

Keeping India's Economic Engine Going: Climate Change and the Urbanisation Question

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Urbanisation in India is both a necessary input and an inevitable consequence of growth. However, we must accept that the existing urbanisation models are unsustainable at the Indian scale and there is no available alternative trajectory. The international climate change negotiations can be seen as an opportunity to create an environment that will help in the discovery of a more sustainable urbanisation. This paper explores a limited set of emergent issues that will have to be considered as India develops its domestic approach to urbanisation, while negotiating its international position on climate change.

It is structured into three broad sections, viz, (a) the feedback loops from urbanisation to climate change and vice versa, (b) actions needed at multiple levels to influence these processes, and (c) the implications of these for India's negotiating position on climate change.

In the multiple transformations that south Asia will undergo over this century, urbanisation occupies a vexed and poorly understood position. It could be both catalysed by climate change, especially through the mechanism of drought and environmental disaster-induced migration; and be a catalyst of climate change via growth, consumption and emission – though probably in a weaker manner than north America, China and Europe. Yet, for India's economic engine to run, as it must if its citizens are to be able to realise their fullest potential, urbanisation is both a necessary fuel and an inevitable outcome.

This paper explores a limited set of emergent issues that will have to be considered as India develops its domestic approach to urbanisation, while negotiating its international position on climate change. It is structured into three broad sections: (a) the feedback loops from urbanisation to climate change and vice versa, (b) actions needed at multiple levels to influence these processes, and (c) the implications of these for India's negotiating position on climate change.

1 The Core Challenge

The processes which lead to an increase in greenhouse gases (GHG) are inherently complex, non-linear processes subject to multi-decade-long lags implying that a decline in emissions may take decades to affect critical climate variables. Urban capital stock exacerbates this by having a highly locked in characteristic, making it difficult to effect changes even over decades. On an urbanising planet, this struggle against climate change will be largely lost or won in the cities of Asia and a few of the Annex 1 countries (developed countries listed in Annex 1 to the United Nations Framework Convention on Climate Change). China and India will play a central role in this because they are redefining the centre of gravity of this planetary urban transformation.

These long lags also imply that mitigation action may already be too late for some of the Indian population, who will be forced to adapt to changes in their physical, resource and built environment. Many weather and geo-hydrological systems, e.g., the Ganga-Yamuna and Brahmaputra river systems, may never return to their current state because of non-linear changes in their boundary conditions. An unalterable change in such systems would be a watershed in the cultural and civilisation identity of the sub-continent. A series of coordinated actions are necessary, all the way up from the household, to state and national level and further into the international domain, if we want to preserve a strong continuity with our past. This will require not only a transformation of the material and energy metabolism of most national, firm

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and city economies; but a change in patterns of consumption, savings and investment and social behaviour in relation to resources in particular, and the global commons, in general.

1.1 India's Role

Over the next 40 years, India could experience one of the most dramatic settlement transitions in history, with its urban population growing from about 300 million to more than 700 million. Three mega-urban regions: Mumbai-Pune-Nasik (50 million), the national capital region of Delhi (more than 30 million) and Greater Kolkata (20 million) may be among the largest urban concentrations in the world (Dyson et al 2004; de Vries et al 2007).¹ This is a potential renaissance in the smaller Class I towns (i.e., those above 1,00,000) and the construction of many new cities ranging from industrial townships to special economic zones (SEZs). This urban transformation has two important relationships to global climate vulnerability:

First, large numbers of India's urban poor and vulnerable households by the late 2030s could well be part of the first generation of climate change-induced environmental refugees fleeing from the drought- and flood-affected regions of rural India, Bangladesh, Nepal and potentially even Pakistan. Many will not find much comfort in these cities, if we continue with our current pattern of development that consigns them to informal settlements located in the more vulnerable locations in the city (Kundu 2003), but they will come to the city nevertheless.

Second, if the Indian middle class aspires to west Asian, east Asian and even Organisation for Economic Cooperation and Development (OECD) standards of consumption using existing technologies, the scale of rise in GHG emissions and potential resource conflicts are clearly unsustainable for both India and the world, even without accounting for China, which will exert an equal if not larger effect.

The focus of much of the attention of the international climate community is on the second, i.e., mitigation challenge, while much of our negotiating rhetoric has been on the first. We, however, argue that, *if a number of social, economic and governance constraints are released*, India, being a latecomer into large centralised scale-economy dominated systems, is placed in a unique position to benefit from the impending sustainability revolution. Such development scenarios could include having a large number (say 15,000) smaller urban areas (up from the current 5,000) with a concomitantly large number of somewhat larger rural settlements (0.3 million, down from the current 0.6 million), matched by a shift to an information-rich network-based gas and renewable energy, water and wastewater and recycling system. This can enable the poverty, development and risk mitigation agendas in high growth environments like Indian cities to be addressed simultaneously. The challenge lies in releasing the constraints.

2 Effect of Climate Change on Urbanisation

Climate change risk is occurring as other environmental transitions, e.g., brown (water, sanitation and environmental health) and grey (air and water pollution), are simultaneously playing out. When taken in tandem with changes in freshwater systems,

it can seriously threaten the global urban culture that draws its economic and social sustenance from them. At the same time, these simultaneous transitions also create a heterogeneous landscape of opportunity to combine poverty reduction with sustainable improvement in the global commons.

