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Chapter 14. Will China deliver urban 'Ecological Civilisation'?

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Abstract (150 words): The world will not be able to achieve sustainable transition without China, yet there is both significant neglect and confusion regarding Chinese environmental innovation and its potential impact. We consider a framework for analysis of this crucial but confounding issue in terms of complex power/knowledge systems (CPKS) and innovation-as-politics. This sets up a quadrant into which evidence from this essentially contested debate may be arranged. The analysis illuminates the exceptional dynamism of Chinese innovation, which is driving seismic socio-technical *and socio-political* change, increasingly at global scale. The significance of Chinese innovation is thus grasped not in terms of what it is itself delivering directly, but rather how it is driving social turbulence that then, in turn, is disrupting incumbent socio-technical systems. As such, it is leading the world backwards into the Anthropocene, not forging boldly ahead. The argument is illustrated with the 'hardest case' of sustainable transition of (digitized) urban mobility.

Keywords: complex power/knowledge systems (CPKS), innovation-as-politics, urban mobility, digitization, disruptive innovation

Chapter word count: 7149 words total

Table 1: The Quadrant of Chinese (Sustainable) Innovation (included in this document)

Introduction

As a new decade begins, it is clear the 2020s will be pivotal for the future of human life on planet Earth. Efforts at decarbonisation must be dramatically and urgently accelerated, to a fivefold increase in current climate action (Early 2019). While decarbonising sources of energy (including the intermediary forms of electricity and heating/cooling) is pivotal, the full complexity of the challenges is best captured in other spheres. The sustainable transition of urban mobility has a good case to claim that dubious honour.

Challenges of decarbonisation are not simply technological problems of substituting 'high-carbon' fossil fuel sources of energy for 'low-carbon' ones. Regarding low-carbon transition of urban mobility the issues are complex, multi-dimensional and 'wicked'– in that we struggle to identify and define the problems, let alone solutions. Indeed, transition in urban mobility has been justifiably called the 'hardest case' (Geels et al. 2013), while urban mobility already represents a quarter of global emissions, and growing.

In turning to this crucial agenda, China, and increasingly its impact around the world, should command our attention. In the late-2010s, Chinese innovation and environmental initiatives exploded onto the global public imagination. Prior to this, studying Chinese innovation – and Chinese *low carbon* innovation, especially – was a niche specialism. Yet the transformation of China's economy over the past four decades from a technological backwater, with per capita GDP in 1978 equivalent to the poorest sub-Saharan African countries (Ang 2017), to a rising global superpower – including in the latest digital technologies – will be seen as *the* global story of the turn of the twenty first century.

China, already singularly populous, has become a growing global presence, not least regarding its footprint of consumption and production of primary resources and waste products, including greenhouse gas (GHG) emissions. In 2007 China overtook the US as top global absolute emitter of GHGs. Chinese emissions have been growing ever since, such that these absolute emissions are now bigger than the US and EU combined (Rapier 2018). Even its per capita emissions now surpass those of the EU (McGrath 2014). Yet Chinese government and commercial efforts are leading the world in various low carbon industries and environmental projects. The country's massive global infrastructure project, the Belt Road Initiative (BRI), seen by many as the largest single national plan for infrastructure since the post-war US Marshall Plan, now promises – or threatens (Hilton 2020) – to multiply that impact significantly. As Nicholas Stern puts it, 'The world cannot go net zero unless China does' (Chinadialogue 2019a).

China's central government has adopted the project of building an 'ecological civilisation'. Many, including senior Western policymakers, claim this is definitive evidence of China's global leadership on climate action (Pike 2019). 'Ecological civilisation' was first floated as a high-level slogan, a common policy device in China's one-party-state, in a speech by then-newly incoming President Xi Jinping in 2012 (Geall & Ely 2018). In 2015 a more detailed 'master plan' presented a wave of legislation covering a wide array of environmental challenges, many particularly severe within China and hence pressing domestic issues. In 2018,

'ecological civilisation' was written into the national constitution and a major reorganization of government departments occurred, to streamline decision-making powers on environmental questions at two new super-ministries. The focus is now on environmental commitments to appear in the major policy-cycle document of the 14th Five Year Plan (FYP), which, published from 2020, comes into force for 2021-25. Most recently, in September 2020, President Xi announced that China has committed to be 'carbon neutral' by 2060. This target has been globally welcomed as keeping the UNFCCC process of the 2015 Paris Agreement alive, even as details of how to deliver this goal remain elusive and the ambition of the target itself falls short of what some climate policymakers argue is necessary.

