 2019, <https://www.bloomberg.com/news/articles/2019-05-15/in-shift-to-electric-bus-it-s-china-ahead-of-u-s-421-000-to-300>.
- 53 Ibid.
- 54 "Chinese Bus Maker Sees Soaring Exports," *Xinhua*, accessed August 14, 2019, [http://www.xinhuanet.com/english/2017-04/22/c\\_136228373.htm](http://www.xinhuanet.com/english/2017-04/22/c_136228373.htm); "Chinese Electric Bus Exports to Europe Show Great Potential, Investment Bank Says," *Global Times*, accessed August 14, 2019, <http://www.globaltimes.cn/content/1159888.shtml>.
- 55 Auer Hans et al., "Wind Energy: The Facts." *Intelligent Energy Europe*, March 2009, <https://www.wind-energy-the-facts.org/home--about-the-project.html>.



- 56 Jon Leary et al. attribute stable support from NGOs, governments, and other institutions as a major factor in whether household power generator projects around the world find widespread use and popularity. Jon Leary et al., “Locally Manufactured Wind Power Technology for Sustainable Rural Electrification,” *Energy Policy* 43 (2012), 173-183.
- 57 For an example of multiple scales of engagement in the transition to sustainable forms of energy see Cymene Howe, “Anthropocenic Ecoauthority: The Winds of Oaxaca,” *Anthropological Quarterly* 87, no. 2 (2014): 381-404.
- 58 Raymond Malewitz, “Climate-Change Infrastructure and the Volatilizing of American Regionalism,” *Modern Fiction Studies* 61, no. 4 (2015): 715-730.
- 59 “A Red Deal,” *Jacobin*, last modified August 6, 2019, <https://jacobinmag.com/2019/08/red-deal-green-new-deal-ecosocialism-decolonization-indigenous-resistance-environment>.
- 60 Of course, Indigenous people are not a monolith, and we recognize that certain nations might prefer to nationalize and intensify their non-renewable energy infrastructure in the short term. The point is that a just international strategy for energy transition would support the efforts of Indigenous people to determine their own paths.
- 61 State Council of China, “The 11th Five-Year Plan (2006–2010) for National Economic and Social Development,” 2006, <https://policy.asiapacificenergy.org/node/115>.
- 62 *Ibid.*, 11.
- 63 The plan frames the call in this manner: “Optimize the layout of wind power development, and orderly promote the construction of wind power resources in rich regions such as North China, Northeast China and Northwest China, and accelerate the development and utilization of wind energy resources. Coordinate the development of supporting power grid and wind power construction, reasonable layout of energy storage facilities, the establishment of wind power grid operation to ensure the power dispatch system. Actively carry out offshore wind power project demonstration, and promote the scale of offshore wind power development.” See State Council of China, “12th Five-Year Plan for Energy Development,” 2013, <https://policy.asiapacificenergy.org/node/38>.
- 64 Jingyi Han et al., “Onshore Wind Power Development in China: Challenges behind a Successful Story,” *Energy Policy* 37, no. 8 (August 2009): 2941-2951, 2949.
- 65 See Jason Deign, “China Plans 6GW of Subsidy-Free Wind in Inner Mongolia,” last modified January 15, 2019, <https://www.greentechmedia.com/articles/read/china-plans-6-gigawatts-of-subsidy-free-wind-in-mongolia>.
- 66 Reuters, “Paw Power: China Plans 100 Panda-Shaped Solar Plants on New Silk Road,” *Reuters*, July 25, 2017, <https://www.reuters.com/article/us-panda-green-power/paw-power-china-plans-100-panda-shaped-solar-plants-on-new-silk-road-idUSKBN1AA0C5>.
- 67 *Ibid.*
- 68 Andrew Pendakis, “Dàtóng,” in *An Ecotopian Lexicon*, eds. Matthew Schneider-Mayerson and Brent Ryan Bellamy (Minneapolis: University of Minnesota Press, 2019), 52–62, 52.
- 69 The omitted lines read, “People in the ideal Confucian society are productively occupied but never overtaxed because the ruler encourages economic activity as a means to shared prosperity rather than unlimited private enrichment (as is in contemporary capitalist societies).” Pendakis, “Dàtóng,” 54.