2.1 Exacerbation of Existing Risks

Climate change risk in most Indian cities is typically associated more with vulnerability than hazard exposure (Revi 2008). It is primarily expected to increase the frequency and intensity of current hazards and the probability of extreme events, and to spur the emergence of new hazards, e.g., sea-level rise. These new climate-induced vulnerabilities could accentuate and further degrade the resilience of poor and vulnerable communities. It is, therefore, important to understand the multiple ways through which climate change can impact Indian urban residents. These will typically be asymmetric in the impact based on gender, age and ability, accentuating existing vulnerabilities. Some of these channels are given below:

- (a) Loss of livelihood opportunities, and hence, income, directly via an interruption of economic activity, short- and long-term displacement or loss of health and ability to work; and indirectly due to structural changes in livelihood opportunities, including housing, household and financial assets, tenure rights, means of identification and usufruct rights.
- (b) Loss of community and informal social safety nets due to displacement, displacement or forced migration.
- (c) Reduced resilience to future shocks and coping capacity due to frequent risk exposure, negative net incomes, livelihood and asset loss.
- (d) Reduced access to affordable public services leading to higher coping costs and consequent compression of discretionary expenditure and spending on basic needs.
- (e) Greater vulnerability to unsustainable debt exposure and predation by commercial organised criminal and political patronage structures that could expand in times of crisis.

Taken together, this forms a body of mechanisms through which vulnerable households fall in or out of poverty due to income or asset shocks (Fuente et al 2008).

2.2 Effect of Migration

A second-order impact of climate change on Indian cities can occur via migration. Migration in India has been constrained by a number of factors, including (a) high urban poverty levels with dismal living and working conditions due to a crisis in creating higher income urban livelihoods, (b) neglect of rural education, and (c) slow processes of social transformation.

Climate change may force the pace of rural-urban migration. It could turn the ongoing agrarian crisis in rural India into a migratory rout, driven by increases in extreme events, greater monsoon variability, endemic drought, and flooding and resource conflict. Such scenarios have, till date, only been broadly articulated, but not systematically investigated with fine-grained GIS-linked models. Alternatively, the low current level of rural-urban migration can persist due to severe stresses induced in urban areas due to a mix of resource scarcity and disease. This indicates the

potential for climate change to induce bifurcation behaviour in migration, and to that extent urbanisation, trends.

3 Urbanisation to Climate Change

As countries urbanise, their consumption of energy rises. Given the complexity of the many direct and indirect links from urbanisation to climate change, we focus here on the following major channels of increased energy consumption, viz: (a) appliances, etc, (b) building forms, (c) transportation, and (d) water supply and treatment.

3.1 Increased Use of Appliances

Energy consumption in urban households is higher than rural households. While the share of consumption expenditure on fuel and light declines as income rises, the rural share of expenditure is consistently below that of the urban share, with the difference being more pronounced at higher incomes, as seen in Figure 1. The declining share of expenditure on fuel and light, as income rises may imply reduced price elasticity and responsiveness to prices.

For electricity, while the ratio of urban to rural consumption varies widely across states, this ratio is declining over time across states, and especially where there was a large discrepancy between urban and rural areas. By 2004-05, according to the National Sample Survey (NSS), there was no difference between urban and rural electrification levels in six, albeit small states and in 14 others (up from nine in 1993-94), the urban share was less than 1.25 times the rural level.

The Role of Lifestyle: Some of the difference in electricity use is attributable to the possession of consumer durables. As shown in Figure 2, which plots air conditioner ownership among households in the top urban quintile against per capita consumption of electricity across states, it has major consequences for aggregate electricity use. Chandigarh and Delhi stand out as having high consumption and air conditioner ownership. For comparison, however, it is useful to note that the annual per capita electricity consumption of the uppermost quintile in Delhi (which begins at about \$2,100 per capita income in purchasing power parity (PPP) terms) is about 470 kwh, which is a quarter of the average consumption in the United Kingdom (UK) and a 10th of the average in the United States (US).

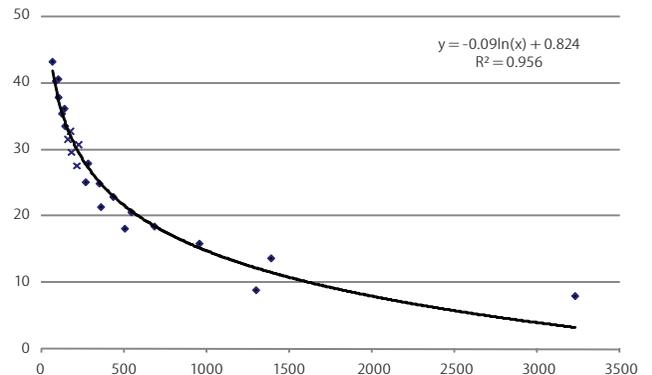
Figure 3, which compares ownership of consumer durables for the top expenditure quintile across rural and urban areas, shows that as incomes increase in rural areas, one can expect to see more use of appliances and vehicles. Once some adjustment is made for income differences,² differences in the ownership of key durables, like air conditioners and cars, reduce considerably. Further, urban consumption may also increase the aspirations of the rural rich.

3.2 Energy Consumption by Buildings

Building Form: The ubiquitous nature of glass and steel construction in aspiring modernist India does indeed owe something to the speed with which glass curtain walls can be constructed

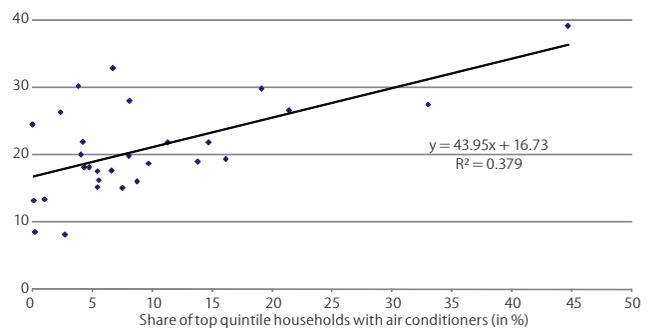
and the increase in productivity that implies for the real estate industry. But much of its commercial acceptability also flows from the widespread acceptance of the aesthetic that underlies such buildings. The role of social values is often significant in determining the form of a building. Despite their aesthetic attractiveness, such buildings often are designed for full time, full space air conditioning, rather than part time, part space air conditioning that is the more familiar pattern of use in Indian homes that have air conditioning. While there are new types of glass