Will China deliver ecological civilization? This chapter offers a framework for thinking about this question. We discover a highly turbulent yet productive multi-dimensional process of Chinese environmental 'innovation-as-politics'. This contrasts with dominant narratives that see China as either singular climate hero or villain. China may be leading the world towards ecological civilisation amidst the challenges of the Anthropocene, but most probably by stumbling backwards, rather than by forging boldly and deliberately ahead. The rest of the world – including not least the socio-technically pre-eminent United States and allied advanced economies – will ultimately be grateful to China for its many mistakes, failures and blunders, painful as this may be, as for its successes.

We must first reassess the 'problem' that sustainable transition, and/or China's 'ecological civilisation', addresses. Section 14.2 contains a brief analysis of the framework and methodology of this chapter. This is followed by an overview in Section 14.3 of the contradictory evidence of China's efforts on environmental innovation in general, using a 'quadrant' analysis that emerges from the framework and is useful for understanding the contested debate about Chinese environmental innovation. Section 14.4 turns to the more specific – and pivotal – issue of urban mobility transition, regarding three key but neglected issues regarding Chinese innovation, namely issues of government, culture and ethics, before we conclude in Section 14.5.

Framework and methodology: complex power/knowledge systems (CPKS)

The emerging orthodoxy for thinking about energy transition adopts a multi-level perspective exploring socio-technical systems (at 'regime', 'niche' and exogenous 'landscape' levels) to chart credible future courses that will maximize shifts to sustainability (Geels 2012). Rather than focus on individual technologies, the multi-level perspective conceptualizes socio-technical systems as key units of transition. This shift in analysis is a significant advance. The multi-level approach, however, is also direct and rationalistic, seeking comprehensive overviews of particular case studies with a view to policy advice and/or abstract characterisation of transition processes.

By contrast, thinking about transition in China invites a different approach that is itself more strategic in perspective. This approach thus foregrounds strategic and power dynamics in empirical case studies, albeit still of complex socio-technical systems, including regarding their very composition. From a complex power/knowledge systems (CPKS) perspective, we

understand socio-technical systems as constituted of relations and technologies of power/knowledge, arranged into dynamic structures. In turn, these dynamic structures shape and are shaped by equally dynamic subjectivities and practices (Tyfield 2018). This approach thus explores the dynamics of innovation-*as-politics*, at the interface between concrete examples and the systems shaped around them.

From this complex power/knowledge systems (CPKS) perspective, transition is best understood as a process of learning how to do government of (global) complex systems well (Tyfield 2018a). This highlights that the challenge is not just intrinsically *socio*-technical but also, thereby, political, cultural and place-based. It is, therefore, a matter of 'government' as dispersed responsibility amongst multiple human and institutional agencies and the relations of power/knowledge that constitute them. As an ongoing learning process, it not only lacks single 'solutions' or 'technofixes' (Markusson et al. 2017), but even a definable end-point. Most importantly, this perspective enables exploration of how a fundamentally creative, constructive process of open-ended socio-technical change may coalesce out of contested political processes such that mitigation and adaptation occurs at maximal pace and scale. These considerations are crucial for understanding the potential environmental impact of Chinese innovation.

For our purposes, we can summarize the unique contributions of this perspective in terms of three issues that emerge as neglected but important aspects of the dynamics of low-carbon transition:

a) *Government*: accelerating transformations in power/knowledge relations and subjectivities;
b) *Culture*: the increasing importance of cultural considerations, e.g. attitudes to openness and change or specific tastes and styles, in the shaping of socio-technical trajectories; and
c) *Ethics*: the increasing evidence of questions of justice, in contemporary politics *per se*, but particularly in spurring growing powerful movements regarding climate change.

In each case, digital innovation(-as-politics) also has particular relevance, even as the conjunction of sustainability and digitization remains widely ignored (WBGU 2019). Our goal is to illustrate the current dynamics and structures of power/knowledge relations regarding China and 'low carbon transition'; first in overview, then regarding urban mobility.

China: overview

Evidence about Chinese innovation capacity and impact is contradictory and confusing. Placed atop high geopolitical stakes, the result is an argument that is essentially contested. Making matters even more complicated is the distinctive dynamic of innovation processes in China, documented by a large, compelling literature across multiple industries, as non-linear boom-and-bust, in which seeming strengths become weaknesses and vice versa (Breznitz & Murphree 2011).

