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Innovation for Sustainability in a Changing China: Exploring Narratives and Pathways

Sam Geall and Adrian Ely

Ecological Civilisation

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Given the environmental impacts of China's current development trajectory and the country's increasing economic and strategic focus on innovation, China's progress on sustainable and low-carbon innovation is of crucial global importance. In order to better understand how the government is accelerating progress in these areas, this working paper explores some of the key political slogans that have underpinned China's policies around sustainable development (可持续发展 kechixu fazhan) and innovation (创新 chuangxin) within the context of broader narratives and changes. Drawing on theoretical insights from work that investigates the role of power in shaping narratives, knowledge and action around specific pathways to sustainability (Leach et al 2010a), this paper begins to explore the ways in which dominant policy narratives in China might drive particular forms of innovation for sustainability, and potentially occlude or constrain others. In particular, we look at ecological civilisation (生态文明shengtai wenming) as a slogan that has gradually evolved to become an official narrative, and is likely to influence pathways to sustainability over the coming years. The paper raises important questions for future research that could help to clarify the relationship between narratives and pathways to sustainability in changing China.

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Acronyms

CAE	Chinese Academy of Engineering
CAS	Chinese Academy of Sciences
CCICED	China Council for International Cooperation on Environment and Development
CE	Circular Economy
ESRC	Economic and Social Researh Council
EV	Electric vehicles
FYP	Five Year Plan
GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
MEP	Ministry of Environmental Protection
MLP	Medium to Long-Term Science and Technology Plan
NDRC	National Development and Reform Commission
NGO	Non Governmental Organisation
PV	Photovoltaic
SEPA	State Environmental Protection Administration
SPRU	Science Policy Research Unit (University of Sussex)
UNEP	United Nations Environmental Programme
UN	United Nations

Abstract

Given the environmental impacts of China's current development trajectory and the country's increasing economic and strategic focus on innovation, China's progress on sustainable and low-carbon innovation is of crucial global importance. In order to better understand how the government is accelerating progress in these areas, this working paper explores some of the key political slogans that have underpinned China's policies around sustainable development (可持续发展 kechixu fazhan) and innovation (创新 chuangxin) within the context of broader narratives and changes. Drawing on theoretical insights from work that investigates the role of power in shaping narratives, knowledge and action around specific pathways to sustainability (Leach et al 2010a), this paper begins to explore the ways in which dominant policy narratives in China might drive particular forms of innovation for sustainability, and potentially occlude or constrain others. In particular, we look at ecological civilisation (生态文明 shengtai wenming) as a slogan that has gradually evolved to become an official narrative, and is likely to influence pathways to sustainability over the coming years. The paper raises important questions for future research that could help to clarify the relationship between narratives and pathways to sustainability in changing China.

1. Innovation for Sustainability: The Importance of Narratives

The global imperative for 'green transformations' (Scoones *et al.* 2015) in China requires understanding the evolution of Chinese narratives around sustainability (and sustainable development). It also requires understanding narratives around science, technology and innovation and the extent to which these intersect with sustainability objectives. In this working paper, we provide an introduction to slogans related to environment and innovation and begin to explore the ways in which they have emerged as sites for the negotiation of contested futures. We introduce and discuss the evolution of these slogans into official narratives, before considering the pathways that they imply (Leach *et al*. 2010a). We do this by investigating examples, in particular that of 'ecological civilisation', which may illustrate the power of narratives in driving eco-innovation pathways, and (beyond technological innovation) consider how their shaping of social, organisational and cultural change might also contribute to social and environmental goals. Through mapping the terrain of high level policy narratives, we hope to provide a basis for further more situated empirical studies of their implementation (and subversion), and the processes through which single or plural pathways might emerge.

The concept of 'sustainable development', first defined in the landmark 'Our Common Future' Report (Brundtland 1987: 43) as, 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs', later sparked academic debates around broader notions of 'sustainability'. This term, particularly since the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992, has typically been defined as, 'The capability of maintaining over indefinite periods of time specified values of human wellbeing, social equity and environmental quality', (Leach *et al*. 2010a: *xiv*).

Many scholars, including Agrawal (2005), Brosius (1999), Chatty (2002), Escobar (1999), Goldman (2006) and Scott (1998), have explored the ways in which the institutionalisation of particular framings of sustainable development over the past two decades have marginalised, displaced or precluded certain motives and actors from the environmental arena. Through their articulation of the 'pathways' approach, Leach *et al.* (2010a) contributed a particular understanding of the role of narratives in that process. In this paper we draw on this understanding of narratives as playing a central role in both enabling and reinforcing particular pathways of systemic change, and in occluding and constraining others.