Figure 1: Expenditure on Fuel and Light as a Share of Non-food Expenditure (in %)



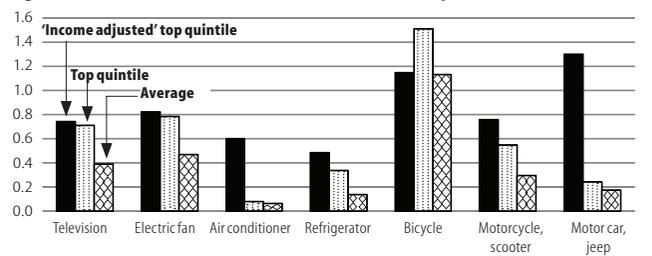
The rural shares are shown as large blocks and are all below the estimated relationship. Source: Data from Report No 509, Parts 1 and 2, i.e, NSS 61st Round 2004-05.

Figure 2: Per Capita Electricity Consumption vs Air Conditioner Ownership



The two right-most points are Delhi and Chandigarh (44.7% and 33%, respectively) with per capita monthly consumption of 39.2 and 27.5 units, respectively. Source: Same as Figure 1.

Figure 3: Ratio of Rural to Urban Share of Households with Specific Consumer Durables



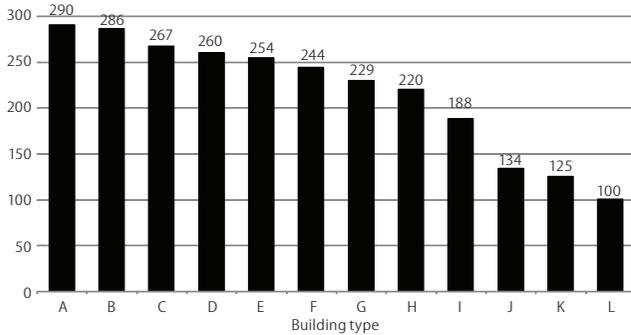
The "income adjusted" ratio refers to the ratio of share of households in the top rural quintile (80th to 100th percentile by expenditure) to the share of households in the fourth urban quintile (60th to 80th percentile by expenditure). Source: Same as Figure 1.

coatings that reduce heat gain while transmitting light,³ widespread use of curtain wall design needs insulated glazing, air conditioning and insulation technologies to offset the heating and cooling loads that come with this form of building envelope. In addition, the embodied energy that are embedded into these building systems, through their extensive use of energy-intensive materials, like cement, steel, glass and aluminium, increase the

carbon footprint of these aspirational spaces, while ignoring the large body of indigenous energy efficient design.

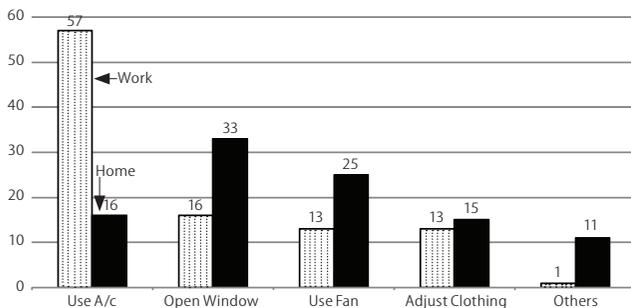
Moreover, the use of green building standards, such as the Leadership in Energy and Environmental Design (LEED), could be inappropriate to the Indian context, in spite of their apparently rising popularity. Domestically developed ratings like the Green Rating for Integrated Habitat Assessment (GRIHA) also exist for sustainable buildings, but according to one estimate, the number

Figure 4: Energy Consumption in Non-Residential Buildings in Beijing (kwh/m2)



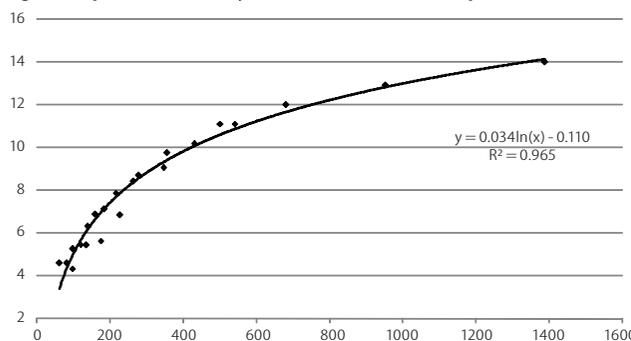
Source: Yang (2009).

Figure 5: Thermal Adaptation Preferences in Taiwan (in %)



Source: Hwang et al (2009).

Figure 6: Expenditure on Conveyance as a Share of Non-food Expenditure (in %)



The uppermost deciles in rural and urban areas have been excluded from the estimation. Once they are included, the fit drops marginally to 0.8272. However, unlike Figure 1, the rural shares are on both sides of the fitted relationship. Source: Same as Figure 1.

of green building area registered under LEED is 200 times more than that under GRIHA.⁴ Scrutiny of standards is especially important given the lock-in effects that flow from the long-lived nature of building stock in urban areas. Aggressive US benchmarks could well be infra-marginal in India, e.g. due to differences in part time, part space vis-à-vis full time full space air conditioning.

Role of Behaviour: There is also considerable role for behaviour in determining actual energy consumption, especially so since

thermal comfort expectations vary widely across cultures. Yang (2009) documents considerable variation across buildings with similar uses and forms, presumably depending on the behaviour of its occupants (Figure 4). Similarly, Hwang et al (2009) presents evidence (Figure 5) from a field survey in Taiwan, documenting sharp differences in thermal adaptation behaviour at home and work.⁵ While the fact that cooling is costless at work presumably plays a large role in this finding, the researchers noted that *only a quarter of workplaces...visited [were] equipped with electrical fan or [had] sufficient operable windows to facilitate natural ventilation*, indicating a strong role for building design.

