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Published online: 27 January 2020
<https://doi.org/10.1038/s41563-019-0594-y>

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China's complex material footprint

The major global challenge for the decade ahead is arguably to reduce carbon emissions dramatically, so as to have any hope of avoiding serious and perhaps catastrophic climate change. There's little doubt that our rate of materials consumption — which has never been higher per capita — is a big part of the problem. It's a concern for other reasons too: the sheer depletion of finite resources, and the environmental despoliation that often accompanies materials extraction and refining.

Statistics on materials use could seem to imply that economic growth does not always make things worse: use of natural resources may in some developed countries increase at a slower rate than indicators of economic growth, or even decline. As our societies become more advanced, it could seem that we use materials more efficiently.

Sadly, that is an illusion. For one thing, more advanced societies simply outsource their materials extraction and production, buying in rather than producing domestically. But as Wiedmann et al.¹ showed, the problem is worse than it seems even when the balance of imports and exports is taken into account. An imported laptop computer represents much more than its material components, for it embodies a mountain of resources that went into its creation. Shockingly, around two fifths of raw materials globally are extracted just to enable the export of goods and serves around the world. Wiedmann et al. argued that a more accurate measure of materials consumption is the 'material footprint' (MF), which takes into account all the embodied materials use in a given product. Looked at this way, it is clear that as wealth grows, so does the overall

materials consumption per capita. A 10% increase in gross domestic product (GDP) entails, on average, a 6% growth in materials footprint.

Jiang et al.² have now shown that it may be harder than thought to generalize about such trends. They have analysed the MF within China on a province-by-province basis, and find that significant discrepancies appear. China as a whole accounted for 30% of the total global MF by 2010. But there are large differences in per capita MF between provinces, even for some that have similar measures of development. So the calculus of materials consumption may be more subtle than it appears from taking a global view.

China feels today almost like the world in microcosm, where the highest levels of technological advancement coexist with considerable poverty and deprivation, and with ways of rural life that have changed little in centuries. Crudely put, the most developed provinces lie towards the eastern coastal regions, and the least developed are in the far west and north — provinces such as Qinghai, Xinjiang and Inner Mongolia. But it is often in the latter that the greatest natural resources (minerals and coal, say) lie. So domestic extraction is higher in general for inland provinces, whereas MF is higher for coastal provinces. Affluent cities like Beijing and Shanghai have a per capita MF of 25–33 tonnes, whereas it is just 10 tonnes in southwest Guizhou province, with a much lower provincial GDP.

Yet there are big anomalies. Qinghai has a GDP per capita only 7% that of the United States, yet its per capita MF is comparable; the MF is also surprisingly large for Inner Mongolia, Gansu and other low-



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income provinces. And the per capita MF for the relatively wealthy coastal provinces of Guangdong and Fujian is among the lowest in China (14 tonnes). How can that be?

Clearly, Chinese provinces are not simply replicating a global pattern of materials being extracted in less developed regions for consumption in the more developed. Jiang et al. think that capital investment is a key variable: where this is high, resource use and MF are high too. This investment is mostly directed into construction projects: real-estate building in wealthier provinces, infrastructure (such as roads and railways) in lower-income ones. In short — as anyone who has travelled across China will attest — even remote, rural provinces are alive with construction activity. You might say that, in those places, investors are buying in the MF. Clearly, there is still plenty to be understood about how development affects the rates and ways we use materials. □

Published online: 27 January 2020
<https://doi.org/10.1038/s41563-019-0599-6>

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