'Particular system framings', wrote Roe (1994), 'often become part of narratives about a problem or issue. These are simple stories, with beginnings defining the problem, middles elaborating its consequences and ends outlining the solutions'. These narratives, explained Leach *et al*. (2010a: 45), suggest particular ways a framing and its dynamics, 'Should develop or transform to bring about a particular set of outcomes'. Thus Leach *et al.* (2010a) draw on constructivist perspectives to explain how actors' situated knowledges (Haraway 1998) and understandings lead to narratives adopting different framings (Goffman 1975) of the systems at play and how they are likely to change. The way that narratives are employed, therefore, has not only a descriptive but also a normative significance, shaping approaches to science and politics and, as we explore in this paper, the role of innovation for sustainability.

Powerful actors, institutions and discourses tend to shape dominant narratives, which, 'Deploy knowledge as a means to justify, persuade, legitimate [and] very often force a process of 'closing down','(Leach *et al.* 2010a: 78) towards particular approaches. In this process of closing down, 'Ideas, institutions and practices reinforce each other… certain pathways become 'motorways', unrolling powerfully across the landscape of understanding and intervention, narrowing other tracks' (Leach *et*

al. 2010a: 87). This can have the effect of, for example, undermining other, potentially more locally applicable, pathways to sustainability, as illustrated by various examples.

The work of Byrne *et al.* (2011) has shown how narratives that adopt technology-finance framings in the field of international energy and climate change policy (and associated policy frameworks such as the clean development mechanism) underplay the contextual needs of rural households in seeking access to sustainable energy services, as well as the importance of building indigenous innovation capabilities for low pro-poor low carbon development. In the agriculture field, work by Brooks *et al*. (2009) on innovation pathways for responding to climate change in arid areas of East Africa has shown how narratives around maize (the primary staple, but not one that is particularly resilient to climatic stress) have locked food security responses in the region into a situation where alternative options that do not relate to that particular crop are often neglected.

Similarly, in their work on forest carbon and green grabbing, Fairhead *et al*. (2012: 240–241) have shown how, as 'green markets' have emerged as an aspect of the capitalist 'green economy' narrative, the trading of 'discursive commodities' (for example, the particular framing of the 'payments for ecosystem services' concept) has influenced the, 'Material political-economic conditions on the ground', Fairhead *et al* 2012). The bureaucratic monitoring approaches adopted by carbon sequestration schemes in Africa have thus put a value on carbon offsets, but as a result people's access to land and livelihoods have been threatened. These problems build on well-known histories of colonial and neo-colonial resource alienation in the name of the environment, whether for parks, forest reserves, or to halt local practices assumed to be destructive.

Analysing another set of material political-economic conditions, Dry and Leach's (2010) work on epidemics has shown how responses to disease can be constrained by narratives and their implied assumptions, which may not capture the dynamics and uncertainties at play in the multi-scale interactions of people, animals and microbes, potentially threatening health and livelihoods. In related work, Leach *et al*. (2010b) have shown how powerful 'outbreak narratives' have led to policies focusing in on stability at the expense of alternative strategies for resilience and robustness that respond to perspectives emphasising longer term structural, land use and environmental change.

At the international level, narratives around the 'clean energy race' (Pew Charitable Trusts 2011) have framed the global landscape of low-carbon innovation through comparisons of scale of expenditures on high-tech, capital-intensive approaches to low-carbon energy provision, such as solar photovoltaic/smart grid combinations and large-scale wind power, where intellectual property is a key driver of investment. Alternative approaches, excluded by such a narrative, could serve other goals, such as social inclusion or poverty alleviation. These might include solar thermal technologies in China which supply affordable water heating without requiring the kinds of complex smart grid infrastructure needed for distributed solar PV generation (Urban and Geall 2014), or the incorporation of local innovations around biomass energy into government-supported programmes, such as those supported under the National Innovation Foundation in India or the Social Technologies Network in Brazil (Ely 2014).

In China, the subject of this working paper, considering narrative framings also requires understanding the country's particular history of top-down narratives and the continued importance of slogans in governance. This is true of environmental and innovation governance, from the totalitarianism of the Mao era to today's political conjuncture, which has variously been described as 'fragmented authoritarianism' (Lieberthal and Oksenberg 1988), or 'adaptive governance' (Heilman and Perry 2011). During the Mao era, the party-state made extensive use of tightly controlled top-down narratives, and environmental narratives were highly uniform and characterised by militaristic conquest of nature (Shapiro 2001). More contemporary work on discourse in China (Nordin and Richaud 2014), however,

notes the continued existence of such dominant narratives, promoted through slogans such as that of 'harmonious society', but also the emergence of their 'creative and ironic reappropriation', particularly in online media.