Data for Indian buildings is not widely available but the Bureau of Energy Efficiency (BEE) is now in the process of establishing reporting requirements for all buildings with a connected load of over 500 kVA or a conditioned floor area of over 1,000 sq m. The BEE has also established a green building code and one expects that the specifications will be validated using actual on-ground performance, as compared to a control stock of buildings using the reported data.

Construction Capacity: Even if one were to understand and appreciate the kinds of buildings that needed to be built, it is not entirely clear that India has the capacity to build them. This reflects the poor quality of training available to construction workers in the country. Despite the efforts of organisations like Construction Industry Development Council (CIDC), most of our construction workers are untrained. Their ability to execute precision high quality construction is therefore questionable.⁶

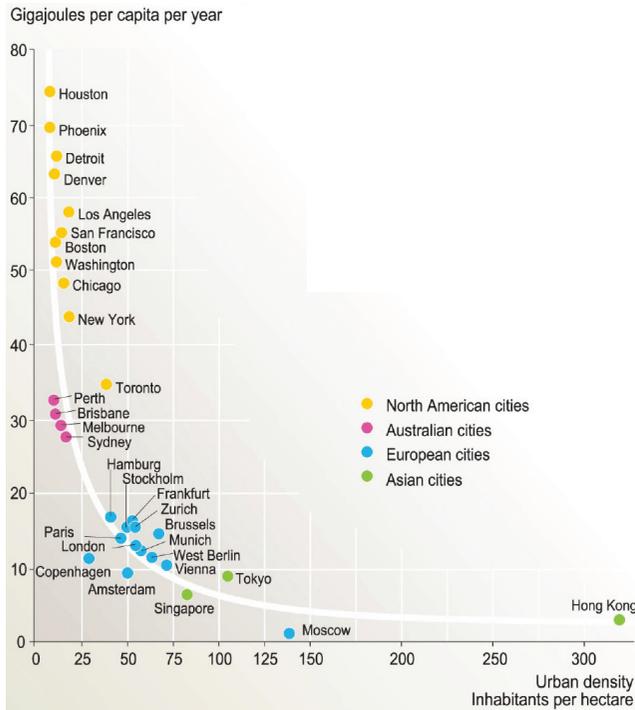
3.3 Energy Consumption by Transport

Unlike expenditure on fuel and light, there appears to be little difference between shares of rural and urban expenditure on conveyance, for a given level of income. Indeed, if the top income classes were excluded, the regression is almost perfect (Figure 6). As a comparison, the share of expenditure of 14% for the penultimate income⁷ class is almost as high as the US, where the share has varied between 15% and 20% in recent years. As of 2004-05, nearly 50% and 16% of the uppermost urban quintile in India own two-wheelers and cars, respectively, as compared to 36% and 3%, respectively, for the next richest urban quintile. As incomes rise, if current trends continue, the use of private transport is likely to increase.

Institutional Factors: Public transport in India is not ubiquitous. Its very presence may depend on extraneous factors. The examination of data for Indian cities from MOUD (2008) shows that the status of a city as a state capital has a significant effect on the availability of public transport (Table 1). Outside the north-east, Raipur is the only capital without public transport, pointing to the critical role of the state government in such decisions.

Table 1: Capital Cities and Public Transport Availability

Capital Cities	Public Transport		Total
	No	Yes	
No	17	36	53
Yes	1	20	21
Total	18	56	74

Figure 7: Urban Density and Transport-Related Energy Consumption

Source: Urban density and transport-related energy consumption (2008). In *UNEP/GRID-Arendal Maps and Graphics Library*. Retrieved 17:09, 1 March 2009 from <http://maps.grida.no/go/graphic/urban-density-and-transport-related-energy-consumption>.

City Form and Settlement Structure: A core assumption underlying city form is that dense compact cities encourage greater use of public transport (World Bank 2009) and are thus better for GHG mitigation. Figure 7 presents the canonical relationship between density and transport-related energy consumption with us cities at one end of the scale and cities like Hong Kong at the other. The sharp difference between European and American cities, referred to in Nivola (1999) is evident.⁸

In India, while linear cities, like Kolkata and Mumbai can benefit greatly from rapid transit corridors, most of the larger cities in India are circular. They, especially if they are multi-focal, are public transport challenges. Most of these cities, like Bangalore and Delhi have a sequence of ring roads and a set of radial spokes. For a transport system to possess the ability to take a person from any point to any other point within the circle, it would need to have multiple modes (e.g., small vehicles, possibly non-motorised, that connect from interior to the ring roads and spokes⁹), predictable and frequent schedules on the rings and spokes and free or low-cost interchanges, so that routes can be customised by the passenger. A few examples of such systems can be found and consequently such cities see growing use of private transport.

The extent to which we tolerate informal settlements also matters. In Mumbai, for instance, Baker et al (2005) find that a high proportion of the poor walk to work, presumably they can live, albeit squalidly, close to their workplaces.

Social Factors: Often, however, much of the decision as to whether one chooses public or private transport is often as much

social as economic and depends on how preferences are constructed. For example, the use of public transport among higher income groups is more in Mumbai and Kolkata than it is in Delhi. These preferences, while taken as given in traditional economic analysis, are also constructed over time and subject to influence, as in current behavioural economic research, and perhaps, especially in transitional societies such as India. The role of such preference construction in the success of policy initiatives is relatively understudied.