Chinese innovation cannot, therefore, be understood in terms of a single coherent characterization. Instead, we need a way to bring all the contradictory snapshots together, seeing the process dynamics of the whole. Using a CPKS perspective helps in this regard, setting up a 2x2 grid (Table 1). This identifies four distinct, and seemingly contradictory, positions, and with the left-hand column alone largely exhausting mainstream commentary and its essential contestation. However, the fourth quadrant incorporates the other three, generating an emergent picture of the extraordinary, turbulent dynamism of the whole (Tyfield 2018).

Table 1 – The Quadrant of Chinese (Sustainable) Innovation

	Direct effects (at agent level)	***Indirect effects (at system level)***
'Intended' outcomes (for national policy) (primarily at techno-economic level)	**'Optimist'** What the CCP Party-state wants to have happened and has – **big, cutting-edge, high technology success**	'**Disrupters'** What has emerged in a seeming vindication or 'success' of Party-state policy, but is actually the result of working around, or in spite of, it – **surprising, off-radar, oblique success**
'Unintended' outcomes (spilling over into other system dimensions)	'**Pessimist'** What the CCP Party-state directly produces that *thwarts* its own goals as deepening structural problems – **big, cutting-edge, high technology failure**	'**Innovation-as-politics'** What dynamics are in turn (now) emerging from or immanent within these effects regarding challenges at the level of systems of power relations – **to what end? For whom?**

<u>Optimists</u>

Optimists regard China's environmental innovation capacities through an endless series of statistics showing that China is effectively unrivalled. Regarding renewable energy technologies, China now dominates both global markets (e.g. for wind, solar PV and hydroelectric power) and global installations, e.g. 180GW of solar PV installed by 2019 against an ambitious national target of 110GW (Chinadialogue 2019b). High-speed rail and space showcase China's technological prowess, while in other technologies, such as nuclear power, China is also fast catching-up (Hodson 2020). Similarly, in our case study sector of electric mobility, China is now home to the largest market for electric vehicles (EVs), with record annual sales of over 1 million in 2018 and 2019 (Yang 2020) . Growing fleets of electric buses, are increasingly exported to global markets (Liévano 2019).

The exceptional size, financial resources and centralized coordination of China is presented as capable of unique mobilization of directed socio-technical change; nowhere more evident than in China's multiple high-profile, ambitious projects for new and large eco-cities, such as Xiong'An (Li 2018), outside Beijing. With its growing set of unquestioned digital giants, command of artificial intelligence (AI) technologies and the singular backing of the party-state

in the form of the flagship 'Made in China 2025' industrial policy drive, a global lead in the growing convergence of environmental and digital technologies is in many ways China's to lose. Last and by no means least, the unprecedented and unsolicited announcement by Xi Jinping in October 2020 that China aims to be carbon neutral by 2060 is a major boost to the country's environmental credentials, even as major questions remain about how that goal will be realised (Wagner 2020).

Pessimists

Pessimists, however, have strong arguments to the contrary. Environmentally, for all its renewable energy capacities, the single greatest global source of GHGs remains China's use of coal. This may have peaked in recent years (Qi 2018), but domestically it shows little sign of declining. China has simultaneously become the leading exporter of coal-combustion technologies across the low- and middle- income countries through the BRI (Hilton 2020). The reasons for this illuminate deep-seated challenges for decarbonizing innovation trajectories in China.

The structures of power relations in China serve the primary imperative of stabilizing the system of one-party rule. This underpins the continued massive use of coal for the foreseeable future through the imperative of securing centralized state control of energy security and generation. Coal is thus run by powerful state-owned enterprises, who have strong influence over governmental decision-making, with self-preservation a priority. As the US-China trade war has negatively affected economic growth in China, which is the primary pillar of popular acceptance of the party-state regime, coal-based stimulus has been unleashed (Wu 2019). Likewise, despite the problematic environmental credentials of BRI projects to date, exporting surplus coal-based capital (both physical and financial) has been pursued as an easy economic win (Pike 2019a). Finally, notwithstanding the announcement of the 2060 zero carbon target, responses to the economic downturn of the Covid-19 pandemic have redoubled questions regarding phasing out of coal in China: more new coal power is under development in China as a result of the associated economic stimulus than the entire remaining coal fleet of the US (Rudd 2020).