2. Green Transformations in China: What are the Stakes?

In 2013 the Intergovernmental Panel on Climate Change (IPCC 2013: 19) concluded that limiting climate change would require, 'substantial and sustained reductions of greenhouse gas emissions'. Given its large population, continued economic growth (which has now started to decelerate somewhat after around 30 years of around 10 per cent growth per annum) and rising energy and resource demands, China is central to achieving any such substantial reductions globally (Urban *et al*. 2009; Urban 2014; Wang and Watson 2009). China is the world's largest energy consumer and carbon dioxide emitter by volume. It is still highly reliant on burning coal for energy (IEA 2013).

Climate change is expected to have extremely uncertain effects on the country. China is home to around 20 per cent of the world's population, yet has only about five to seven per cent of the global freshwater resources and less than 10 per cent of the world's arable land. Some scenarios see slight net benefits for China's crop yields in a warming climate (Ye *et al*. 2013), yet there is also the potential for severe water shortages, the further deterioration of aquatic systems and more flooding disasters (Zhang *et al*. 2009). Meanwhile China's mega deltas are particularly vulnerable to climate change and sea-level rise, with warming potentially increasing the frequency and level of inundation in delta megacities, such as in the Pearl River Delta, due to storm surges and floods from river drainage (IPCC 2007), potentially affecting residents and damaging critical infrastructure in heavily industrialised low-elevation coastal areas (McGranahan *et al.* 2007).

Beyond climate change, earth systems' scientists have explained that anthropogenic changes to nitrogen and phosphorous cycles, freshwater use, biodiversity and other 'planetary boundaries' threaten to push human development toward dangerous tipping points (Rockstrom *et al*. 2009; Steffen *et al*. 2015). The scales of China's other environmental problems (related to some of these planetary boundaries but with localised effects) are also enormous. In 2013, for example, the Government found that in 198 cities inspected, more than 57 per cent of the groundwater was rated 'bad' or 'extremely bad, while more than 30 per cent of the country's major rivers were 'polluted' or 'seriously polluted'. Nor did the air in 86 out of 113 key cities reach acceptable air quality standards. The state of the country's soil is also a major concern. More than 40 per cent of the country's arable land is degraded according to the state media (Patton 2014).

Scholars thus argue that transformative innovation of many different kinds is required, not only to bring the trajectories of global development into the 'safe operating space for humanity (Rockstrom *et al*. 2009), but also to address poverty alleviation and social-justice imperatives (Leach *et al*. 2012). With regard to this planetary challenge, China is not only critical for the development of low-carbon transitions around the world but also for unlocking the transformative innovation needed to reconfigure patterns of global development (Tyfield *et al*. 2014a).

3. Chinese Narratives around the Environment

As Edmonds (2011) has noted, *huanjing* (环境) 'environment' in Chinese has a similarly wide application as in English. It refers not only to geographical spheres but also to social ones, such as the political environment (政治环境 *zhengzhi huanjing*). The natural environment is thus often referred to as the ecological environment (生态环境 *shengtai huanjing*). Older ecological analogues are sometimes said to be found in traditional philosophical concepts such as *tianren heyi*, or 'unity of man and nature' (天人合), which has been described as an ancient root for environmental thinking in the Chinese context (Zhang and Barr 2013: 6).

However, not all such environmental slogans have expressed ecological ideals. The Maoist slogan 'man must conquer nature' (人定胜天 *ren ding sheng tian*) also used the term tian (天), which can be rendered as heaven or as nature (Weller 2006: 49–50). Environmental narratives and policies during the first decades of the People's Republic of China, after its founding in 1949, were characterised by this and similar slogans, which Shapiro (2001) described as reflecting a militarised discourse, the hallmarks of which included 'utopian urgency' and 'dogmatic uniformity', seen, for example, in the promotion of large-scale relocation and reclamation projects.

The year 1972 is generally identified as a turning point for environmental narratives in China. Two events in China were seen to have persuaded policymakers in the State Council to establish the first investigation and treatment committee on environmental issues, headed by then Premier Zhou Enlai. The first was a red tide (a toxic algal bloom) in coastal waters near Dalian, in north-eastern China, which caused a huge die-off of shellfish. The second was the discovery that fish sold in Beijing had high levels of toxic chemicals in their flesh (Muldavin 2000: 252). Furthermore, following the US–China rapprochement, the People's Republic had come to occupy the China seat in the United Nations and had participated in the influential 1972 Conference on the Human Environment held in Stockholm (Edmonds 2011: 15–16). This led to the first public challenges to the 'pollute first, clean up later' (先污染后治理 *xianwuran houzhili*) model of development.