3.4 Energy Consumption in Water Supply

In addition to the negative effect of climate change on freshwater availability, increasingly, as water begins to be transported over long distances, as in Bangalore, Indore and now Delhi, a significant energy component is also embedded in water supply. In many Indian cities, even before they begin to treat their wastewater, electricity is among their main expenditures, so much so that in many Indian states, fiscal transfers to them are made after deducting their dues to the state-owned electricity distribution company. When wastewater treatment becomes widespread; it would add to the energy bill.¹⁰ This implies that the existing lower energy use for water in India is at the cost of increased pollution of water sources.

Following the channels identified above between climate change and cities, we turn to possible actions that can help cities adapt to the effects of arriving at the climate change and arrest carbon emissions. A key area of policy for India will be to balance adaptation and mitigation.

4 Action Space in Adaptation

4.1 Urban Climate Hazard Risks

Since the response of the global climate system to mitigation actions will have a multi-decade lag, because of the dynamics of GHG accumulation, adaptation measures are inevitable. A serious challenge to Indian urban climate change assessments is the availability of appropriate downscaled forecast climate change data but even with uncertainty about the precise impact, there is some consensus that the enhanced risks in the foreseeable future (MEA 2005; IPCC 2007a and 2007b) will include (a) increased mean and peak temperatures, (b) changes in the mean, peak and the distribution of precipitation, (c) extreme weather events with associated storm surges, and (d) sea-level rise. These factors independently (or combined) lead to a large set of urban climate-related hazard risks, which, as discussed in Section 2, are an extension or intensification of an existing disaster risk set, for which some level of assessment and intervention already exists. The “units of exposure” in an archetypical Indian city are people (clustered into various socio-economic classes), enterprises, lifeline infrastructure elements, buildings, livelihood clusters and ecosystem services. Among these, populations, enterprises and livelihood groups can be vulnerable for many reasons, viz: (a) location, (b) multiple episodes of displacement, (c) inability to ride out extreme events, (d) disempowerment from entitlements, and (e) lack of capacity for preparedness and community and social safety nets.

4.2 Urban Climate Adaptation Plan

This form of analysis is central to the development of detailed Urban Climate Adaptation Plans for the vulnerable, which should be an important segment of such plans. Some of the concrete policy instruments and programmes that could help the blending of development, poverty and climate change agendas include:

- (a) Enabling new construction to meet climate vulnerability norms. Considerable enterprise and institutional development inputs will be required to make this a reality.
- (b) Technical measures to strengthen and retrofit buildings have both adaptation and mitigation benefits but would take considerable institutional and financial innovation.¹¹
- (c) Improving water use efficiency and conservation in conjunction with appropriate water management practices as a strategic defence against drought.
- (d) Hazard modification by repairing and strengthening strategic flood, storm surge and coastal defences. A detailed analysis will be needed to assess whether these investments are appropriate vis-à-vis other adaptation options.

Finally, relocation and rehabilitation as a climate change adaptation measure should emerge as a policy option *only after all other options have failed*. Planning, market and financial instruments will be needed to adequately address local needs, with the recognition of the rights of residents to compensation. However, today even the most progressive rehabilitation policies, rarely address climate change-related concerns.

4.3 Multi Level Institutions

A city climate adaptation and mitigation plan would ideally need to link national, state and city policy, political and institutional arrangements, and interventions at local levels. It would also need to serve as a platform for dialogue between government functionaries, political leaders, the community-based organisations (CBOs) and non-governmental organisations (NGOs) who are active in trying to channel citizen and community energy towards productive ends, and private entrepreneurs who could provide the motive power for adaptation implementation. A sketch for a possible framework at multiple levels is presented below.

- (a) At the national level it is important to perform the following functions, viz:
 - (1) Articulate a clear definition of responsibilities that enables the integration of a cross-cutting climate change agenda into the national policy planning and investment process.
 - (2) Allocate the finances necessary for the effort and adopt the necessary fiscal measures.
 - (3) Assimilate and aggregate knowledge at a high level of granularity. The development of a national Risk and Vulnerability Atlas that includes climate change-related risks and estimates of potential effects could be an important first step.
 - (4) Assist in the creation of appropriate state and city institutional capacity to execute the adaptation agenda.

Among institutions, the National Disaster Management Agency (NDMA) could serve as a bridge between short- and medium-term risk mitigation and long-term climate adaptation.

(b) As at the centre, in the state, the finance and planning ministries will need to:

- (1) Integrate climate change adaptation into medium-term planning and expenditure frameworks and try to synergise cross-sectoral adaptation and mitigation investments.
- (2) Articulate the role of state finance commissions in enabling transfers and capacity-building within urban local bodies (ULBs).¹²
- (3) Make changes to appropriate housing and urban development, town planning and infrastructure legislations, to integrate disaster and climate change concerns into urban planning and development.
- (4) Build capacity of state public functionaries and bureaucrats in climate change risk assessment and adaptation planning.
- (c) Regardless of actions at national and state levels, structured urban governance frameworks will be necessary to link urban development to climate vulnerability. The current governance structures and the institutional culture are inadequate to this task. One method of operationalising climate adaptation is through a re-examination of city development plans.

None of this is going to happen automatically. These governance developments remain a formidable challenge in a world, where city growth remains tied to surplus extraction from real estate, and where the dominant paradigm does not recognise the interrelationships between the poorer and more vulnerable residents of the city with their better endowed neighbours. Climate change risks will only manifest themselves over a multi-decade period. While this provides an opportunity for pre-emptive actions to reduce the disruption to economic and social development processes, it also carries with it the danger that the *longue durée* may also imply inaction, since its effects and benefits lie beyond the political and perception horizon.

5 Action Space in Mitigation

Many OECD countries, especially Europe, are now engaged in trying to decarbonise their cities. This has led to improvement in energy and resource efficiency in appliances, vehicles and buildings. Some successful behaviour change has occurred, but mostly in small defined areas, e.g., increased public transport use in central London and increased bicycle use in central Paris. However, most such initiatives result in incremental changes, given an existing and locked-in urban infrastructure. The slow rate of urbanisation in India means that much of urban India remains to be built. Can this be taken advantage of?