Regarding electric mobility, the environmental benefits of EVs remains a significant question. So much electricity in China is still coal-generated that growing adoption of EVs may increase emissions. The key 'circular economy' issue of recycling vehicles' lithium batteries also remains neglected (Beall 2018) by both private industry and policy. EV adoption itself also raises fundamental problems. While the national market has a global lead in terms of absolute numbers of sales, proportionally EVs (including hybrid electric cars) remain a modest 4% of annual total sales, and stalling (cf. 45% in Norway, 5% UK, 2% US, for 2019 Q4, McKinsey 2020). Chinese sales figures also remain heavily dependent on government-backed schemes, in particular subsidies and preferential access to licence plates. These are, however, both financially unsustainable and being wound down unpredictably, in part due to their fraudulent exploitation (Yang 2016).

The result is that 'showcase' examples of EV transition in Chinese cities remain dominated by government schemes (Zhang 2018), notably government-procured vehicles, such as taxi fleets. Conversely, adoption by consumers and private businesses remains slow (Yang 2017). Indeed, despite a boom from 2014-19 in private sales, the current EV market may already have peaked. In January 2020 (i.e. *before* the added economic pressure of the coronavirus), leading Chinese EV company, BYD, reported EV sales plunging 72% (Yang 2020). Meanwhile, recent assessments of a feasible date for phasing out conventional internal combustion engine (ICE) sales in China suggest it will be more laggard than vanguard (Pike 2019b).

So China is not, therefore, on the verge of a wholesale replacement of ICE by electric vehicles. From a systems transition perspective, though, the simple substitution of one sort of car engine by another hardly constitutes a low-carbon urban mobility transition (Freudendal-Pedersen & Kesselring 2017). Just as the structures of the party-state have imposed enduring limitations on a single-minded environmental drive, similar structural considerations underpin the emerging weakness in its approach to EV transition. This is evident in China's broader automotive sector, despite nearly 40 years of committed industrial policy (e.g. Thun 2006). The challenge of mass adoption of a such an important *socio*-technical artefact as the car systematically militates against the top-down and purely technical focus of China's policy-making process. Cars are not just a matter of technology, but also a singularly important financial investment, a matter of personal safety that must be utterly reliable in that regard, and a key symbol of personal cultural status.

Disruptors

Nonetheless, the Chinese EV market does increasingly evidence dynamism of domestic companies. This includes both those, such as BYD, selling smaller, cheaper vehicles, that currently dominate EV sales, and the intense competition amongst start-ups all aiming to be 'China's Tesla', such as Nio, LeEco or Faraday Future. This dynamism leads us to our third quadrant. This concerns a large and growing segment of Chinese innovation that does not fit neatly into either optimist or pessimist narratives. On the one hand, there are resounding success stories (Tse 2016), even as these have emerged out of the boom-and-bust dynamics of Chinese innovation. On the other hand, the successes are not the direct and intended result of government interventions and the organization of Chinese society and politics. Rather they manifest a flexibility and complexity-adeptness that succeeds *in spite of*, and even by *learning to manoeuvre around*, the multiple dysfunctionalities and obstacles of the party-state regime.

These successes may be claimed as vindications of the political system's foresight and support, but they are rather evidence of its persistent failings. Private sector 'disruptive' innovators have succeeded by taking an approach that is in effect the opposite of the top-down, technology-fetishizing approach of government policy. Instead they have become industrial titans by offering cheaper, easier-to-use goods and services that bundle surprising functionalities together in ways that are attractive to Chinese consumers, without subsidy or government R&D support (*cf.* Tyfield 2018b).

These EV companies also characteristically have a digital aspect, a reflection of the exceptional appetite (as a matter of aggregate demand, if not personal desire) of the Chinese market for digital innovations. By giving consumers new products they can afford, this has also generated the exceptional techno-economic momentum that has enabled many of these companies to upskill quickly. The result is that they have first redefined and then assumed a global lead in their particular sectors.

The most high-profile examples of these 'disruptor' companies are China's digital giants, such as Alibaba, Tencent and, at a lower level, Baidu (collectively called the 'BATs'). But across multiple other industries such as container shipping or pianos, this model was apparent over a decade ago (Zeng & Williamson 2007); and it is also evident in low-carbon innovations. For instance, the domination of global markets of wind, solar PV and solar thermal energy (e.g. Kirkegaard 2017, Urban et al. 2016) all fit better into this disruptor quadrant than into that of the optimist narrative. All these companies are private, and have developed technological capacities by relentless focus on growing market share through cost reductions, thus enabling the revenues then to build a more conventional R&D programme.