The following year, the first national conference on environmental protection was held in Beijing (Muldavin 2008: 253). This called for, 'overall and rational planning, reduction of harm, a reliance on the masses and both the protection of the environment and the enriching of the people' (Meng 2012), and led to a series of regulatory decrees and targets on 'end-of-pipe' pollution control (Weng *et al.* 2015: 7). In 1973 China also founded its first environmental publication, *Environmental Protection* (环境保护 *huanjing baohu*), with the writer and official, Guo Morou, providing the calligraphy on the masthead (CCICED 2013).

Twenty years later, China's participation in the Rio conference in 1992 (mentioned above), saw a renewed and official focus on sustainable development emerge. In official Chinese publications sustainable development is rendered as *kechixu fazhan* (可持续发展), 'development that can be sustained', and the official definition tends to follow Brundtland (1987) word-for-word, 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs', (既满足当代人需要有不对后代人满足需要的能力构成威胁的发展 *ji manzu dangdai ren xuyao you budui houdai ren manzu xuyao de nengli goucheng weihai de fazhan*).

Throughout the 1990s, sustainable development became a key phrase in government literature (Meng 2012). The Ninth Five Year Plan (FYP), from 1996 to 2000, was the first to include the phrase (Edmonds 2011: 16) and in 1997 China published its first National Sustainable Development Report. In 1994, China became the first country to issue a national *Agenda 21*, which laid out the country's strategic sustainable

development plan (Weng *et al.* 2015: 8). The 15th Party Congress, in September 1997, listed the, 'huge environmental and resource pressures caused by population growth and economic development', as major difficulties facing the nation (Meng 2012).

In 2002 the, then President, Jiang Zemin included sustainable development as part of *xiaokang* (小康), the 'moderately prosperous', or literally 'small comfort', society of modest means that was a signature theme of his leadership (Tilt 2010: 11), one aspect of which was expressed officially as:

> The continual strengthening of sustainable development ability, improvement of the environment, clear increases in resource efficiency, the promotion of harmony between humanity and nature and putting society as a whole onto a development path of production, wealth and environmental-friendliness.
> (Meng 2012)

President Hu Jintao's administration saw the emergence of the 'scientific view of development' (科学发展观 *kexue fazhanguan*) and the 'two-oriented society' (两型社会 *liangxing shehui*), which conserves resources and is environmentally friendly. This era also saw Pan Yue, outspoken Vice-Minister of China's State Environmental Protection Administration (SEPA) (now the Ministry of Environmental Protection, (MEP)), promote the study of 'eco-socialism' (生态社会主义 *shengtai shehuizhuyi*). Pan, who was later sidelined (Ansfield 2013), explained that sustainable development should be defined as economic growth, environmental protection and social justice, and that the social justice imperative, in particular, meant that, 'in theory, socialism is more suited to the realisation of sustainable development than capitalism'. Current patterns of development in China had gone against socialism, he said, since, 'the rich consume and the poor suffer the pollution' (Zhou 2006).

However, despite such concerns about China's environmental deterioration having been incorporated into narratives at the highest levels of state, there have been chronic problems with the enforcement of environmental laws and regulations (Geall and Hilton 2014). At local levels of government, contradictory laws, collusion between officials and polluters, misaligned political evaluation metrics for officials and restricted scope for citizen oversight have thwarted environmental initiatives (Economy 2005; Wang 2007). At the elite level, vested interests, inter-agency rivalries and an overriding focus on high growth rates have worked against green policies (Heggelund 2004).

4. The Evolution of 'Ecological Civilisation'

In 2007, the phrase 'ecological civilization' (生态文明 *shengtai wenming*) made its debut appearance at the Chinese Communist Party's 17th Congress, the Party's highest body, which meets about every five years. Hu Jintao, then China's President, said, 'The construction of an ecological civilisation will be given a prominent place and included in all aspects and processes in economic, political, cultural and social development'. *China Daily*, an English-language Party mouthpiece, wrote in an editorial on the subject:

> [Ecological Civilization] is not a term the Party has coined just to fill a theoretical vacancy in its socialism with Chinese characteristics, but rather a future-oriented guiding principle based on the perception of the extremely high price we have paid for our economic miracle.
> *China Daily* 2007

Under President Xi Jinping, the slogan has also been promoted prominently over the past two years. Yet, as Oswald (2014) noted the, 'aims, goals and methods' of achieving ecological civilisation were 'hazy'. Instead of being codified into an implementable narrative, the slogan rather served as a site for negotiation among different actors, institutions and discourses.