5.1 Sustainable Habitat Mission

It is useful to briefly review our National Action Plan on Climate Change (NAPCC), which proposes a Sustainable Habitat Mission. It seeks to promote energy efficiency as an integral component of urban planning and renewal, through three initiatives: (a) application of the energy conservation building code; (b) urban waste management and recycling, including power production from waste and waste water recycling; and (c) better urban planning and modal shift to public transport.

Earlier, we had questioned whether green building codes are really green, given the local context. Moreover, we have not been very successful in applying building codes as part of our

standard urban planning. We may, therefore, also want to consider an incentive-based regulation, e.g., impose additional fees on buildings whose energy use exceeds a benchmark, like increasing block tariffs.¹³

On water, urban areas should begin by reducing use; much as India demands that Annex 1 nations offer proof of their resolve to address climate change. The use of pricing to reduce use, albeit a minefield in India, needs to be tackled politically. Freshwater demand should then be further reduced by recycling.¹⁴ Apart from adaptation benefits, the other significant reward from wastewater treatment is the mitigation of industrial abuse of surface and groundwater, which, more than actual use, is rendering water resources unusable for any purpose. The use of urban waste for energy is more problematic. This chimera diverts attention from implementable solutions for waste management, leaving one with a dysfunctional facility and no treatment.

It is not clear how better urban planning will help with our level of implementation. Besides, how will public transportation of indifferent quality with per trip fares compete with the ease and economy of the two-wheeler? If implementation could be addressed, low-cost modern ticketing systems, coupled with better predictability of service (using GPS and SMS technology) could increase the use of public transport. More fundamentally, as noted earlier, the decision to provide public transport is often not that of the city (see Table 1). Another major issue in mass transit is bus vis-à-vis rail. Despite being older technology than the bus, urban rail is an aspirational mode. However, besides being high investment and having a high lock-in character, from a climate change perspective; its embedded energy is high. Despite this, many cities in India are attempting rail-based mass transit, usually in the private sector. Within rail, high speed rail is another double-edged sword. It has not only the potential to increase sprawl, but also a series of compact cities good for local impact and adaptation. Finally, intermediate public transport is neglected, though their low capital cost and capacity allows frequent operation, increasing the overall attractiveness of public transport. Here, allowing per seat fares helps make this mode more poor-friendly.

The issue of parking is at the interface of transport and building. In countries that can enforce parking restrictions, it may make sense to limit in-building parking provisions, to discourage car use. However, in India, where the absence of that capacity is painfully evident, and street parking interferes with traffic flow, adding to the GHG problem, should in-building parking be encouraged or even mandated? Or, should the solution be stricter enforcement of on-street parking? Once one adds the congestion created by violation of traffic rules, it would seem that more and better trained traffic police is an essential component of sustainable urban habitat.

On balance, our NAPCC addresses mitigation issues only partially, though one must reserve further judgment until the first Sustainable Habitat Mission report is released. In their defence, however, one must also accept that these are “wicked problems” (Rittel and Webber 1973); almost incapable of resolution. Indeed, it may be feasible only to ameliorate, not resolve them.

5.2 Wicked Problems in Urban India

There is a good reason, beyond the lock-in effects, why OECD countries are not focusing on city forms, building forms or behaviour patterns, especially with respect to thermal comfort, and transport choices. We do not yet know how does to go about achieving it or even which policy areas we should target. A good, but by no means comprehensive, exposition of this indeterminacy is the analysis by Nivola (1999) of the broad empirical feature that European cities are typically more compact than American (see also Figure 7). He offers a number of possible hypotheses about this phenomenon. It is instructive to enumerate them to illustrate the breadth of action space that exists when one is dealing with urban form.

- (a) Public Security: Abandoning the core city because of a perception of lack of security. This begets the question as to why the core city should be a bed of crime.
- (b) Agricultural Subsidies: In Europe, they keep the value of peripheral land high and restricts the growth of private housing developments.
- (c) Income Tax Codes: In the us, it subsidises home-ownership over renting since interest on home loans are tax-deductible.¹⁵
- (d) Indirect Tax Codes: High fuel taxes and car taxes in Europe discourage personalised travel that sprawl would entail.
- (e) Roads: Investment in highways in the us instead of transit investment favours car use.
- (f) Utility Prices: High electricity prices in Europe do not encourage appliance-rich large homes and industrial freezers needed to compensate the lack of neighbourhood stores.
- (g) Forms of Fiscal Federalism: Limited transfers to local government for local public goods, exacerbated by unfunded mandates on local governments, creates incentives for sub-groups with similar tastes in public goods to opt out and create their own communities.

What makes these explanations “wicked” is that they do not relate to standard building by-laws and master plans but refer to much broader economic policies relating to general tax and subsidy policy that nevertheless seem to have an effect on the urban form, through a multiplicity of channels, which do not offer themselves to easy manipulation.

India has its own set of wicked problems. Though it is necessary for us to think out of the box because the box has proved to be unsustainable, it is unclear as to which aspects of the orthodoxy should be discarded and which should be retained. The subsequent questions in this section should be seen as a point of departure for such a process of inquiry.

Level of Decentralisation: The first of these wicked problems is the relevance of the local government. The 74th constitutional amendment to the Indian Constitution places the tools traditionally used for moulding the city form, viz, town planning, with the local government. But, not only have states not transferred this function to the city effectively, we saw above that city form is affected by not only planning and zoning decisions, but also broader economic policies, outside local control.¹⁶ Despite pious intentions to use it as an opportunity to build self-governing cities, Jawaharlal Nehru National Urban Renewal Mission (JNNURM)

has been largely used as a means to build traditional infrastructure (with a strong focus on water supply and drainage systems), often executed by state government agencies.

