



# China: Coming Full Circle



In the wake of the current China-induced recycling crisis in the West, CIWM President, **Professor David Wilson MBE**, recounts his personal perspective on China's journey in waste management and recycling over the last 30-40 years and moving forward...

I have been an avid China-watcher since I lived in Hong Kong in 1982-83, when I led a consultancy team developing the decision support system used in the preparation of their first waste disposal plan. I was a regular visitor to Hong Kong, and occasionally to mainland China, for the next 20 years, and since 2000 have supervised numbers of Chinese Masters students at Imperial College London on their projects.

So, when I was invited as CIWM President to an East Anglia Centre Open Meeting on the current "China recycling crisis", I offered to give some informal opening remarks based on that personal perspective. I found myself challenged when that turned into a full presentation on "40 years in China:

past, current and future perspectives". This took time to research, including data from the invaluable online collection of China Statistical Yearbooks, so I was pleased to be able to reuse it at a North West Centre Open Meeting, and to prepare it for reuse in this column.

We all know that China has developed rapidly over the last sixty years. Up to 1980, less than 20 percent of the population was urban, which rose to 50 percent by 2010, and will reach 70 percent by 2030. Under Mao, economic development was slow, but began to pick up through the 1980s. The baseline year for official statistics is 1978; GDP doubled over the following 10 years, after which agriculture continued growing steadily, increasing fivefold by 2014. In

contrast, growth in both industry and services “took off” from about 1990, showing more than 40-fold increases by 2014; while GDP per capita increased 20-fold.

## Waste Management Up To 1985

A KEY constraint to growth under Mao was identified as raw material shortages. One response was to set up a network of state-run material recovery companies in every city. These achieved very high rates of recycling, covering a huge range of products – including several thousand tonnes per year of human hair in both Beijing and Shanghai, used as an organic chemical feedstock. People separated anything saleable at home, and sold it to itinerant buyers or direct to redemption centres (of which there were 400 in Beijing).

The 1970s system of municipal solid waste (MSW) management has been described as “garbage farming”. With near-maximum recycling rates, the residual waste was largely organic, with high ash content particularly in Northern China in the winter. The waste was taken to local transfer points and transported into the countryside, with 2,282 deposit/composting points around Beijing, from which local farmers collected material for use after further composting and/or maturation.

If the 1970s Chinese system of resource and waste management really did work like this, then maybe it could be viewed as an early example of a circular economy.

My first direct experience came in 1985, when I was invited by the Shanghai Sanitation Bureau, which employed 30,000+ people, to give their senior staff a one-week training course in “modern” solid waste management. I found a system in transition. MSW was collected in bicycle carts or small vehicles, and discharged directly into barges at transfer points before being taken into the countryside. I was absolutely not allowed to visit any of these, which I

believe were rapidly becoming uncontrolled dump sites. I was told that fewer farmers wanted the compost, as new subsidies for inorganic fertilisers had been introduced in 1975 and there were now more visible contaminants in the waste. A particular problem came in summer: there is a huge peak in water melon rinds, from which apparently the initial leachate is phytotoxic, which was killing off the rice paddies around the now overflowing deposit points.

## MSW Management Since 1985

CHINA BEGAN to shift to “market-oriented” operations after 1985. Private companies have gradually replaced the state-owned material recovery companies. The focus has shifted from all materials to selected more profitable materials, with an emphasis on metal recycling from industry. Household recycling went into a downward spiral – redemption centres accepted less materials, the prices were frozen, so there was less incentive for people to recycle as living standards rose, so centres closed, etc.

The demise of the old “circular” system coincided with an explosion in the quantities of MSW collected, from 31m tonnes in 1980 to 191m tonnes in 2015, as urban populations and living standards increased rapidly.

My next snapshot of the developing MSW system came in 2004, when one of my students, Amy Nan Guo, compared Beijing with London, two cities preparing to host the Olympic Games. She found that the 2,282 small dumps inherited from the old system had been replaced by 17 controlled landfills and two small, basic incinerators. Waste composition had also changed significantly, with packaging content increasing since 1984 from seven percent to 47 percent, while the overall (dry) recycling rate had declined from 27 percent to 10 percent. Recycling was now informal, with itinerant buyers and junk shops buying direct from householders.