Ecological civilisation was effectively the fourth in a series of slogans that started in the 1980s with Spiritual Civilisation (精神文明 *jingshen wenming*), Material Civilisation (物质文明 *wuzhi wenming*) and Political Civilisation (政治文明 *zhengzhi wenming*). Previous 'civilising' slogans put a strong emphasis on individual behavior change for national development. Oswald (2014) pointed out that ecological civilisation was, by contrast, the first with a global dimension. Environmentalist Ma Jun (2007) drew on this aspect, for example, to argue ecological civilisation reflected, 'The state of Chinese thinking on the future of global civilisation in the light of the world's shared environmental challenges', founded on a belief that, 'our model of industrial civilisation is unsustainable'.

Others conceptualised it differently. For Chinese scholars (Wang *et al.* 2014) influenced by ecological Marxist ideas (Foster 2002) ecological civilisation represented a novel challenge, not only to the Communist Party to take ecological responsibility, but to capitalism itself, and even to the anthropocentric world view advanced by Western modernity, which could help, 'the Chinese people revalue their own traditional ecological wisdom' (Wang *et al*. 2014: 54). Wen Tiejun, a prominent intellectual in the New Rural Reconstruction Movement, described ecological civilisation reviving, 'China's long tradition of agriculture', to cushion a future economic crisis (Oswald 2014). For others, it was better viewed in the context of the green economy, such as the large green investments in China's stimulus in 2008 (Weng *et al*. 2015: 9) and in the implementation of 125 local 'ecological civilisation construction' pilots (Weng *et al*. 2015: 30).

However, the slogan has recently been codified. This process of closing down a period of debate and negotiation in order to articulate a slogan as an implementable narrative presents a novel insight into environmental governance in China. In April 2015, the highest level state policy document to have discussed the term was published unpromisingly entitled 'Central Document Number 12: Opinions of the Central Committee of the Communist Party of China and the State Council on Further Promoting the Development of Ecological Civilization'. In this, ecological civilisation is set alongside the other, high level political slogans that are emerging as the signature of President Xi Jinping's leadership, notably the Chinese Dream and the Two Centenary Goals, the twin ambitions to double GDP and *per capita* income by 2020 on a 2010 baseline (in time for the centenary of the Communist Party of China) and to turn China into a 'socialist modernised country' that is 'rich, strong, democratic, culturally advanced and harmonious' by mid-century (the centenary of the People's Republic of China).

Much of the text is florid and underscores the scale of the challenge. But it also fleshes out for the first time the policies and approaches the Government now proposes to comprise ecological civilisation. These include targets, principles and plans for various sectors in Chinese economy and society, including regional development and urbanisation, innovation policy, resources use and ecosystems conservation. However, it also acknowledges that the transition will demand reforms in governance, and thus it contains the seeds of a coherent narrative. As discussed below, by calling for new ways to punish and reward officials and by promising expanded public participation and environmental disclosure, the text signals a significant effort to reform governance for ecological civilisation in China through new standards and systems. Thus, this process of codifying a high-level narrative may, when viewed on a larger scale, represent the opening of a pathway to sustainability, which will be discussed further below.

5. Chinese Narratives on Innovation

While science (科学 *kexue*) and technology (技术 *jishu*) have been central to Chinese development narratives over much of the past century, and certainly since the 'Four Modernisations' (四个现代化 *sige xiandaihua*) formulated by Zhou Enlai and later championed by Deng Xiaoping, innovation (创新 *chuangxin*) has only more recently become an important concept. Translatable more broadly as bringing forward new ideas innovation has been used in various ways, not only in those relating to technological change, but also to describe China's approach to policy experimentation and reform (Husain 2015). In this Section we focus on technology related uses of the term.

China's science and technology policies since the reform and opening up period have explicitly moved from a catch up model, largely based on importing new technologies from overseas, towards a model that focuses on 'new-to-world' technologies emerging from Chinese firms themselves. Narratives of 'indigenous innovation' (自主创新 *zizhu chuangxin*) became commonly used under President Hu Jintao, in particular, with regard to the country's Medium to Long-Term Science and Technology Plan (MLP) (State Council of the Peoples Republic of China 2006). This identified priorities for 2006–2020, including setting Gross Expenditure on Research and Development (GERD) at 2.5 per cent of GDP by 2020 in a range of strategically important areas linked to China's economy and development, including energy, environment, agriculture, manufacturing, transport and public health (Wilsdon and Keeley 2007). Scholars identified three different formulations of the 'indigenous innovation term' in the MLP (Bound *et al*. 2013).

