Energy efficiency: low-hanging fruit for India

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At the Copenhagen Conference of Parties (COP) in 2009, India voluntarily committed to reducing its emissions intensity of GDP by 20–25 per cent from 2005 levels, by the year 2020. Although it is currently on track to meet (and perhaps even overachieve) this target, India faces challenges in sustaining this momentum; its population is rapidly urbanizing, but over 50 per cent still work in agriculture, and a third currently lack access to any form of modern commercial energy. Several factors – such as subsidized energy, delays in the adoption of efficient technologies, a large unorganized industrial sector, and the lack of mandatory building codes – pose further impediments to this target. In this context, energy efficiency could arguably be the biggest determinant of whether, and of the extent to which, India will achieve its target.

Policy vacuum

Globally, most policy attention on the energy sector is concentrated on select areas such as 'energy security' (typically taken as 'security of supply'), pricing, absolute reductions in carbon emissions, and facilitating energy access. The efficient use of energy has not featured very highly on this priority list, although it is linked to the achievement of all of the aforementioned areas.

The IEA *World Energy Outlook Special Report, 2013* ('Redrawing the Energy–Climate Map') in fact argues that four key policy measures can keep the door open to the 2 °C target before a new climate agreement comes into force in 2020. These are:

1 Adopting energy efficiency measures.
2 Phasing out inefficient coal-fired power plants.
3 Minimizing methane emissions from upstream exploration.
4 Partially phasing out fossil fuel subsidies.

Of these, energy efficiency alone could account for 49 per cent of the emissions reduction required to stay on course. Further, investments in the right technologies and low-carbon energy pathways can substantially avoid and reduce the requirement for additional investments up to 2020 and thereafter.

About 93 per cent of the global growth in energy demand between 2010 and 2030 is predicted to come from non-OECD countries (*BP Energy Outlook, 2030*). Within this, India is likely to register the second-highest growth after China. The IEA estimates India's energy intensity at one of the highest in the world at over 0.4 tonnes of oil equivalent per US$1000 GDP. While there are a number of reasons – including the steady devaluation of the Indian rupee by over 33 per cent over the last three years – why this estimate may not be accurate, India compares poorly on this front. Therefore, incorporating efficiency into India's modern commercial energy systems is essential. Yet, no comprehensive policy agenda exists on this vital aspect of India's energy economy.

A recent scenarios-based analysis undertaken by the Planning Commission – 'India Energy Security Scenarios 2047' (IESS 2047) – has estimated that India's total energy demand could be reduced by 25–40 per cent over the next three decades through the adoption of economy-wide energy efficiency measures. The IESS 2047 estimates that India's total primary energy demand could rise five-fold by 2047 to approximately 24,000 Terawatt hours (TWh), in a scenario where there is a failure to act on policy. But this figure could be 40 per cent lower if 'heroic' measures were adopted: encouraging the widespread uptake of technologies such as ultra-super-critical power generation, Electric Vehicles (EVs), and process improvements in the manufacturing sector.

Whilst India grapples with high import dependence (currently a third of consumption, but predicted to double over the next three decades), and strategizes to raise its domestic fossil fuel production, efficient energy use could partially substitute these efforts as a solution towards the country's energy problem. Based on the IESS 2047 analysis, there are several areas where gains from energy efficiency could be achieved.

Scope for savings

Industry is the single largest energy consuming sector in India, using over 2,200 TWh (2012) of primary energy out of total primary energy consumption of 4,905 TWh, with steel and cement accounting for 30 per cent of this. The Specific Energy Consumption of the steel sector compares very poorly with global averages, while that of the cement sector is about average. With urbanization and the expansion of infrastructure, these two construction-linked industries will continue growing. India's current building stock is estimated as representing just 30 per cent of the floor space area that will be in existence by 2030. Steel manufacturing capacity is expected to grow from 90 million tonnes per annum (Mtpa) in 2012 to over 600 Mtpa by 2047. If cement and steel were to adopt more efficient technologies, primary energy consumption from industry could be brought down by 30 per cent from its projected level in 2047 (from 11,326 TWh to 7,960 TWh). India launched an incentive programme under its Energy Conservation Act in 2001; this included an efficiency trading scheme to encourage large industrial units to adopt energy efficient processes. However, it is the unorganized sector (including brick kilns, refractories, and small-scale units) comprising nearly 50 per cent of the total energy consumed in industry, that holds the key to savings. The challenge is therefore to deliver efficient technologies, together with finance for such investments, and to regulate these units.

The *transport* sector accounts for the second-highest energy consumption (850 TWh) but also has the potential for the largest energy savings; these savings could be brought about through policy measures encouraging transit-oriented urban development, shifts towards public transport, and the adoption of EVs. Freight is an important driver of energy consumption in transport, as current policies aim at increasing the share of manufacturing in GDP from 16 to 25 per cent by 2022 (in comparison, it is 34 per cent in China). Therefore, logistical planning and modal shifts could be of assistance in the management of freight and the moderation of energy thus consumed. These measures could reduce the demand for energy in transport by nearly 50 per cent in 2047 (from 6,085 TWh to 3,035 TWh). Efficiency savings measures in transport potentially have positive externalities, in terms of reducing the dependence on liquid fuels, and reducing air pollution in cities. Arguably, policy initiatives encouraging these savings are already in place – for instance, India's 'National Electric Mobility Mission' – but need scaling up.