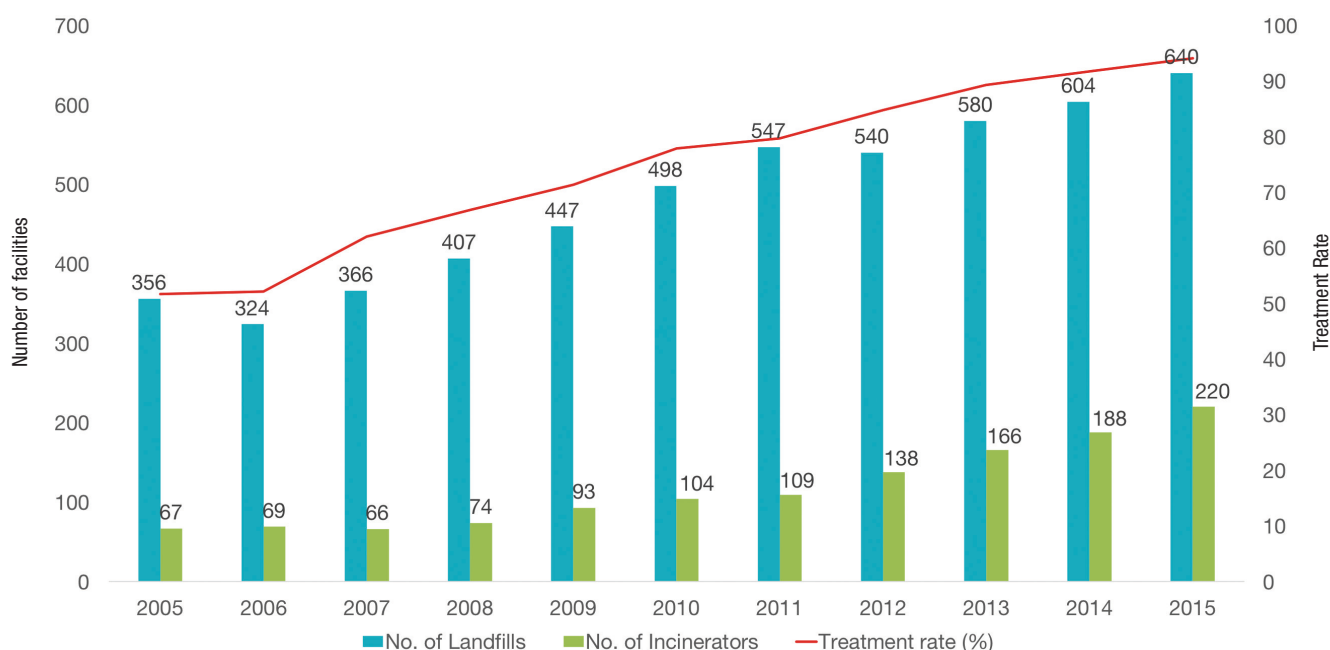


Figure: Development of modern waste management facilities in China 2005-2015 (Source: China Statistical Yearbooks)

The city profile prepared for Nanjing in 2009, as part of UN-Habitat's *"Solid Waste Management in the World's Cities"*, which I co-edited, reported two sanitary landfills, constructed with World Bank finance in 1997, in the course of replacement by two new incinerators of 1000 and 1600 tonnes per day capacity. Another student's application of the Wasteware benchmark indicators, which grew out of the UN-Habitat work, to Nanjing in 2016 showed a high-performing city, with two large, modern incinerators and one landfill, complemented by three smaller district landfills serving outlying areas.

These anecdotes confirm the official statistics shown in the Figure. The treatment rate for collected MSW in controlled landfill and incineration facilities increased from 52 percent in 2005 to 94 percent in 2015; while over the same period the number of landfills increased from 356 to 640 and incinerators from 67 to 220. The standards for each likely increased over the period; the official statistics changed from "burning" to "incineration" after 2009.

So, for MSW management, China appears to have moved from crisis to a relatively modern, well developed system in 30 years, over which time quantities have increased five-fold – which is quite impressive. Unfortunately, the rapid nature of that progress is being used against them. So, for example, the recent "Jambeck" paper in [*Science*] currently being used as the definitive reference on the quantities of plastics entering the oceans, names China as the largest source, accounting for 28 percent of the World total. On digging into the detailed modelling and assumptions, one finds that the data used is from 2004, when they estimate that 78 percent of waste in China was mismanaged. That may well have been pessimistic then, but given recent progress in China, using such estimates today gives a very wrong impression.