Table 5.1: *Formulations of the term 'Indigenous Innovation' in the MLP*

Chinese	**Official translation**
原始创新 *yuanshi chuangxin*	Original innovation
集成创新 *jicheng chuangxin*	Integrated innovation
引进消化吸收再创新 *yinjin xiaohua xishou zai chuangxin*	Re–innovation based on assimilation and absorption of imported technology (Literal translation: Introduce–digest–absorb re–innovation)

President Hu Jintao also called on China to become an 'innovation–oriented society' (创新型社会 *chuangxin xing shehui*) in a speech unveiling the MLP in January 2006 (Suttmeier *et al*. 2006), and these principles contributed greatly to the science and technology components of the Twelfth FYP (2011–2015), which highlighted seven new strategic emerging industries, including renewable energy technologies and electric cars, to receive sustained investment and preferential policies. More recently, Central Document No. 12 on ecological civilisation (discussed above) also addressed, 'technological innovation and structural adjustment', and pointed to continued government support for strategic industries in the Thirteenth FYP (2016–2020), while suggesting the Government give, 'full play to the decisive role of the market in determining the orientation of green industries and choosing technology routes', rather than specifying specific technology goals for state supported innovation, as was in the case in the Twelfth FYP.

Western scholars have long studied processes of catch up, including the social capabilities required for countries, not only to absorb technology from outside, but also to forge ahead in new areas (Abramovitz 1986) in a way that is consistent with the indigenous innovation narrative. Other scholars have looked at processes of leapfrogging, asking whether it might be possible for China (or other emerging nations) to bypass environmentally damaging stages of development by moving straight to clean technologies

(Watson and Sauter 2011). This concept refers to 'technology following' countries or firms skipping over various stages in the trajectories that have previously been followed by 'technology leaders', rapidly allowing the former to become competitive at the international level. Evidence of leapfrogging has been presented in the Korean steel and automotive industries, and in the Chinese and Indian wind energy industries (Watson and Sauter 2011).

Although some have critiqued this idea (Rock *et al*. 2009), similar concepts have entered Chinese policy narratives. Leapfrogging is normally rendered as 'breakthrough model of development' (跨越式发展 *kuayueshi fazhan*), or occasionally as 'leaping' (飞跃 feiyue). However, the Chinese Minister of Science and Technology (and former executive of the car company Audi), Wan Gang, has also described the opportunities for the country's automotive sector to 'overtake around the corner' as international car firms compete on the basis of environmental performance. 'Corner overtaking' (弯道超车 *wandao chaoche*) particularly has been applied to the development of the electric vehicle sector in China, one of the areas highlighted in the Medium-Long Term Plan (Tyfield *et al*. 2014b). Rather than the traditional leapfrogging concept described above, the metaphor of taking a short cut to a cleaner technological trajectory, outcompeting standard (and more carbon intensive or environmentally damaging) trajectories, into which incumbent firms are locked, is compelling.

6. Towards System Innovation

Beyond innovation for sustainability and competitiveness in individual technologies (as discussed above) Chinese narratives are beginning to allude to what some scholars in the international literature call system innovation (Elzen *et al*. 2004), which may lead to a transition or transformation of the entire economy. Earlier narratives point to this more systemic level of change, but without explicitly linking them to both social and technological change. One such narrative is cleaner production (清洁生产 *qingjie shengchan*), an established concept in international debates,[1] which was explicitly linked to technological change through in the academic literature in Europe throughout the 1990s (Clayton *et al*. 1999). The *Law of the People's Republic of China on Promoting Cleaner Production* (中华人民共和国 清洁生产促进法) was passed by the National People's Congress and came into force in June 2002 (Ely *et al*. 2011).