- 70 “发展才是硬道理.” These famous lines should be contextualized next to the less commonly quoted “Not to

- support socialism, not to reform and open up, not to develop the economy, not to improve the lives of the people: this is the path toward a dead-end.” Quoted in Li Jintian (李金田) and Zhang Airu (张爱茹), “Deng Xiaoping Identifies Problems within the “Left” (第二十四章 邓小平一针见血批评 “左” 的言论) in *Deng Xiaoping in Zhongnanhai* (去中南海的邓小平) (Beijing: Taihai Publishing House, 2011) (台海出版社), [http://fuwu.12371.cn/2014/07/14/ART1405324324122503\\_15.shtml](http://fuwu.12371.cn/2014/07/14/ART1405324324122503_15.shtml).
- 71 David Schwartzman, “Solar Communism,” *Science & Society* 60, no. 3, (1996): 307–331.
- 72 Schwartzman also argues of human needs in general that they “are problematic, generated by political struggle and cultural history. Beyond physiological necessities (the number of calories, vitamins etc. needed for optimal health, itself not entirely without uncertainty) and the other conditions for healthful life such as an unpolluted environment, adequate shelter, and loving relationships, our needs, both material and spiritual, are largely social constructs. Of course even the prospect of substantially extending the human life span will be a social construct, while becoming an arguably new entitlement for all human beings.” Schwartzman, “Solar Communism,” 318.
- 73 *Ibid.*, 322.
- 74 *Ibid.*, 316.
- 75 *Ibid.*
- 76 *Ibid.* On the representational problems associated with nuclear waste see Maja Fjaestad, “Nuclear Waste and Historical Time,” *Technology and Culture* 54, no. 2 (2013): 371–372; Brent Ryan Bellamy, “Into Eternity, On our Containments and Energy Futures,” *Paradoxa: Studies in Literary Genres* 26 (Fall 2014): 145–158. For nuclear energy’s fossil fuel dependence see Julie Jowett, “Fossilised Myths: Fresh Thinking on ‘Dirty’ Coal and Dwindling Oil,” *Guardian Weekly*, last modified March 23, 2006, <https://www.theguardian.com/environment/2006/feb/05/business.climatechange>.
- 77 Jasper Bernes, “Between the Devil and the Green New Deal,” *Commune*, accessed June 17, 2019, <https://communemag.com/contributor/jasper-bernes>.
- 78 See Scientists of the Palestinian Youth Movement et al, “Lithium Is the New Oil: A Statement in Opposition to the US-Backed Coup in Bolivia,” *Palestine in America*, December 4, 2019, <https://www.palestineinamerica.com/blog/lithium-is-the-new-oil-a-statement-in-opposition-to-the-us-backed-coup-in-bolivia>.
- 79 The question of waste facing non-carbon-producing modes of energy generation, such as nuclear energy, does not apply to solar generation.
- 80 Dustin Mulvaney, *Solar Power: Innovation, Sustainability, and Environmental Justice* (Oakland: University of California Press, 2019), 1.
- 81 Mulvaney, *Solar Power*, 3.
- 82 *Ibid.*, 2.
- 83 Rujun Shen and Jacqueline Wong, “China Solar Set to Be 5 Times 2020 Target,” *Reuters*, last modified May 5, 2009, <https://www.reuters.com/article/china-solar-idAFPEK12384620090505>.
- 84 According to Mahmood H. Shubbak, “Policies increased in the direction of subsidizing the deployment of Chinese PV panels domestically through introducing [feed-in tariffs], developing grid infrastructure, and implementing a six-year poverty alleviation programme aimed at electrification and raising living standards of poor households

- through the installation of PV panels.” Mahmood H. Shubbak, “The Technological System of Production and Innovation: The Case of Photovoltaic Technology in China,” *Research Policy* 48, no. 4 (May 2019): 993-1015, 998.
- 85 “China Brings Solar Home,” *Nature Energy* 4, no. 8 (August 2019): 623.
- 86 Josh Gabbatiss, “Solar Now ‘Cheaper than Grid Electricity’ in Every Chinese City, Study Finds,” *Carbon Brief*, last modified August 12, 2019, <https://www.carbonbrief.org/solar-now-cheaper-than-grid-electricity-in-every-chinese-city-study-finds>.
- 87 “In all of the 344 prefectures, household solar systems can now generate electricity at a cost equal to, or lower than, the local grid-supplied electricity.” “China Brings Solar Home,” 623. See also Jinyue Yan et al., “City-Level Analysis of Subsidy-Free Solar Photovoltaic Electricity Price, Profits and Grid Parity in China,” *Nature Energy* 4, no. 8 (August 2019): 709-717.