In electric mobility, these companies are prominent and central to China's story. However, it is not electric *cars* but electric *bikes*, and other small 3- and 4-wheeled vehicles and buggies, that is the most striking domestic success story of e-mobility innovation (Zuev et al. 2018). While banned from the centre of most big cities, there are over 200 million e-bikes. This rivals the *total* number of cars, while EVs struggle in the low single figure percentages of *annual sales*. China also offers evidence of 'digital disruptors' (Tse 2016) across this emerging domain, including Didi Chuxing (China's ride-hailing firm, which forced Uber to exit from the Chinese market), the multiple QR-enabled bike-sharing companies (e.g. Mobike) and the various 'Chinese Tesla' start-ups. Moreover, the boom-bust dynamic of wasteful cut-throat competition has underpinned their rise to dominance, leaving rivals, such as Kuaidi, Uber or Ofo, stranded.

New 'automated, connected, electric and shared' (ACES) models of urban mobility are now emerging (Freudendahl & Kesselring 2017), in innovative combinations of technologies and their affordances. Competition for dominance in this new sector, however, has only just begun, including in China. Yet the capacity of Chinese entrepreneurs to forge highly attractive and affordable novel combinations of technologies now has over 20 years of striking precedent across an array of industries, and specifically those with digital elements. To this we can add the unquestionable strength of Chinese firms in digital technologies, including AI and big data. Meanwhile, on the demand side, there are the emerging 'middle classes' of China's megacities and their growing aspirations for post-materialist and high-quality living. Altogether, it seems highly likely that Chinese digital innovations will have a significant, if not pivotal, role in the key twenty first century industrial sector of urban mobility.

Innovation-as-politics

Yet what is apparent regarding digital innovation especially, and perhaps most obviously in China, is that such socio-technical change is never just a techno-economic race to be the first

to introduce a new product or sector successfully. Rather, it is also and inseparably a process involving the profound reorganization of the power/knowledge relations of society. It is thus a very high stakes process of *innovation-as-politics* (Tyfield 2018a), the fourth quadrant. The key question regarding low-carbon innovation, in China as elsewhere, thus concerns how actual ongoing processes of low-carbon innovation are shaping and being shaped by parallel, broader evolution of the system of power/knowledge relations.

As a matter of an ongoing research programme, this is not a position that can be tidily summarised here. Instead, we illustrate this final innovation-as-politics quadrant by considering the pros and cons of current Chinese urban mobility transition capacities across the key three neglected dimensions noted above of government, culture and ethics. The goal is to provide a contemporary snapshot of key dimensions on which to focus regarding the still-undetermined role of China in global transition. From this is it possible to suggest strategic openings and focus for future research.

Assessing Chinese e-mobility innovation

What are the strategic advantages of the model of innovation emerging in China around the issue of sustainable, digital urban mobility in comparison with the other incumbent advanced economies?

Advantages: government

The dynamism of China's digital 'disruptive' innovators and entrepreneurs is not just a techno-economic phenomenon, but a political one. There are powerful organisations and individuals within China's political economy and broader culture that attract the party-state's attention. But they represent the tip of an iceberg of many millions across China currently pursuing similar entrepreneurial strategies. Altogether, they comprise the most dynamic constituency in global capitalism today.

On the 'demand side' are the rising Chinese 'middle classes'. This amorphous and difficult-to-define group (Goodman 2015) is the primary engine of continued economic growth in China. The rising middle classes are primarily clustered in more prosperous megacities and/or provinces along the eastern/southern coast. They are the ultimate holders of power within the country, with sufficient resources to make their demands heard, while willing to give the regime their definitive support so long as economic growth stays strong and their material opportunities prosper. They are also the primary source of 'venturesome consumption' (Bhidé 2009), meaning they underpin the rocketing growth of China's digital giants and its mobility innovations.

These disruptive innovators and middle-class urban digital consumers constitute a formidable political body. It promises to underpin a continuation of the socio-technical change that they have become accustomed to over 40-plus years of China's economic 'miracle'. But further change still lies ahead in China, not least regarding the 'hardest case' of greening and digitizing the entrenched system of 'steel-and-petrol' automobility (Urry 2004).