## Recycling In China

PRODUCTION OF machine-made paper and board in China increased steadily from 1.7m tonnes in 1965 to 28m tonnes by 1995; after a slight dip, it took off again in 2000, to reach 117m tonnes by 2015. Primary plastics production similarly grew steadily from a low base, reaching 1m tonnes around 1990 and 11m tonnes by 2000, then accelerating again to 78m tonnes by 2015. This provides the background for the surge in demand for imported paper and plastics for recycling, particularly over the last 10-15 years.

When China first moved to "market-oriented" operations after 1985, rapid economic growth was prioritised over health and safety and environmental protection. In the 1980s and 1990s, there was an emphasis on "township and village enterprises" in the countryside, often under state control. These then morphed into what another of my students, Si Hui Zhou who looked at Chinese imports of plastics for recycling in 2012 as an input to an ISWA report, called from the Chinese literature the "three non-enterprises" (or "3-nons"): no rules of operation, no quality standards, no inspection.

Environmental protection in China has been gradually ramped up since the 2000s, starting with large state-owned and private enterprises. So, at the time of our 2012 study, there were in effect two systems working in parallel. Our results showed that imports of plastics for recycling were about 10 percent of primary plastics production, and that domestic collection of plastic wastes for recycling was significantly higher than imports. Our interpretation was that the large companies using recycled plastics to make products for the export market needed the higher quality that could only be guaranteed by imports. Plastic products for the domestic market were at that time made mainly by the "3-nons", using cheap flourine surfactants and other additives, impacting on the quality of the used plastics



Formal sector waste collection bicycle cart in one of 120 small transfer stations in Kunming in 2009. Photo: Ljiljana Rodic.

collected for recycling. Local recycling was also by small, private “3-nons”, often clustered into recycling villages. Operation Green Fence in 2012 was intended to reinforce the official status, and ensure that imports were indeed high quality and were not illegally diverted to the domestic recycling “3-nons”.

Our conclusions at that time were twofold. We saw that some high-quality recyclates were becoming ‘normal’ commodities; so, for example, China and the US were competing to buy high quality PET bottles for recycling, which was partly responsible for putting Closed Loop in the UK out of business as it could not afford to pay the increasing market price. We also predicted that at some point over the next 10-15 years, the quality of domestic plastics collected for recycling in China would increase so that they could displace the need for imports.

Since then, environmental protection has seriously moved up the political agenda in China, both in response to domestic issues on air pollution in cities, and to fill a perceived international void in terms of leadership on climate change. There has been a serious clampdown on the “3-nons”. When I sought photos on the web for my presentation, I found that the infamous Guiyu e-waste recycling village, which had long been targeted by the Basel Action Network (BAN), Greenpeace and others as a major illegal destination for Western WEEE, had been closed down in December 2015. Any companies wishing to continue operations were relocated to a new industrial estate with communal wastewater and hazardous waste treatment facilities, and restricted to treating only domestic e-wastes. Similarly, a typical plastics recycling hub, Luwang village in Shandong province, had been closed down by government inspectors in

May 2017, with a compensation payment being made of 30 percent of the capital cost of equipment in return for closing.

And it’s not just the “3-nons”. All companies importing waste and scrap, large and small alike, were visited by 60 teams of inspectors in July 2017; some were closed down, and all have had their import licences reviewed. New licences under Operation National Sword have been severely curtailed, and are renewable quarterly rather than annually.

So, it would appear that change has come about more quickly and dramatically than we had predicted in 2012, in particular the complete ban on imports of post-consumer plastics. A parallel development is the coming online of significant new plastics production capacity on the US Gulf Coast, fuelled by cheap fracked gas. It is possible that China is content to see a short-term increase in imports of (cheap) virgin plastics, until such time as the quality of domestic recycling improves so as to fill the gap caused by their import ban.

The 1970s Chinese system might have approached a circular economy, albeit on a fairly small scale. China passed its Circular Economy Promotion Law in 2008, which for some years was of interest mainly for its name. It now looks as if China really could lead the world as we attempt to transition to the circular economy, this time on a large scale. ■

David became President of CIWM in October 2017. He is a career waste & resource management consultant, starting work at the old Harwell Laboratory in the 1970s. He then spent 20 years at ERM before becoming independent 15 years ago. David has also been a Visiting Professor in the Civil and Environmental Engineering Department at Imperial College London since 2000.