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- 90 For a discussion of the possibilities of repurposing technologies see Alberto Toscano, “The Prejudice Against Prometheus,” *STIR*, August 15, 2011, <https://stirtoaction.wordpress.com/2011/08/15/the-prejudice-against-prometheus/>; Alex Williams and Nick Srnicek, *Inventing the Future: Postcapitalism and a World without Work* (New York: Verso, 2015); Aaron Bastani, *Fully Automated Luxury Communism: A Manifesto* (New York: Verso, 2019); cf. Alberto Toscano and Jasper Bernes’s ongoing logistics debate: Alberto Toscano, “Now and Never,” in *Communization and its Discontents*, ed. Benjamin Noys (New York: Minor Compositions, 2012), 85-104; Alberto Toscano, “Logistics and Opposition,” *Mute* 3, no. 2 (2012), <https://www.metamute.org/editorial/articles/logistics-and-opposition>; Jasper Bernes, “Logistics, Counterlogistics and the Communist Prospect,” *Endnotes* 3 (September 2013), <https://endnotes.org.uk/issues/3/en/jasper-bernes-logistics-counterlogistics-and-the-communist-prospect>; Alberto Toscano, “Lineaments of the Logistical State,” *Viewpoint Magazine* 28 (September 2014), <https://www.viewpointmag.com/2014/09/28/lineaments-of-the-logistical-state>; Jasper Bernes, “The Belly of the Revolution: Agriculture, Energy, and the Future of Communism” in *Materialism and the Critique of Energy*, eds. Brent Ryan Bellamy and Jeff Diamanti (Chicago: MCM Publishing, 2018), 331-376.
- 91 Arrighi, *Adam Smith in Beijing*, 274.
- 92 For example, Arrighi describes how British imperialism forcibly transformed Indian workers from “major competitors of European textile industries into major producers of cheap food and raw materials for Europe.” This forced hyper-deprivation of workers, along with colonial administrators raiding emergency grain stocks, resulted in calamitous famines that claimed around nineteenmillion lives in the Indian subcontinent at the end of the nineteenth century. *Ibid.*, 245. See also Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (New York: Verso, 2000).
- 93 Arrighi, *Adam Smith in Beijing*, 266.

- 94 Ibid., 268. We understand “mattering” here from the perspective of the classical economic ideal of the relatively even proliferation of benefits among all freely trading parties.
- 95 See Robert Brenner, *The Economics of Global Turbulence: The Advanced Capitalist Economies from Long Boom to Long Downturn, 1945–2005* (New York: Verso, 2006).
- 96 The interstate system took shape during the Han dynasty, and undertook transformations in the extent of material exchange during shifts between unipolar and multipolar power relationships in the system from then on. Multipolar dynamics became especially pronounced during the Song-Liao (Khitan)–Jin (Jurchen) Exchange (960–1234 CE). See Wang Yuan-Kang, “Explaining the Tribute System: Power, Confucianism, and War in Medieval China,” *Journal of East Asian Studies* 13, no. 2 (2013), 207–232. See also how Arrighi frames it: “Prior to their subordinate incorporation in the European system the national states of the East Asian system were almost uninterruptedly at peace with one another, not for one hundred, but for three hundred years. This three hundred years’ peace was bracketed by two Japanese invasions of Korea, both of which precipitated a war with China. . . indeed, insofar as China is concerned, we should speak of a five hundred years’ peace, since in the two hundred years preceding the 1592 Japanese invasion of Korea, China was at war with other East Asian states only during the invasion of Vietnam in 1406–1428 to restore the Tran dynasty.” Arrighi, *Adam Smith in Beijing*, 316. Compare with the Hundred Years’ Peace in Europe (1815–1914), “a phenomenon unheard of in the annals of Western civilization,” according to Karl Polanyi, that nonetheless was filled with unceasing wars of conquest undertaken by the European states against their colonies.” Karl Polanyi, *The Great Transformation* (Boston: Beacon Press, 2001), 5.
- 97 Arrighi, *Adam Smith in Beijing*, 317. The Qing fought its frontier wars to try to prevent the fate of the Ming, who was overrun by the Qing itself, then a northern frontier that the Ming could not appease, from befalling it.