Advantages: culture

China's disruptive innovators exemplify a broader culture that has become particularly adept at working with complexity. Chinese culture, language and (traditional) practice are marked by a longstanding pragmatism. Today common-sense, everyday orientations to the world have built upon this in ways now adapted to the fast-changing high-stakes nature of contemporary Chinese political-economic life. Combined with population size, the result is a culture of complexity-adept, resourceful and well-resourced individuals on a globally significant scale.

This includes an openness to experimenting with digital innovations, especially those offering increased personal autonomy, convenience and/or opportunity. Added to the distinctive lack of squeamishness (Jacobs 2018) regarding data privacy (though this may be changing fast (Chandler & Morris 2019), contemporary Chinese culture may prove particularly accommodating of experiments – and hence inevitable failures and scandals – regarding emerging AI/data-driven digital mobility innovations. Finally, attempts to include China's rural poor in the ongoing digital revolution may also be hugely profitable (e.g. Prahalad 2009) and have significant implications for rapid adoption of Chinese technologies across the low- and middle- income countries that are also the sites of greatest economic growth globally.

Finally, there is evidence of significant, world-leading artistic dynamism in China. This spans the visual arts, literature (especially science fiction), music (classical performance) and digital arts/games, if not yet film, TV, theatre and music (composition & pop). Although such developments are perhaps surprising given the tightening authoritarian regime, they create dynamism that shapes frontiers of innovation. Cultural savvy and a trend-setting style are crucial for successful new products and services, especially digital ones. These concerns are particularly important in development of new mobility services (e.g. Weber & Kröger 2018).

Advantages: ethics

In terms of ethics there are also advantages, especially in the medium-to-long term. The economic miracle (building on the utter chaos of the Cultural Revolution that preceded it) has unleashed an unprecedented form of rampant, amoral materialism and consumerism, accompanied by ecological destruction, economic polarisation and societal disintegration. But there is also growing evidence of a profound yearning for ethical renewal. This is especially so amongst the rising middle classes who are exposed to the risks and dangers of contemporary Chinese society, but also sufficiently resourced and educated to consider alternative paths (e.g. Xu & Wu 2016). This is set to intensify in the context of continued disruptive innovation, intense environmental risk and tightening centralized control.

The Chinese have shown themselves to be fast learners in technology and business. There is no reason to presume the same is not true regarding changing worldviews and ethical outlooks. An 'inner awakening' is increasingly presented as the inspiration for these entrepreneurs and their respective ventures (Martindale 2019). This coincides with a re-engagement with traditional Chinese schools of thought that stress issues of harmonious social and ecological relations as pre-eminent, after a century of their neglect and/or persecution.

In short, the intense crucible of forces, tensions and contradictions currently shaping Chinese socio-technical change can be read as generating powerful dynamics for continued world-changing sustainable innovations. But this is at best half the story. Persistent strategic weaknesses and disadvantages also arise from these circumstances.

Disadvantages: government

In terms of governmental dynamics, the greatest obstacle to Chinese 'ecological civilisation' is the *re*-centralization of top-down power in the hands of the central party-state (if not Xi personally). This system of government requires the preservation of the unrivalled power of the one-party-state, an imperative that then conditions all dynamics and initiatives. The system can claim significant responsibility for the growth of China's economic prowess over the past 40 years, holding the country together and steering a productive course through the hostile waters of Washington Consensus globalization. Today, however, the clear-and-present challenges to China (and globally) are increasingly those of government of complex systems. Confronted by these qualitatively novel and unprecedentedly complex challenges, the centralized, top-down and engineering mindset is ever more of an impediment.

No arena of innovation illustrates this better than sustainable digital urban mobilities (as discussed above). Sustainable, equitable digital mobilities are inseparably matters of shaping new socio-technological assemblages that are yet to take clear and settled form. This technological stabilization will only materialize in parallel with major changes in everyday social practices. This includes the demand for mobility of working and commuting, provisioning and waste disposal, ferrying children, dwelling and leisure time.

