**Fossil fuel consumption outside the rich countries: research questions**


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**Introduction**

This is part of a research project on the history of fossil fuel consumption globally since 1950. The purpose is to contribute to understanding the drivers of rising consumption, and the failure of efforts to restrain it in the light of global warming.

At the beginning of the period, in 1950, fossil fuel consumption outside the rich world was limited to a few industrialised islands, such as the South African mining sector; the countryside outside the rich world had little or no electricity and little or no motorised transport. This began to change in the 1970s, as developing countries moved by various routes towards urbanisation, industrialisation and electrification.
In 2007, commercial energy consumption (mostly from fossil fuels) by the so-called rich countries’ club, the OECD, fell behind that of non-OECD countries for the first time.\(^1\) The biggest single reason for this was the industrial boom in China. Of course per-capita consumption of fossil fuels in the rich world remains many times higher than in the other countries, but consumption outside the rich world is more than half of the total, and growing.

You have all heard the dominant narrative around the international climate negotiations: that hundreds of millions of people in China, India and other developing countries now want the same standard of living as people in the rich countries, and the danger is that they will consume excessive amounts of fossil fuels as a result.

The presentation aims to question this false logic, by showing that people consume energy through systems – social, economic and technological – and that it is the ways that these systems work, rather than individual choices by consumers, that are the primary driver of the increase in fossil fuel consumption outside the rich world. My research questions concern how these drivers have caused change in the period since 1950. To connect that with the themes of the conference: if we reject approaches that separate society and nature, we should be able to show how developments in social and economic relationships produce so-called “environmental” problems, in this case global warming.

\(^1\) Non-OECD total primary energy consumption (TPES) (about one-seventh of which in recent years comes from nuclear, hydro and renewable sources, and the rest from fossil fuels) overtook OECD TPES. By 2014, non-OECD TPES was 57.5% of the world total. *BP Statistical Review of World Energy 2015*, p. 40. The BP review excludes non-commercial biomass (fuelwood etc) that accounts for 10% or more of total world energy consumption, mostly in the countryside outside the rich world.
The economic and technological systems I will refer to are the largest users of fossil fuels: (1) electricity systems, (2) industrial production systems, (3) industrial agriculture, and (4) cities and their transport systems based mainly on cars.

The slide is based on statistics produced by the International Energy Agency (IEA). I have included as a consumption item the energy used to produce electricity (coloured black), just to underline the point that producing electricity is itself a very energy-intensive process. This energy is used up in power stations and transmission lines and not directly consumed by anyone. The other items show the big role of industry (including blast furnaces and coke ovens and metals and mining). Direct consumption by agriculture is small, but much of what is labelled chemical & petrochemical is used in producing inputs for industrial agriculture. The other significant consumer is residential consumption, mostly electricity going to households.

In the presentation I will offer you some comparative observations and would welcome your comments and criticisms. I will try to generalise. The examples are mainly from the two most populous Asian countries, China and India, and sub-Saharan Africa’s most populous and most industrialised countries, Nigeria and South Africa.

**Electrification**

Two quick general points about electrification. 1. As I mentioned, producing electricity is itself a very energy-intensive process. The efficiency of the most modern power stations is only 60%, and of most power stations, 25-50%. And about 10% of the electricity they produce, usually more than that outside the rich world, is dissipated from cables before it gets to the consumer. There is not much that can be done about these engineering realities;
sustainability advocates say it is important to use electricity only when you can’t find other ways of converting heat or light or motive force into the form you need it. 2. The histories of urban electrification and rural electrification are completely different. Whereas cities, in India for example, have quite often been electrified by private companies, rural electrification has nowhere (that I know of) been undertaken by a private company. Even in the USA, under the New Deal, it was the state that bore the cost of rural electrification.

The slide shows the huge differences between countries outside the rich world, and these correspond largely to the state’s attitude to economic development. China adopted a policy of total rural electrification from the 1970s; the other countries by design or default prioritised urban electrification. Notice that in Nigeria the level of urban electrification has actually fallen since 1991; this is presumably because the system has expanded less rapidly than the urban population has. Some key points about electrification are as follows.
In China, rural electrification moved ahead rapidly from the 1960s onwards. Chinese state policy encouraged the construction of relatively small-scale local electricity plants, mainly hydro, coal and to a lesser extent biodigesters. Although electrification policies were directed at agriculture, and irrigation schemes were significant consumers, it turned out that the lion’s share of rural electricity consumption – nearly two-thirds by the 1990s – was by industry in rural areas. From the 1980s, household consumption in the countryside also grew; by 2004 more than one-third of rural households had washing machines and one-eighth had fridges, although even today there are still more than 300 million people in the Chinese countryside who rely on coal-fired stoves for cooking.