- 98 Hsiao-Ting Lin, “The Tributary System in China’s Historical Imagination: China and Hunza, ca. 1760–1960,” *Journal of the Royal Asiatic Society* 19, no. 4, (2009): 489–507, 492. Additionally, David C. Kang writes, “The *Da Qing Tong Li* (Comprehensive Rites of the Great Qing) begins the section on receiving envoys with reference to the ancient Zhou Dynasty (1027–481 BCE).” David C. Kang, “Hierarchy and Legitimacy in International Systems: The Tribute System in Early Modern Asia,” *Security Studies* 19, no. 4 (2010). The so-called “tribute system” itself has come into question in recent years as a largely British and Western gloss of a diplomatic structure that gave states considerable freedom to leverage their positions vis-à-vis China to their advantage. Arrighi notes, for instance, that China’s “tribute trade” “had greater economic costs than benefits . . . after the Tang dynasty, especially after the Yuan dynasty.” Arrighi, *Adam Smith in Beijing*, 324.
- 99 Kang, “Hierarchy and Legitimacy in International Systems.”
- 100 The historical Chinese interstate system is not the only historical interstate system that witnessed less bloodshed, violence, and subjugation than the European path. The Indigenous interstate system operating in what is now called the Americas similarly developed highly complex diplomatic relationships centered around trade and ritual that did not result in system-wide destruction and bloodshed typical of the European development path. See Roxanne Dunbar Ortiz, *An Indigenous Peoples’ History of the United States* (Boston: Beacon Press, 2015) and Inga Clendinnen, *Aztecs: An Interpretation* (Cambridge: Cambridge University Press, 1991). Ravi de Costa explores the Indigenous system of interrelation and exchange among communities in the

- Australasian context: Ravi de Costa, "Cosmology, Mobility and Exchange: Indigenous Diplomacies Before the Nation-State," *Canadian Foreign Policy* 13, no. 3 (2007): 13–28.
- 101 See Neta C. Crawford, "Pentagon Fuel Use, Climate Change and the Costs of War Final," *Watson Institute*, June 12, 2019, and Neta C. Crawford, "The Defense Department Is Worried about Climate Change—and Also a Huge Carbon Emitter," *The Conversation*, accessed August 16, 2019, <http://theconversation.com/the-defense-department-is-worried-about-climate-change-and-also-a-huge-carbon-emitter-118017>.
- 102 Arrighi, *Adam Smith in Beijing*, 384.
- 103 Ibid., 388. Li Minqi also sees this as a main barrier to Chinese goals of maintaining continued economic growth and political stability. See Minqi Li, "The Future of the Chinese Economy: Four Perspectives," *Journal of Contemporary Asia* 50, no. 2 (2019), 228–247.
- 104 Arrighi, *Adam Smith in Beijing*, 388.
- 105 Ibid.
- 106 Samir Amin, "China 2013," *Monthly Review* 64, no. 10 (March 2013), <https://monthlyreview.org/2013/03/01/china-2013>.
- 107 Joseph S. Tulchin writes about Belt and Road loans in the Latin American context: "Traditionally, China has not made its investments or loans conditional on political stances or macroeconomic policies. Its position has contrasted sharply with that of multinational agencies, which put numerous fiscal and budgetary conditions on the loans they offer, and the U.S., which frequently pushes for political changes." Joseph S. Tulchin, "China's Careful New Focus in Latin America," *The Asia Pacific Journal Japan Focus* 17, no. 13.2 (July 2019), 4.
- 108 Frank Ching, "Is the Belt and Road Initiative a Debt Trap?" *Globe and Mail*, August 31, 2018; Colum Lynch, "Bolton Builds Anti-China Campaign at the U.N.," *Foreign Policy*, April 3, 2019.
- 109 Maria Abi-Habib, "How China Got Sri Lanka to Cough Up a Port," *New York Times*, June 25, 2018, <https://www.nytimes.com/2018/06/25/world/asia/china-sri-lanka-port.html>.
- 110 Efem Nkabi Ufi, "How Africa Can Benefit from China's Belt and Road Initiative," *Financial Nigeria*, June 18, 2019; Agatha Kratz, Allen Feng, and Logan Wright, "New Data on the Debt Trap Question," *Rhodium Group*, last modified April 29, 2019 <https://rhg.com/research/new-data-on-the-debt-trap-question>; Deborah Brautigam, "Is China the World's Loan Shark?" *New York Times*, last modified April 26, 2019; Laura Zhou, "Why China's Belt and Road Loans Might Not be the Debt Trap That Other Countries Fear," *South China Morning Post*, April 30, 2019.
- 111 John Mathews and Xin Huang, "China's Belt and Road as a Conduit for Clean Power Projects," *Energypost.eu*, last modified October 3, 2018, <https://energypost.eu/china-belt-and-road-renewable-energy-investments>.