



TRACKING CHINA'S URBAN EMISSIONS

China's vast cities are hungry for energy. **Shobhakar Dhakal** discusses emissions with **Owen Gaffney**.

China is now the number one emitter of carbon dioxide, according to the Global Carbon Project. Its 1.3 billion people contribute five percent of the world's gross domestic product and 15 percent of global primary energy demand. But because of a heavy reliance on coal, this equates to 19 percent of global carbon dioxide emissions.

All indicators suggest these statistics, alongside rapid economic growth, are rising sharply and show no sign of slowing. The challenge of controlling these emissions starts with an accurate knowledge of where they are coming from. Shobhakar Dhakal, an energy expert and one of the two executive directors of the Global Carbon Project, has made the first estimate of China's urban energy use in close collaboration with the International Energy Agency.

First, what did you discover about China's urban energy use?

We found that 84 percent of China's commercial energy use is from urban areas, and China's 35 largest cities contribute 40 percent of its CO₂ emissions. Throughout the 1990s it looks like China made rapid progress in reducing the carbon intensity of its economy. But, alarmingly, progress has either slowed or reversed recently.

Across the 35 largest cities, did any patterns emerge?

Yes. Three groups emerged. Cities like Beijing, Shanghai, Guangzhou and Fuzhou have adopted a relatively low-energy consumption but high economic output model. These cities are close to China's coast, the climate is warmer and service industries tend to dominate.

Cities like Xining, Yinchuan,



Dawn over Shanghai

Credit: istockphoto

Guiyang, Hohhot and Urumqi are farther inland, cooler and contain more energy-intensive industries. These are the big emitters. They are basically less developed than the coastal regions. These cities will be flashpoints of tension when it comes to reducing emissions. The third group falls between these two models.

How quickly have coastal cities moved to a less carbon-intensive energy model?

For Beijing, between 1985 and 2006 coal's share of emissions declined from 58 percent to 26 percent. In Shanghai and Tianjin this was 51 percent to 18 percent, and 61 percent to 33 percent, respectively. These are rapid transitions. But this treats electricity as a separate source of emissions. When you count electricity, which mostly comes from coal, such transitions are slower.

I thought natural gas would play a larger role than it does. Beijing and Chongqing have increased their natural gas infrastructure. It forms 4.9 percent and 8.2 percent of their energy systems, respectively. But Shanghai and other cities have not really improved their share of natural gas significantly. I conclude the shift to cleaner fuels is not significant and it has not contributed to the dampening of CO₂ growth despite the perceived impression that the role of natural gas is expanding rapidly in Chinese cities.

Increasing urbanisation is a national priority in China. Does China have a wish to reduce emissions?

China has put a great deal of effort into energy security. Lots of China's efforts at energy efficiency are not to do with climate change, they are to do

with energy security, and, at a local level, to control air pollution. However, these will improve carbon performance in general.

Given the speed of economic growth, Chinese cities fail to reduce emissions in all key sectors: commercial, household and transport systems.

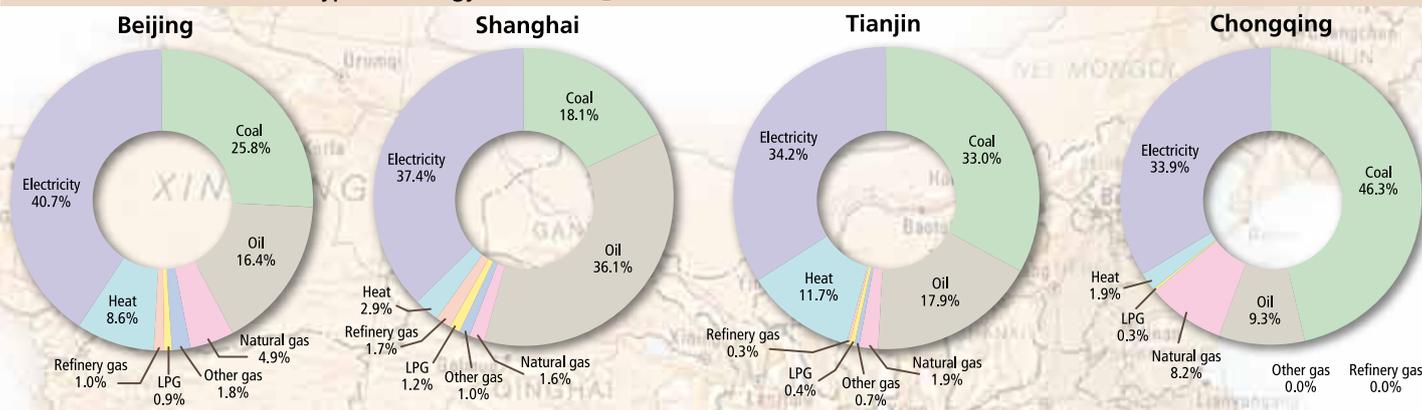
How can China start reducing its emissions?