But, GHG mitigation is a global public good, and perhaps local governance should not be entrusted with producing it. On the other hand, centralised decision-making can negatively affect the urban metabolism. Putting aside questions of capacity, the replacement of the local by higher levels of government in the climate change sphere has the potential to both derail adaptation efforts and push back mitigation. The right allocation of responsibilities across levels of government remains a vexed and “wicked” question.

Federal Finance and Urban Areas: The responsibility of different levels of government is tied to intergovernmental financing. In the Anglo-Saxon framework, property taxes have been the core of local revenue. Much of the urban reform agenda in India is structured around improving property tax collection. It now, however, appears that not only will climate change require much more investment in cities that property taxes can generate, the tax itself may be responsible for urban sprawl. Arguably, property taxes enables people to organise themselves into communities, self-providing certain services to themselves, leading to the sprawling settlement landscape in the us. This may be less of a problem in India, where the levels of income/property values may not permit the provision of services based on such taxes alone, but it is important to consider what the nature of the federal financial system should be.¹⁷

It can be argued that if the quality of local public goods remains high and equitable, there will be less interest in establishing a separate community. Achieving this requires addressing questions on the quality of service delivery and the appropriate mix of financing vis-à-vis local taxes and statutory transfers.¹⁸ It may appear odd to consider education delivery and statutory transfers as climate change instruments, but they may be much more relevant than traditional measures like better fuel efficiency. For example, only 4.5% of trips in Atlanta are by public transport, compared to 30% in Barcelona. Regardless of how efficient Atlanta’s cars become, its residents will still emit more carbon than Barcelona.¹⁹

Home-Ownership and Transport Demand: In addition to property taxes, the propagation of home-ownership, e.g., through tax benefits, may also cause urban sprawl. The supply of such homes in the core city would involve densification, which, even if it permitted by building by-laws, is difficult to provide, since it involves replacing existing structures. This is usually hard to do, except in countries like China. New homebuyers, therefore, move outside the core city resulting in urban sprawl. Added to this, the new labour market implies multiple job changes. Once a home is purchased, the costs of relocating closer to a new job are high. Over time, this leads to a rise in transport demand.

In this context, increasing the supply of rental housing may prove to be climate-friendly. While many non-pecuniary reasons for neighbourhood preference, such as schooling for the children and quality of neighbours, etc., are not affected by ownership status, renting does reduce the cost of relocation and O’Sullivan and De Decker (2007) indicate that differences in policy of

regulating private housing rentals in Europe do seem to affect the proportion of renters.

To summarise, we have, in this section, argued that aspects of decentralised local governance, intergovernmental and home-ownership all affect the climate change agenda, even though these are not traditionally considered to be climate change issues. As India stands at the cusp of urbanisation, it is important to debate these issues thoroughly.

6 Negotiation Space

6.1 Context

South Asia will have over two billion residents by about the late 2050s, with just over a billion people in urban areas. The entitlements and aspirations of India’s current and future citizens are at stake. Further, in the life cycle of cities major changes in infrastructure elements, planning and tenure regimes occur over a 100-year time frame. So, the emissions time frame for calibration needs to be estimated over 1900-2100; a century into the past and a century into the future. We are thus negotiating on more than just the development and economic options for a billion people; instead we are negotiating on behalf of approximately 150-200 billion life years, i.e., a large fraction of all human civilisation.

To protect these interests, India’s negotiating position needs to be structured around a set of strict boundary conditions. Regional climate security negotiations will be necessary to resolve ongoing and potential conflicts. This escalates the terms of the negotiation beyond standard economic and market-based instruments to that of national security and sovereignty. In this context, these are some non-negotiable conditions that India could bring to the negotiations:

- (a) India’s right to place its territorial, political, economic and resource security before climate mitigation or adaptation regime needs to be recognised.
- (b) India’s right to place poverty reduction, and linked climate change adaptation measures before international mitigation priorities needs to be recognised, especially if Annex 1 emitters are unable or unwilling to achieve drastic reduction in their emission levels.
- (c) India’s right to place livelihood interests of existing and future Indians above international commitments to climate change mitigation needs recognition.

The last two imply that a minimum per capita economic output growth would need to be maintained at least till 2050.

6.2 Key Elements of a Framework

Around these boundary conditions, we can outline some broad elements of a negotiating framework. The following discussion is classified into these broad areas, viz, (a) conditioning on actions by Annex 1 countries, (b) the inclusion of adaptation and mitigation in the scope, (c) the affixation of responsibility on production or consumption, and (d) mechanisms for resource and technology flow.

(i) Conditioning on Actions by Annex 1: Given that climate change has a prisoner’s dilemma structure, it is important to

ensure that the Annex 1 countries do not free-ride. So far, the negotiation has been structured around what it would take for developing countries to adopt some form of mitigation actions. On the side of the Annex 1 countries, the commitment has been to quantitative reductions in emissions. However, their adherence to commitments on this count has not been very encouraging. The current approach gives countries flexibility as regards how they choose to reduce emissions. This is efficient but not effective for monitoring purposes. So, is there a case for committing to actions, e.g., should the US be asked to commit to raising its mileage standards on vehicles (as it is currently trying to do) and impose carbon taxes (as it tried to do in 1993, but failed)?

In any event, it is useful to ensure that India's commitments are related to actual measurable reportable and verifiable reductions in Annex 1 countries.

(ii) Responsibility: Where should the locus of responsibility for emissions lie? Currently, it lies on the production side. This was acceptable in an autarkic world when trade was a small proportion of consumption, but now, it is time to rethink this aspect. Where should one allocate the emissions of an auto-component factory in Pune producing for cars produced in Japan and ultimately consumed by American consumers?

