

PREFACE

In this book I present an argument that is grounded in recent and emerging developments and framed to make sense of the evidence. My argument starts with the enormous transformation that is under way in the global economy as manufacturing activities shift East – to China as well as to India and other Asian countries. Behind the shift in manufacturing lies an energy revolution needed to power the new world factories. And as China and other countries seek to build their energy systems in the same way that powered the West – with fossil fuels and unlimited resource flows – they come up against the inconvenient truth that the Western model will not scale. It will not scale to the level needed by China and India and certainly not to the global scale needed by the ‘rest’ as they embark on their industrialization. My argument then proceeds to identify the source of this inconvenient truth. It is not so much that there are physical limits to the powering of economies by fossil fuels (of the kind made famous by the ‘limits to growth’ arguments) as that there are immediate environmental limits in the form of unbreathable air and undrinkable water, and equally important near-term geopolitical limits. As China scours the planet in search of fossil fuels and expanding resource flows, so it meets limits in the form of civil wars, revolutions and terror – the real ‘limits to growth’ faced by an industrializing giant in the twenty-first century.

This is where greening enters the picture. My argument is that China is greening its energy system and its resources system (by closing industrial loops and building a circular economy) not so much because of fears of global warming, but because greening represents the only feasible way of resolving the geopolitical limits to growth that would otherwise halt in its tracks the country’s industrialization. It is not that China sees global warming as unimportant – far from it. But China and to some extent India as rising industrial powers have to find ways to feed their huge energy and resource appetite in a way that enables them to evade the geopolitical limits to growth. Such a source

of energy is available, based not on drilling or mining but on manufacturing; feeding that appetite would similarly require a source of commodities that is based not on mining or extraction but on closing industrial loops. How convenient it is then, that China has stumbled on just such a solution – renewable energies and the circular economy – and is framing a feasible path forward that can be emulated by India and by many others. For renewables are always the products of manufacturing – and as such can be renewed virtually without limit – and without costing the earth. Renewables benefit from the exercise of manufacturing capabilities and reduction in costs associated with the learning or experience curve. And the circular economy (or urban mining) adapts manufacturing to the capture of resources not as virgin commodities but from circular flows under manufacturing control. Greening thus represents a way forward towards industrialization in a form that goes a long way in reconciling economy with ecology – and at the same time provides China, India et al. with their only hope of a prosperous and industrious future.

My account starts with the significant shifts taking place in the east in manufacturing, and it frames the demonstrated rapid rise of renewables in China (a green energy revolution that is overtaking the black coal-fired economy) and the emergence of a circular economy based on urban mining as strategic responses taken to support these shifts. My analysis accounts for these great transformations *not* so much as an effort to reduce carbon emissions as a means of mitigating climate change (important as this may be, albeit more as a serendipitous side-effect) but rather as a fierce drive for energy and resource security. Successful industrialization depends on enhancing these sources of security.

Most discussions of renewables and the circular economy tend to start with climate change; they then proceed to frame the need to decarbonize industrial systems as a moral imperative to mitigate climate change. This book takes a different tack. It emphasizes the drive by China et al. for energy and resource security as primarily a geopolitical and domestic legitimacy imperative that leads them inevitably to promote renewables and the circular economy. For these countries it is not so much a moral choice as an economic imperative to green their economy. Reduced carbon emissions are a fortunate side-effect (Weber's 'unintended consequences') that these strategic choices generate. Emerging industrial giants are more readily attracted to renewables and circular flows precisely because renewables devices are always the products of manufacturing, as are closed resource loops – creating pathways that enable resource-hungry industrializers to find ways around the geopolitical hurdles that would block their way forward were they to attempt to follow the conventional fossil-fuelled pathway.

The broader framework for my story is one that grounds it in technological and industrial dynamics and successive waves of industrial epochs, as captured in Schumpeterian analysis. In the Schumpeterian world it is waves of creative destruction that unleash the new against the old, mediated through changes in cost structures that destroy the status quo and allow the insurgents to access the finance that drives their new investments. In the world of neoclassical economics, by contrast, there is only a limited sense of how firms and consumers react to shocks that disturb the prevailing equilibrium and induce substitutions – facilitated by market-based instruments like carbon taxes. Such a limited picture of the world has never been able to account for major technoeconomic shifts in the past – like the rise of steam power, or railroads, or electrical power grids or the IT revolution – and certainly cannot account for the major transformations that are now under way with the greening of industrial economies.

A proto-version of this argument was outlined in my 2014 book *Greening of Capitalism*. It was elaborated succinctly by Hao Tan and myself in our two articles published in *Nature*, in 2014 and 2016. As one of the world's two leading science journals, *Nature* requires that articles selected for publication be radically compressed – every word counts. This book grows out of the need to amplify and elaborate the argument that we made in these articles.

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My first debt then is to my long-time collaborator Dr Hao Tan, with whom I have co-authored many articles on China's greening strategies, culminating in our publishing two articles in *Nature*, on manufacturing as a means of providing energy security and on China's circular economy initiatives as a means of providing resource security. As I sketch above, this book is conceived as an elaboration of the argument of these two articles. The next debt is then to the editor of the Commentary section of *Nature*, Dr Joanne Baker, who showed confidence in our argument and provided us with superb editorial guidance in bringing the articles to fruition. Likewise our editor at *Asia-Pacific Journal*, Professor Mark Selden from Cornell University, who has critically engaged with many of our joint articles on China and its greening strategies, has proven to be an insightful collaborator.

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