

Editorial

Environmental Innovation for Sustainable Development: The Role of China

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CHINA IS TODAY THE WORLD'S LARGEST USER OF NATURAL RESOURCES, SUCH AS FOSSIL FUELS, BIOMASS, MINERALS AND metal ores, but also a leader in environmental innovation for sustainable development. China is today also the world's second largest user of freshwater resources, and the world's largest emitter of greenhouse gases that lead to climate change (World Bank, 2015). As per capita natural resources are limited and below the world average (Pamlin and Baijin, 2007), innovation in the environmental field is crucial for enabling sustainable development. Recently, China has become one of the global leaders in environmental innovation, for example in the fields of hydropower, solar energy, wind energy and electro-mobility (Urban *et al.*, 2012; Lema and Lema, 2012).

At the same time, the lack of sufficient domestic natural resources has driven China to invest overseas in low and middle income countries in Asia, Africa and Latin America to access natural resources such as energy and minerals, to access new markets and to create employment overseas for Chinese workers (Mohan and Power, 2008; McDonald *et al.*, 2009). It is theorized that by doing so Chinese actors may be able to transfer environmental technology, innovation and knowledge to countries and trading partners in the global South and thereby influence the development and environment agenda of the recipient countries. Yet little empirical research exists in this field to support or reject this point.

This special issue, written by leading experts from China and world-wide, explores the complex and multifaceted relationship of environmental innovation, sustainable development and the role of China, from both the domestic perspective of China and that of China's overseas impacts in low and middle income countries. The special issue also discusses how China aims for sustainable development and examines these issues from an environmental innovation perspective. This raises two issues: first, China's domestic agendas for environmental innovation for sustainable development (or sustainability-oriented innovation systems, as Altenburg and Pegels (2012) frame it), and second, how these may be exported to other countries via trade, aid and investments.

This special issue approaches these issues from various novel and holistic perspectives: First it brings together the environmental, social, political, economic, technical and development agendas of sustainability-oriented innovation, which still tend to be discussed in siloes rather than together, particularly in relation to China (Tyfield *et al.*, 2014). Tyfield *et al.* (this issue), Urban *et al.* (this issue) and Nordensvard and Urban (this issue) aim to align these debates by discussing the importance of social innovation, political perspectives and development agendas for sustainability-oriented innovation. Second, the special issue addresses both China's domestic perspectives in the field of environmental innovation and sustainable development and its overseas impacts in low and middle income countries. In particular, the environmental impacts of Chinese investments overseas are still largely under-explored (Urban *et al.*, 2013), especially with regards to innovation. This special issue provides empirical evidence to this new field of study. Third, this special issue deals particularly with issues that are relevant for low carbon transitions in the light of climate change, such as low carbon innovation in the energy, transport and agriculture sectors, renewable energy and energy efficiency.

Tyfield *et al.* (this issue) explore environmental innovation in China and its potential for contributing to global transitions to low carbon, more sustainable patterns of development. The paper examines key domains of low

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carbon innovation: solar energy, electric urban mobility, and food and agriculture. This paper examines the differences and complexities between high tech and low(er) tech approaches in the energy, mobility and agricultural sectors, the divide between bottom-up and top-down responses in China, demand and supply side issues and social and technological implications. The paper particularly addresses issues of changing power relations and social practices: theoretical issues that need attention in the literature generally but are notably absent when studying transitions in China. This shift in perspective points to both opportunities and challenges to low carbon systems transitions that are overlooked by an orthodox focus on technological innovations alone.

Zhou *et al.* (this issue) analyse how public demonstration projects are used to promote the upscaling of green-manufacturing technologies in China, in order to expedite innovation 'catch-up' and transitions to sustainable development. This paper examines an energy-efficiency demonstration project in China to support the large-scale diffusion of green technology and its pilot implementations. Through the case study, this paper reveals that these demonstrations face a different set of diffusion barriers in testing technologies and promoting learning. In addition, this case also shows that a new policy model may be needed in order to cope with these barriers, when emphasizing market-oriented policies and non-legislative actors as well as combining them with traditional mandatory measures.

Urban *et al.* (this issue) examine the impact that China has overseas on low and middle income countries, by drawing on fieldwork on large hydropower dams in Asia. Large dams have been controversially debated for decades due to their large scale and often irreversible social and environmental impacts. In the pursuit of low carbon energy and climate change mitigation, hydropower is experiencing a new renaissance. At the forefront of this renaissance are Chinese firms as the world's largest dam builders. This paper aims to discuss the role of South-South technology transfer of low carbon energy innovation, its opportunities and barriers by using a case study of the first large Chinese-funded and Chinese-built hydropower dam in Cambodia. Using the Kamchay Dam as an example, the paper finds that technology transfer can only be fully successful when host governments and organizations have the capacity to absorb new technologies. The paper also finds that technology transfer in the dam sector needs to go beyond hardware and focus more on the transfer of expertise, skills and knowledge to enable long term sustainable development.

Nordensvard and Urban (this issue) introduce a new and often overlooked perspective, namely exploring social innovation in relation to environmental technologies. Their study examines the nexus between hydropower dams, social innovation and corporate social responsibility (CSR). This paper discusses these issues in relation to the world's largest builder of hydropower dams, Chinese state-owned enterprise Sinohydro. The research finds that Sinohydro recently developed its first comprehensive policy framework for social and environmental safeguards that was in line with international standards set by the World Bank / International Finance Corporation. These policies were however later replaced by weaker, vaguer policy. The paper suggests there is a need for Sinohydro and other dam builders to re-engage with social innovation to mitigate some of the negative social and environmental implications of hydropower dams.

What China does domestically and overseas matters world-wide. It matters not only because China is the world's largest economy and the most populous country today, with rapidly increasing economic, political, social and environmental influence, but also owing to its high consumption of natural resources and its huge greenhouse gas emissions contributing to climate change (Urban *et al.*, 2013). Transboundary environmental problems such as climate change and geopolitical struggles for accessing natural resources overseas mean China's development is of global importance. To reduce the high environmental impact and to achieve a transition to sustainable development, it is imperative that China invests in, and becomes a leader in, environmental innovation. This is not only for the sake of China, but also for the sake of our global environment.

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