Although the rate of rural electrification in China is far higher than in most other developing countries, the really gigantic increase in electricity production was driven by the industrial boom of the 2000s, a mainly urban phenomenon. It was the main reason for the tripling of coal consumption in the 2000s, shown on the right hand pair of columns.

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2 This huge experiment in state-directed use of small-scale technologies deserves attention in its own right. There is a discussion in V. Smil, *China’s Past, China’s Future: Energy, Food, Environment* (Routledge, 2003), pp. 42-52.

Nigeria is an example of a country without a successful electrification programme. (In the columns showing final use of energy, electricity is represented in red.) The slide shows that the vast bulk of energy is supplied to Nigeria from non-commercial biofuels, i.e. fuelwood etc. The volume of such traditional fuels essentially doubled between 1971 and 1991, and almost doubled again between 1991 and 2011. I have added to the slide a column showing the volume of crude oil produced and mostly exported (black), with a small amount used domestically (grey). In the 1970s, the oil exports were, measured in energy terms, more than twice the volume of Nigeria’s energy supply. By the 2000s, the energy supply was about the same volume as the oil – but note that most of it is fuelwood, much of which is collected by rural women walking hours each day.

Nigeria is the largest-scale example of a country from which fossil fuel resources are exported while the population relies on traditional fuels and is denied electricity. Other examples of the same basic neo-colonial inequality (albeit concerning energy produced from hydro rather than fossil fuels) are provided by (a) Mozambique, where a large hydro project was completed to supply electricity to South Africa, while nearby villages remain in a traditional fuel economy, and (b) Ghana, where the Akosombo dam, constructed in the 1960s, provided power for the manufacture of aluminium for export, decades before electrification of the surrounding area.\(^4\)

In India, rural electrification has made far more progress than in Nigeria for example, but it has been far more uneven than in China. In the countryside, large farms using energy-intensive methods including electric water pumps and chemical fertilisers, have become significant consumers of electricity. But these co-exist with a huge number of poor rural households that carry out subsistence farming with human and animal labour. These households, operating in what is in many respects a separate economic and ecological system of their own, have continued to rely on biomass, that is fuelwood, for cooking, heating and lighting. Electrification schemes have reached tens of millions of households but failed to reach tens of millions more: in 2011, the census recorded that one third of all households (almost all in the countryside, comprising almost 400 million people) had no electricity.5

**Industrial agriculture**

Important issues about rural electrification in the 1970s and 80s and the way that it reflected class relations, have been raised by the historian Sunila Kale.6 Industrial agriculture has a prominent place in the story. Kale researched in particular the states of Maharashtra, Odisha and Andhra Pradesh. In Maharashtra, a strong political lobby, representing well-off farmers in the west of the state who did energy-intensive sugarcane farming and cane-crushing, pushed for rural electrification and gained most from it. They benefited especially from a flat-rate tariff system, based on the size of the farm’s electric pump. In the 1990s, when there was a drive by the central government in India to create liberalised electricity markets, these farmers were largely protected from the effect by local government. (This was indirectly

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6 Sunila Kale, *Electrifying India: regional political economies of development* (Stanford, 2014)
related to the clash between the state government and Enron, whose Dabhol power plant project in the state became the by-word for opportunist gaming of the liberalisation programme.)

In Andhra Pradesh, the political relationship between farmers and the state government was more confrontational. There, rural electrification was only pushed forward as the result of a substantial protest movement by farmers. In the 1990s, that same movement successfully resisted privatisation.

In Odisha, one of the poorest states, electrification in the 1970s and 80s was focused mainly on industrial development and urban consumers; it passed by large parts of the countryside. This was the worst outcome for rural communities, but the best for independent power producers who were brought into India by the 1990s reforms, and invested more heavily in Odisha than in other states.

Some conclusions on rural electrification and industrial agriculture are that (1) it is not only state policy that is crucial, but also social and class forces that both shape and disrupt that policy, as the examples from India show; and (2) that electrification itself reflects social and class divisions. Even within the countryside, there are privileged consumers, such as Chinese rural industry, or better-off Indian farmers, and non-privileged consumers, usually poor peasant farmers.

**Industry**

As I mentioned before, it was the industrial boom of the 2000s that mainly accounts for the huge rise in Chinese energy consumption during that decade. You can see on slide 4 (“Where fossil fuels go”), above, the large volumes of energy used by blast furnaces and coke ovens, i.e. for steel production, by metals and mining, and construction, as well as directly in industry.

A key point about this industrial boom is that it was (and is) export-oriented. Researchers have sought to express in numbers the degree to which it has been driven by rich-country demand for Chinese manufactured goods.