Similarly, narratives of the circular economy (CE) (循环经济 *xunhuan jingji*), which parallel earlier Western notions such as industrial ecology (see Graedel and Allenby 1995), emerged in China following its use by former President Jiang Zemin at the Members' Assembly of the Second Global Environment Facility held in Beijing in October 2002. The term has been repeated by leaders such as Hu Jintao (Yong 2007) and featured as an aspect in the Eleventh FYP. According to the National Development and Reform Commission (NDRC), China's top economic planner,

> the theme of the CE concept is the exchange of materials where one facility's waste, including energy, water, materials – as well as information – is another facility's input. By working together, the community of businesses seeks a collective benefit that is larger than the sum of the individual benefits each enterprise, industry and community would realize if it intended to optimize its performance on an individual basis.
> NDRC 2006, quoted in Pinter 2006

In 2007, China initiated its first wave of circular economy trials in ten different provinces and, later in 2009, passed the *Circular Economy Promotion Law* (Su *et al*. 2013). Some scholars (Ely *et al*. 2011) have suggested that the national approach may have drawn lessons from experiments at the level of municipal regulations in Shenzhen. As well as targeting resource/energy efficiency, the national law has spawned research around indicators and metrics associated with the circular economy (Geng *et al*. 2013).

Whilst the corner overtaking narrative implicitly suggests changes across technical systems (including charging stations and infrastructure), there has been a notable absence of discussion around interacting socio-technical systems and changes in, for example, individual user/citizen behaviors (explored further in Tyfield *et al*. 2015). Beyond this, none of the narratives above acknowledge or appear to question whether or how institutional structures or governance arrangements might need to be reformed in order for the kinds of system-wide transition pathways that are necessary for required emissions reductions to actually emerge. This is discussed further in the following sections, where recent developments to ask whether these are beginning, through more clearly articulated visions of system change, to move from narratives to pathways are also reviewed.

[1] Use of the term dates back to the United Nations Environment Programme (UNEP) 1991 definition of. 'the continuous application of an integrated preventative environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment'. (UNIDO 2015)

7. From Environmental Narratives to Pathways

The environmental goals laid out in 2015's Central Document No. 12 on ecological civilisation (introduced above) are ambitious. Importantly, the document also represents the first official articulation of the narrative in a way that focusses on building specific pathways and, also importantly, on fostering potential system innovations that make those pathways more likely to emerge. Section six of the 12,000-character text, which is divided into nine sections (four of which concern implementation mechanisms) proposes a 'comprehensive system of ecological civilization', which would include improved legislation and enhanced compatibility between China's many environment-related laws. It emphasises the need, 'to improve the system of property rights of natural resource assets', and 'to stick to and improve the most stringent systems of cultivated land protection and land conservation'. Measures that seem designed to curb land-grabbing by local officials and developers in rural areas. It also cites the, 'need to improve the system of monitoring' the environment, including the closure of facilities that illegally discharge pollutants and the strict observation of environmental, resources, land and energy-use 'red lines'.

The text also includes a pledge for reforms in 'the system of government performance assessment', the report card that judges the performance of Chinese officials against criteria set from above, to address the enforcement challenge described above. The document makes an explicit pledge to abandon 'the concept of regarding economic growth as the only criterion in government performance assessment' and promises to align targets, assessments, rewards and punishments 'to the requirements for ecological civilization'. It also goes as far as to promise 'to cancel assessment of GDP of areas where development is forbidden or restricted and key counties of national poverty alleviation and development with a fragile ecological environment'. In future, the text says, performance assessment will prioritise agriculture in mainly agricultural areas and ecological protection to areas critical to ecological function.

Similarly, the document proposes a new lifelong accountability system for officials, which would prevent officials from achieving promotions that could obscure a prior record of environmental destruction and would, 'investigate the regulatory accountability of officials who perform their duty perfunctorily, conduct weak regulation, neglect their duty and perform malfeasance according to discipline and law'. Other sections concern improvements to statistical monitoring and law enforcement supervision and the cultivation of good social morals for promoting ecological civilisation. Despite its overtones of paternalism, it refers to environmental education in schools, communities and government, to giving full play to the role of news media, to promoting awareness about green policies and principles and to fostering green lifestyles among the public and officials through publicity campaigns.

The document also supports active public participation in ecological civilisation, which mainly refers to civil society oversight of environmental regulation with a specific commitment to: accurate and timely environmental information disclosure; the expansion of the scope of this transparency; guaranteeing the public right to know; safeguarding the environmental rights and interests of the public; and improving the systems of whistle blowing, public hearings and public environmental interest litigation. It promises that ecological civilization 'will expand public participation in the initiation, implementation and post-assessment of construction projects in an orderly manner' and that it will 'guide all types of social organizations […] to pursue healthy and orderly development and give play to the role of non-governmental organisations (NGOs) and volunteers'. In conclusion, the text seems to signal China's efforts to achieve shift through system innovation has been awarded high priority, set out at the highest level under the rubric of ecological civilisation.