'… URBAN PLANNERS EXPECT A NEAR DOUBLING OF THE URBANIZATION RATE FROM 30 TO 60 PER CENT …'

India's population is expected to stabilize at nearly 1.7 billion by 2050. On the back of this, urban planners expect a near doubling of the urbanization rate from 30 to 60 per cent of the population, as early as 2030. Urbanization has led to the emergence of the *buildings sector* as a growing energy consumer, using 480 TWh of energy in 2012; however, this consumption could rise nearly 13 times to 6,350 TWh (2047). Efficiency measures could reduce this by 42 per cent to 3,688 TWh. Potential areas for savings in this sector include Heating, Ventilation & Air Conditioning (HVAC), lighting, and domestic appliances. The buildings sector will also continue to be a major electricity consumer, as nearly 25 per cent of the current global figure of 1.3 billion people without access to electricity live in India. Consequently, efficiency measures in buildings, such as in the phasing out of incandescent lamps (similar to the EU and Japan), in lighting and cooling, through LEDs and variable speed compressors in air conditioners – will have positive externalities, aiding the phasing out of kerosene. India has done extremely well in 'star rating' its domestic appliances and has achieved major efficiency gains though this. However, Energy Conservation Building Codes, which present an opportunity to scale up these benefits in the sector, have yet to be mandatorily applied to new constructions.

'SUBSIDIES ARE ENTRENCHED IN INDIA'S POLITICAL ECONOMY …'

Agriculture and cooking together account for roughly 30 per cent of total primary energy consumed. Energy consumption in these sectors is influenced through indirect pathways, such as socio-economic factors and access to infrastructure. Seventy per cent of the population live in rural areas, where the primary energy source is often non-commercial energy (wood, dung) or subsidized liquid fuel (diesel, kerosene). Subsidies are entrenched in India's political economy – diesel helps support pumped irrigation and farm mechanization (mainly tractors), while kerosene supplements biomass in cooking and lighting. The importance of biomass to this constituency is highlighted by the fact that roughly 25 per cent of India's primary energy consumption comes from non-commercial fuels. Due to the poor availability of modern cooking fuels and limited grid connectivity, the agriculture and cooking sectors present both a challenge and an opportunity in terms of energy efficiency. It is difficult to engage with this constituency, due to wide dispersal and large numbers, but nevertheless there is large scope for energy savings. The IESS 2047 argues that the expansion of the electricity grid and the availability of cleaner cooking fuels can potentially lead to the phasing out of biomass. In agriculture, electric irrigation pumps could replace inefficient diesel pumps. Agriculture and cooking hold the potential for a reduction in energy consumption from 2,855 TWh to 1,830 TWh in 2047, or a 35 per cent saving.

Energy, development, and environment

A decision on India's 'energy pathways' could allow policymakers to pursue the goals of economic development in an environmentally sustainable manner. On an aggregate basis, India's energy consumption could rise five-fold from 4,905 TWh in 2012 to 23,679 TWh in 2047 in the 'Least Effort Pathway' in the IESS 2047 scenarios analysis. However, in the 'Heroic Effort Pathway' (discussed above), consumption could rise to a figure of just 14,732 TWh, which is 40 per cent lower than the figure in the 'Least Effort Pathway'. This presents challenges, but the size of the 'prize' of efficiency gains makes the effort potentially worthwhile.

The IESS 2047 scenarios discussed above have not delved into the supply side, where there are challenges that risk constraining or neutralizing the potential efficiency gains discussed above. India's per capita energy consumption in 2011 was approximately 614 kilograms oil equivalent (kgoe) against the global average of 1,890 kgoe (according to the World Bank), indicating scope for India to step up energy supplies to its citizens. Specifically, coal, which comprises two-thirds of electricity generation, remains the 'elephant in the room'. The efficiency of India's coal-based thermal plants (on a Higher Heating Value basis) was just 33 per cent (2012), which is substantially lower than the plants in China and the USA (IEA Energy Technology Perspectives, 2014). India's energy-related emissions (which comprise two-thirds of its total GHG emissions) could rise from the present 1.4 tonnes/capita to 7.6 tonnes (in 2047) in the 'Least Effort Pathway'; this rise could be limited to a lower level of 3.3 tonnes, if policy action to usher in renewables (alongside other measures) is taken on the supply side.

Energy efficiency as energy security

India has arguably responded to domestic concerns over climate change through the adoption of various policy measures. In 2008, the Indian Government announced eight National Missions as part of its National Action Plan on Climate Change, in the areas of energy efficiency, solar energy, water, sustainable habitats, and agriculture, amongst others. India's Bureau of Energy Efficiency (BEE) has statutory powers to implement the Energy Conservation Act across economic sectors, and has earned global recognition for launching schemes aimed at market transformations, efficiency labelling and star rating, and efficiency trading certificates. India's large thermal generation capacity augmentation programme after 2017 will be solely based on super-critical, and later, ultra-super-critical technology. India has also announced Corporate Average Fuel Economy standards for passenger vehicles, effective from 2016.

However, thus far energy efficiency is recognized more as a response to climate change, and separate from the issue of energy security, which is perceived as a bigger challenge. The IESS 2047 scenarios, however, reinforce the validity of energy efficiency as a key dimension of energy security. While 'clean energy' investments in climate change mitigation may be subject to movements in the prices of fossil fuels and national income considerations, energy security is typically placed by nations on a higher pedestal.

On the one hand, India's energy imports are rising, its current account is stressed, and its industries are uncompetitive (the price of power to industry on a Purchasing Power Parity basis is among the highest in the world). On the other, the adverse effects of climate change are increasingly visible with recent unprecedented floods in its Himalayan Rivers, and frequent coastal storms. These twin challenges call for a concerted strategy – with the efficient use of energy at its centre.