One well-known analysis, covering 2002-08, concluded that 48% of carbon emissions by Chinese industry were “embodied” in exports. Although such calculations can not capture the complexities of industrialisation and urbanisation – and don’t include, for example, the fossil fuels that the workers who migrated to the Chinese coast from the countryside use at home, the fossil fuels used to build those homes, or the more fossil-fuel intensive city economies of which those homes are part – they do point to the scale of the phenomenon.7

In India, although there has been no industrial boom on anything like the Chinese scale, industrialisation and urbanisation have nevertheless been the main drivers of higher fossil fuel consumption. From the 1980s to the 2000s there was a rapid increase in the consumption of electricity, mainly generated from coal. The average growth rate reached almost 8% per year. But most of this electricity was consumed either by industry or in the cities. Notwithstanding all the changes in the countryside that I have discussed, the sharp increase during the 1990s and 2000s resulted, as the slide shows, mainly from mining, industry, construction, and transport, which I will return to shortly.

An important conclusion on industry is that, while writing on “consumer agency” focuses on individual consumers, it is often forgotten that the impact of their choices is dwarfed by the impact of decisions by owners and managers of industry, e.g. about market, or about investment in more or less energy-intensive manufacturing processes.

**Cities and cars**

Urbanisation is a key driver of fossil fuel consumption. A major research project in the early 1980s hypothesised that the energy intensity of cities in developing countries – where each person consumes far less energy than in rich-world cities, but where there are many more people per square kilometre – is about the same as the energy intensity of rich-world cities.\(^8\) It is urban infrastructure that drives up consumption.

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\(^8\) Jeanne Anderer, Alan McDonald and Nebosja Nakicenovic, *Energy in a finite world: paths to a sustainable future* (IIASA, 1981), vol. 2 p. 16. They estimated that cities consume about 5 watts per square metre (or 3504 tonnes of oil equivalent per square kilometre per year) of energy.
The most striking example is of road-based transport infrastructure and the cars that use it. Whereas mass car ownership was solely a rich-country phenomenon until the 1980s, since then the urban middle class, in developing countries and also in former Soviet countries where car ownership was previously very low, have begun to acquire cars in vast numbers. In 2010, the rate of car ownership per person in OECD countries was still well over ten times the rate in developing countries, but car ownership in the latter was rising extremely rapidly.\textsuperscript{9}

Note that car manufacture, as well as car ownership, consumes large amounts of fossil fuels. In Europe in the 1980s, researchers estimated that motor manufacture accounted for between 15\% and 50\% of steel demand in the main car-producing countries.\textsuperscript{10} Since the turn of the century, the figures in China, particularly, may have risen to somewhere in that range.

In the 2010s China has led the way in terms of both car ownership (which rose from 8 million to 73 million in the decade to 2011) and sales of new cars (which rose from 1.9 million to 17 million in the decade to 2010).\textsuperscript{11}

Two of the issues that arise from this are: (1) In many countries, China included, for long periods the state was either absent from shaping urban development and infrastructure (a huge determinant of motorisation trends) and/ or actively supported motorisation. (2) Consumerism – by which I mean the social practice of consuming material goods far beyond

\textsuperscript{9} In 2010 there were 535 cars per 1000 people in OECD countries and on average 47 cars per 1000 people in developing countries. UN Human Settlements Programme, \textit{Planning and Design for Sustainable Urban Mobility Global Report on Human Settlements 2013}, p. 30.

\textsuperscript{10} Andrew Wright, \textit{The Motor Car Industry: a case study in structural change and its impact on energy demand} (Cambridge Energy Research Group, 1987)

\textsuperscript{11} Peter Newman and Jeffrey Kenworthy, \textit{The End of Automobile Dependence: how cities are moving beyond car-based planning} (Island Press, 2015), p. 80; Daniel Yergin, \textit{The Quest}, p. 221.
the amount that could be described as necessary, and the ideas that go with that – is relevant not only in the rich countries, but also in the urban middle class of developing countries.

Some research questions

1. How to better define, in view of the trends described, the drivers of fossil fuel consumption? I am satisfied from my research that statistical methods that focus on consumption-per-head data, as though individual consumers are the main agents, conceal more than they explain. On the other hand, the economic sectors that consume most of the fossil fuels – manufacturing industries, transport, construction, industrial agriculture, the energy industry itself – obviously supply definite demand. There are ways in which they themselves create this demand. But the interaction of these factors needs to be better explained.

2. What about the roads not taken, and what they tell us about the roads that were taken? As I mentioned with respect to electrification, for example, the state plays a key role in infrastructure development, which in turn plays a key role in determining the growth of systems (technological, economic and social) that consume fossil fuels. There are many points at which different policies would have led to different outcomes. Why was so little progress made in developing urban public transport systems? Why was the potential of decentralised electricity systems not realised?

3. From the 1990s, by which time the scientific explanation of the link between fossil fuel consumption and global warming were pretty clear, it is striking that this made so little difference to state policies, either in the rich world or outside it. This needs further research.

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12 This phrase was coined with respect to energy by Amory Lovins in 1976. See A. Lovins, “Energy strategy: the roads not taken”, (Foreign Affairs, 1976).