8. Pathways to Innovation for Sustainability?

In 2014, in a speech to the Chinese Academy of Sciences (CAS) and Chinese Academy of Engineering (CAE), President Xi Jinping stated that, 'the direction of China's science and technology development is innovation, innovation and innovation', and noted that, 'independent innovation [should be] the essence of a strategy to free up the huge potentials of science and technology' (Xinhua 2014). China's contribution to innovation for sustainability, of course, reaches beyond its narrative or rhetorical contributions. A large and rapidly growing literature on low-carbon innovation in China documents impressive developments regarding renewable technologies such as wind energy, solar photovoltaics, hydropower and electric vehicles (EVs). China has become the world leader in renewable energy. The country has the largest investment, production and installed capacity of renewable energy (IEA 2013). Chinese firms made up six of the top 10 solar photovoltaic (PV) module suppliers in 2014 (Renewable Energy World 2014). Top turbine manufacturers like Goldwin now compete as leaders in the emerging wind sector (Lewis 2013). These are fast-becoming the dominant trajectories of energy innovation, creating new leaders in the field and challenging powerful incumbents.

Innovation of this kind can be seen as an important contribution from China towards a green economy, an ambition underscored by some of China's most recent targets, plans and pledges made at a central government and an international level. China published the first national climate-change plan of any developing country in 2007, which formalised China's commitment to addressing climate change mitigation and adaptation. Climate change is also prioritised in the Twelfth Five-Year Plan (2011–15), which lists seven strategic emerging industries for support. These include environmental protection and energy efficiency, new energy, biotechnology and clean energy vehicles. Low carbon targets were further internationalised recently by China's commitment to the United Nations (UN) climate talks, which included a pledge that China's greenhouse gas emissions will peak by 2030, if not before, and that the country will reduce the carbon intensity of its economy (carbon emitted per unit of GDP) by 60 – 65 per cent below its 2005 level by 2030.

However, closer attention to the complex, systemic and emergent nature of the multiple processes involved in transition (see Tyfield *et al.* 2015) reveals the potentially overlooked importance of: bottom-up and emergent innovations (Smith *et al.* 2005); low(er) technology, below-the-radar, disruptive or frugal innovations (Kaplinsky 2011; Breznitz and Murphree 2011); social aspects of innovations (Smith and Ely 2015) and; innovation demand (Bhidé 2009) in China. All aspects of low-carbon innovation that can be overlooked or marginalised by top-down, high-technology and supply-side dominated framing, narratives and pathways. It remains to be seen if the potentially emerging pathways and opening or broadening out signaled by the codification of ecological civilisation, and the suggestion that this can engendered system reforms, could help bring light to such overlooked perspectives on innovation for sustainability.

9. Preliminary Conclusions and Future Work

This working paper has attempted to employ Leach *et al*'s (2010a) pathways approach by examining a range of narratives associated with innovation and sustainability in common usage by China's political elite, and exploring the role that these seem to play in promoting and constraining particular pathways. Using the examples of sustainable development, innovation narratives and in particular ecological civilisation, we have found that while elite narratives may neglect or occlude certain actors and certain forms of emergent innovation, these narratives often also serve to accommodate a diversity of potential pathways. Perhaps surprisingly for a polity that is often characterised as authoritarian in nature, the case indicates that there are in fact tensions and debates about China's future pathways, and that dominant narratives might engender some opening up of potential pathways to sustainability.

In the case of ecological civilisation, we have described a moment in which a slogan evolved to represent an official narrative. From here, we would expect the narrative to produce certain framings. It will be important to observe whether the closing down effected through the Number 12 Document has genuinely enabled new pathways to emerge through laying out implementable changes in governance, or whether it restricts the flexibility of local experimentation, or the challenges raised by civil society or other non-state actors. Similarly, while the recognition in the text of civil society's important role is to be welcomed, it remains to be seen how much (and how) these words translate into action. In particular, how the role of non-government actors articulates with more traditional forces within the context of a reformed cadre evaluation system. Will these reforms leave room for a more active civil society or does a recent crackdown on foreign NGOs, for example, presage a regime under which civil society's role in encouraging system innovation is more constrained?

It is clear that, as far as this preliminary study can conclude, there are interesting challenges associated with applying the pathways approach in China that warrant further research, not only because of the scale, diversity and importance of the country, but also because of the contemporary shifts in governance that it is experiencing, which may serve to support further or inhibit progress towards the country's stated environmental targets. Future studies could explore broader (or more situated) empirical cases of innovation for sustainability narratives and pathways across the many diverse contexts in a changing China, considering the contributions that these can and are making to green transformations at sub-national, national and international levels.

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