However, a top-down programme of centralized system *management*, as opposed to emergent system self-*government*, is likely to prove not just an increasing frustration but a positive obstacle. Notwithstanding the authoritarian regime's persistence, China's disruptive innovators indicate that there has actually been significant room for such growth over the past 40 years. But today even these openings seem under threat. The *success* of the Reform period since 1978 has created a large, prosperous and individualistically ambitious middle class but also the deepening confrontation with these novel complex system challenges. So long as the party-state regime prioritizes its own self-preservation in dealing with these issues, though, there is but one pathway open to it: for each opening and compounding complexity, it must now ratchet up an equal-and-opposite capacity and determination to keep things under its control. The most graphic illustration is the movement of the CCP's control of Chinese online and social media activities. This has transitioned from a mere 'networked authoritarianism' in 2011 (MacKinnon 2011) to an Orwellian 'digital totalitarianism' (Strittmater 2019).

For sustainable digital urban mobility, this tightening control is increasingly problematic for, if not incompatible with, innovation. Experimenting with new forms of citizen participation in shaping future-oriented plans for urban mobility systems is necessary if these are to become resilient, equitable and attractive, and hence rapidly and massively adopted. Yet even minimal public participation in government, including in the shaping and regulation of mobility plans,

has proven a challenge for Chinese cities over past decades. Indeed, at present political space for such participation is shrinking, just as the need for even more involvement is growing. Emerging struggles in its high-profile eco-city projects indicate these tensions (Li 2018).

Disadvantages: culture

The world is currently confronted by challenges of socio-economic polarization. Such concerns are a key issue for cities and urban mobility, and are exacerbated by digitization. Inequality will likely continue to be a particular challenge for Chinese society, and hence also shape the innovation that develops in parallel with it (Curran & Tyfield 2020), not least because it takes a powerful cultural manifestation, illustrated by the electric two-wheeler (E2W). It may once have been possible to imagine this distinctively Chinese low carbon innovation being promoted for low-cost transition to electric mobility – leapfrogging the 'American', 'twentieth century', gas- and space-guzzling car. Today, though, that window now appears closed. This development involved widespread, and government-encouraged, cultural deprecation of such vehicles as not only dangerous but also as markers of low social status and even low personal 'quality' (or *suzhi*). Their cultural meaning was overlain with the existing polarized cultural politics of snobbery in Chinese megacities, with E2Ws identified with 'low quality' migrant workers from the countryside treated with abomination by 'high quality' urban residents (Zuev et al. 2018).

Indeed, although still nominally 'socialist', concerns of fairness and equity in contemporary China are not much of a cultural or political priority, much less a strength; and this is unlikely to change quickly. It seems more plausible to forecast cultural dynamics of deepening class resentment and polarization in the short-term (Curran & Tyfield 2020). Such conditions would tend to cultivate a deepening of the existing culture of self-preservation, if not active disdain, for those who fall behind.

Disadvantages: ethics

Any 'ecological civilisation' worthy of so grand a title presupposes some ethical renewal, a significant degree of public and individual empowerment, political openness and/or justice. Altogether, these features may be called 'liberality', following Murray (1938). Liberality, however, is what the current power/knowledge system governing China is least equipped to provide, as it attempts to preserve top-down control over an increasingly restive, complex polity confronting deepening existential challenges (e.g. of air, soil, water, food, energy, flood/drought and disease).

There is no escape from a deepening confrontation in China between the incumbent system of government and the challenges of developing a culture of liberality and, hence, the widespread capacities for strategic and ethical *self*-government. However, there are grounds to read these weaknesses as potentially productive. Here 'incumbent system of government' in the broadest sense includes not just the institutions and working practices of high state power, but also their inseparable counterpart: the subjectivities of a population largely accustomed to entrusting and handing over *ethical* responsibility for the direction of their society and their lives to the party-state. In these circumstances, the unavoidable tendency to intensifying tension at the heart of

Chinese society will not just strike at the institutions of CCP power but afflict the hearts and lives of Chinese people. It will thus disturb China's current not-entirely comfortable acceptance of illiberality and drive it through the painful – but potentially rapid – learning process towards greater self-government.

Moreover, these dynamics are not just domestic. They will play out globally as the rest of the world becomes progressively more interested and entangled in China's affairs. China's massive global infrastructure project, the BRI, involves big and often controversial, construction projects. Many of these are urbanization and/or mobility projects. 'China' (not the specific organizations in charge) will largely be held responsible for these, in a huge diversity of political, economic and cultural contexts. Chinese business remains inexperienced in dealing with overseas partners, and it starts from an unfavourable base. To the extent stakeholders overseas demand political accountability, this is not even something that many Chinese organizations had to learn to deal with *at home*. Conversely, the pragmatic mindset that enables striving on in the face of uncertainty is an introverted approach largely uninterested in what others think. Global policy scholar Zhao Tong argues that a singular weakness in China's external dealings is that 'China has not acquired the capacity to look at issues from the perspective of others' (Rennie 2019: 7). Chinese initiatives are thus likely to be surprised by the vehemence with which certain issues are defended, which to them appear utterly irrational. Issues of religion/sacredness are particularly obvious examples..