In the past, even very senior government officials of what was SEPA (now Ministry of the Environment) openly complained that cities compete with each other to attract direct foreign investment and are paying very little attention to the environment. Cities are not serious about reducing emissions as of yet.

National government really needs to provide some comprehensive guidelines for improving the carbon performance of

84 percent of China's commercial energy use is from urban areas.

Contribution of various fuel types in energy-related CO₂ emissions in 2006.



Key indicators and estimated energy and CO₂ of China's 35 largest cities, 2006

	China	35 cities	35 cities' contribution
Total population, million	1314	237	18%
Gross Regional Product (marketprice), billion US \$	2719	1109	41%
Total commercial energy consumption, million TJ	65.7	26.2	40%
Per capita commercial energy consumption, MJ/person (registered permanent population)	50,000	110,771	2.2 times more
Per capita GDP/GRP, US \$/person (registered permanent population)	2068	4681	2.3 times more
CO ₂ emissions (commercial energy-related), million tonnes	5645	2259	40%
Per capita CO ₂ emissions (commercial energy-related), tonnes/person	4.30	9.54	2.2 times more

Sources: Calculated from base data of China Statistical Yearbook (2007) and China Energy Statistical Yearbook (2007).

urban development. They need to provide incentives for cities to optimise urban energy efficiency. The urban planning, building and transport sectors need to grow in a more integrated way, so the total energy demand for the city is reduced.

I think an initial step is an overarching national system providing comprehensive guidance to cities. This is weak right now. Second is to get numbers right. City energy and carbon accounting are not done by cities, and basic information for cities other than big ones is obscure. Proper accounting, scenario analyses and identifying alternative low-carbon pathways are key.

Beijing's emissions from transport have seen a sevenfold increase between 1985 and 2006? What is being done to address this?

Basically little has been done. Whatever they have done they

These cities will be flashpoints of tension when it comes to reducing emissions.

have done for energy security and air pollution.

Beijing is perhaps a less industrial city compared with Shanghai. But it is also more highly motor dependent. A great benefit of the Beijing Olympics was that it extended the subway system and improved other public transport modes such as regular bus services, Bus Rapid Transit systems and integrated transport planning. The policy initiatives aimed at reducing the supply and demand of private motorised transportation are, however, weaker. One such weak policy I see is parking supply and cost which could have much stronger potentials. Road pricing, similar to Singapore and London, could yield good results.

Shanghai's transport emissions shot up tremendously in the same period, despite much stronger control over vehicle ownership and use in the city. The Shanghai authorities have restricted the

number of licence plates issued each year. To register a car you have to bid in an auction for a restricted number of licence plates. But there is a lot of pressure to abolish it.

Are there any underlying patterns going on in these cities?

Yes, there is some sort of structural shift happening. If you look at the manufacturing sector, its share of CO₂ emissions is going down, but the transport sector is going up. Motor vehicles are on the rampage. People are getting rich. They have more money in their pockets and they are all buying cars.

Is there an ideal model they could follow?