The challenges, however, will be just as intense on the other side. China is not about to retreat back into the self-contained isolation that characterised the last 500 years. Here the clearest example is the global Tech Race that has clearly emerged between China and the US. Rennie (2019: 3) notes there is 'already an undeclared cyberwar' with the American's technological lead in semiconductors 'the hill the Pentagon is willing to die on'. This Tech Race will increasingly overlap with the BRI as the so-called 'digital Belt Road' spills this rivalry across the world. All countries, not least the US itself, will have to learn how to work anew with a rising China, whether they like it or not.

China's strategic weaknesses are thus set to become powerful productive forces. They are driving processes of learning how to do complex systems government well both domestically and internationally. But this is precisely the challenge currently confronting humanity anyway. And it is the relationship of interconnectedness *and* incommensurability of contemporary China with the still-dominant global norms, fashioned by the 'West', *and vice versa*, that is the key to this dynamism.

Conclusion

The world urgently needs a sustainable transition. 'Ecological civilization', while unclear in its meaning, appears to capture a compelling vision. Yet both strategically and normatively, construction of this 'ecological civilisation' presupposes liberality. As such, while the phrase is the coining of the Chinese Communist Party, contemporary China faces profound challenges in generating a complexity-adept system of government and the innovations to underpin it; let alone to become an/the exemplar and light for the world. And yet, China in its seismic

dynamism and widespread pragmatism, is still likely to be a major driver of 'ecological civilisation', even as it is unlikely itself to deliver it as direct achievement.

A more accurate characterisation of China's role in global sustainability transition is that it is leading the world backwards into the Anthropocene. Here, the unquestionable strengths of China are not just its capacity for singular massive mobilization of resources, but also its chaotic dynamism and pragmatic, complexity-adept approach. China's substantial contributions to realizing ecological civilization are most likely to feature both its successes *and* its failures. This is likely to unfold across numerous dimensions of contemporary complex system challenges, with urban mobility and urbanization a pivotal domain. China's successes will continue to fuel deepening geopolitical tensions with the erstwhile global 'core' (especially the US), while its failures will shore up the case to distrust, reject or fear China's rise.

This dynamic relation, however, is not just one of China as 'stick' to the erstwhile core of advanced liberal democracies. There is a significant element of 'carrot', and mutual complementarity laced with competition. Specifically, China could lead the global process of creative destruction necessary for movement to a new system. Meanwhile, the rest of the world (and these advanced economies especially) will benefit considerably from this. But in being forced to hold China and its (digital) innovations to account, other countries are increasingly developing new governmental 'technologies' and social innovations of public sphere engagement that can circulate and spread, even back to China.

The deepening conflict between China and the 'West' that currently looms thus may catalyse significant change *within* both regions, from which new possibilities of mutually beneficial courses of action may arise. But there are no guarantees. Powerful voices in the West could choose to focus on the bad news stories from China, even as it may benefit from its technologies. In China, the party-state machinery could abandon even the economic rhetoric of supporting global trade and focus on its programme of techno-nationalism, propagandizing its population that the West (and the US in particular) is irredeemably anti-China.

Conversely, holding China to account, and particularly in its growing ventures overseas, will be driving the learning process – governmental, cultural and ethical – both in China and the rest of the world. The fourth quadrant of Chinese eco-digital innovation suggests that China could well be the engine, while the rest of the world acts as the steering wheel-cum-brake, to construct global sustainable transition. , This could create new 'facts on the ground', via China's unrivalled socio-technical momentum, and a resurgent liberality respectively, possibly in a turbulent but productive complementarity.

For energy transitions more generally the case of China – and the CPKS understanding of it – highlights key changes in perspective. Transition is neither a matter of identifying agents that themselves deliver desired change. Nor is transition solely or primarily dependent on such agents. Rather, confronted by huge challenges and the need for new paradigms of understanding, it is a contested process in which the depth of the ensuing *socio-political* turbulence is inseparable from progress toward sustainability goals. In short, the case of China

strongly counsels a shift in perspective from rational and analytical approach, to a strategic learning process.

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