I think one city cannot be a full model to another given that all cities are different social, political, cultural, geographical, economic and infrastructure settings. However, big Chinese

cities should be able to look at the Tokyo model for public transportation and mixed land uses. The way the public transport has been developed in Tokyo is quite amazing. It is so good no one thinks about using the car.

How does your analysis of Chinese urban areas, particularly megacities (population greater than ten million), compare with the rest of the world?

We have shown that the larger cities have a disproportionate influence on China's economy and energy use. While they house just 18 percent of the population, they produce 41 percent of GDP and contribute 40 percent of CO₂ emissions (in 2006). This counters the argument that larger cities are getting unfair attention. The opposite in fact, we show that large cities should be the primary target for improving energy security and climate-change mitigation to start with.

Our work on four megacities, Beijing, Shanghai, Tianjin and Chongqing, revealed a number of interesting facts. Energy use and CO₂ emissions have increased several-fold in the last two decades, with the industrial sector contributing the most. While we show that the average per capita urban energy use of China is small, in the case of the megacities, it is huge. In Beijing it is 11.9 tons per registered person a year, Shanghai is 16.7 tons and Tianjin, 12.4 tons. These figures are well above other key cities. Tokyo is 5.9 tons, Greater London 6.9 tons, New York 7.1 tons. The common wisdom that per capita emissions of developing countries are far smaller than developed countries does not seem to hold true for megacities at least. I must also mention that comparing cities is a complex issue – they can be compared with multiple viewpoints and multiple definitions of carbon responsibilities.



What are the key steps China needs to take?

Reduce reliance on coal and move to new technology, such as clean coal technology and carbon sequestration from power plants, if coal cannot be avoided in the medium term. But the second important aspect is to try to address the city as a place where carbon optimisation can be done. In China, everything is looked at from the national perspective and a very much sectoral perspective. So not much thought is going into how to optimise the urban system as a whole, and how they can develop low-carbon cities. Those kinds of approaches are not being discussed as much as they should be.

But our analysis showed that, in 2006, the urban contribution to China's total commercial energy use was 84 percent (similar for energy-related CO₂ emissions). Given such a high contribution, the ratio between urban and rural contributions is huge: 6.8. Similarly, the ratio of urban to national per capita commercial energy use is 1.9. Since the per capita energy use in highly urbanised cities is rising and the rate of urbanisation itself is itself

rapid, it is inevitable that the urban contribution will increasingly determine China's energy use and CO₂ emissions for the next few decades. China needs a comprehensive national strategy for integrated planning for urban development and energy efficiency. This is especially important because urban development led by individual cities in China has been rampant with little thought for environmental considerations and climate-change mitigation.

You are involved in a high-level policy advisory body providing information straight to the Chinese government. Are you optimistic about change?

Yes, I am part of a task force on energy efficiency and urban development (China Council for International Cooperation for Environment and Development). I have also closely communicated with many Chinese colleagues in this area for several years and, if my sample is not biased, most of my Chinese colleagues are very optimistic. Reducing CO₂ emissions is one tough issue but I see strong prospects and willingness to dampen the growth rate of emissions. I am happy to see a positive mood in the scholarly community. Commitment in political negotiations is another matter altogether.

My take on Chinese policymakers is that they want to address the climate issue sincerely. But it is difficult for them to commit and express this openly for fear of being pushed into a corner in the face of international pressure. The need for economic growth is hard to deny and balancing it with climate concerns is something we need for humanity's quest for survival. ■

MORE INFORMATION

Urban energy use and carbon emissions from cities in China and policy implication, *Energy Policy*. Shobhakar Dhakal 2009.

Dr Shobhakar Dhakal is executive director of Global Carbon Project's Tsukuba International Office, based near Tokyo, and leads the Global Carbon Project's Urban and Regional Carbon Management (URCM) Initiative, set up in 2005. He also works closely with ICSU's other global environmental change programmes such as the International Human Dimensions Programme, and contributes to several global assessments.

My take on Chinese policymakers is that they want to address the climate issue sincerely.