This is not an idle comment. It is arguable that the decline in per capita GHG emissions in some Annex 1 countries could be due to the relocation of GHG intensive production from that country to another, but the product continues to be consumed in the Annex 1 country. Should the concerned Annex 1 country get credit for a reduction of CO₂ emission?

One must however be careful with this argument. If the consumption is actually penalised in the Annex 1 country, the reduction in demand will affect the producing country but the tax revenues will accrue to the Annex 1 country. On the other hand, if the producing country levies the taxes, the economic effects may be similar but the tax revenues will remain with the producing country. However, politics is usually about direct incidence and not indirect effects. So, a green tax on Annex 1 consumers may be more politically acceptable, than an employment-reducing tax in developing countries. In such a situation, the negotiation should be about the mechanism by which the revenues from such taxes will be shared with the developing countries.

(iii) Financial Resource Flows: The core Kyoto mechanism for financial flows across countries is the clean development mechanism (CDM), which has a cumbersome additionality test and a regulatory structure which may be self-defeating (see Wara and Victor 2008). As it stands, if India enacts domestic legislation to mandate clean energy public transport, it would not be able to claim offsets, but if it does so without mandatory legislation, it will be able to. This makes the CDM an incentive to keep green laws off the books. Furthermore, if India focuses on adaptation, even those that have carbon co-benefits, it may not be able to pass the CDM test. So, the questions are:

(a) If CDM continues, should the test of additionality be discontinued or substantively modified, so that it is with respect to a benchmark rather than a baseline?

(b) Should one move from outputs (correct in principle but difficult to measure) to measurable reportable and verifiable actions (given that countries have more control over actions)?

(c) Should one simply put an administrative price on an offset, making it like a carbon tax?

(d) Should CDM be discontinued?

There is arguably a case for discontinuing CDM. In its supplemental submission to the United Nations Framework Convention on Climate Change (UNFCCC) in February 2009, India projects financial transfers of the order of several hundred billion dollars for mitigation and tens of billions for adaptation. It also goes on to claim that flows under the proposed financial mechanism under Article 11 of should be treated as legal obligations and not repayable loans, with developed country governments being treated as assesses. Currently, political circumstances seem unfavourable to paying for what a country may be doing in any case. However, this may change as countries realise that these investments can help to accelerate investments with strong carbon benefits or co-benefits when time is of the essence.

(iv) Scope of Support: Assuming such an unconditional fund could be established, what will such a fund cover? Will it cover water recycling investments? What about gas pipeline networks – absolutely critical for urban areas to make a transition out of coal? Will it pay for supercritical boilers? What about buses for public transport and low carbon cement? More interestingly, will it compensate urban areas for reducing property taxes, assuming the argument against them is accepted? The state governments in India reimbursed their local governments, when they removed octroi, a tax that provided substantial revenue to local bodies but interfered with the free movement of goods. Can such a mechanism be contemplated internationally? How will such a fund be governed?

We have argued above that, given the foot-dragging by Annex 1 nations, a significant warming is unavoidable. The first charge of climate change resources will be for adaptation. Indeed, we may need to undertake various such actions in non-urban areas too, so as not to flood the city with an unmanageable tide of eco-refugees. Must India finance and undertake these necessary but large and expensive adaptation actions using its own resources to retain full sovereignty in determining its policy and programmatic options or is there a via media? Can India establish partnerships to fund adaptation, while retaining the framework of its independent policies? Answers to these, and many other such questions, need to be found in the negotiations.

(v) Technology Transfer: Who pays for the technology? Would a focus on technology transfer imply an engagement with sector-based approaches that we have abjured so far? The compulsory licensing system under the World Trade Organisation Trade Related Aspects of Intellectual Property Rights (TRIPS) regime provides one approach for goods that are privately owned but have a high public value. But, there are other options that can be contemplated.

One can envision a country-specific externally-funded pool with broad conditions on its use – possibly more politically palatable in the Annex 1 countries as compared to unrestricted aid. For those who worry about the fungibility of resources, there are likely to be strong flypaper effects, i e, additionality, if research on inter-governmental finance is any guide.²⁰

Alternatively, there could be direct payments by developed countries to their firms which hold the intellectual property rights. Given the relative bargaining powers of the countries, the deadweight costs of bargaining time are likely to be low, given that the firms interact repeatedly with their own government. One can expect other Annex 1 countries to try and ensure that firms of a specific country are not overly subsidised as a result. Such a scheme could be complicated by the indeterminate nationality of multinationals.

6.3 Domestic Negotiations

Finally, negotiations are not limited to the international domain. Restoring mutual trust across urban and non-urban spaces is equally important. Urban areas are seen as consuming water, land, energy and the environment to the detriment of non-urban areas. Unlike China, where urban areas also consumed these resources rapaciously, the extent of corresponding benefit, in terms of employment, has been much less and the freedom to protest, thankfully, that much more. Actions for adaptation, because it addresses those urban residents who have the deepest connection to non-urban areas, i e, the poor, and mitigation actions, because it reduces the growth in consumption of resources in urban areas, if undertaken sincerely, have the possibility of restoring this delicate inter-sectoral balance. If not, these tensions will find their expression either in the political space or worse, outside it. Mitigation and adaptation thus come with significant co-benefits for the political harmony of the country.

7 Conclusions

Urbanisation in India is both a necessary input and an inevitable consequence of growth. We have argued here that given their historical behaviour and continuing emissions, especially since the Kyoto Protocol, from Annex 1 countries, it is almost inevitable that we shall see significant effects of climate change. These effects are likely to have an impact on our urban residents adversely, especially the more vulnerable among them. They can also lead to increased migration, especially of eco-refugees or discourage migration, by turning cities into even more hostile environments than they already are.

Some of this is caused by our own contribution to GHG emissions from our urban areas. Our urban lifestyle, building design, transportation behaviour, the way our cities now raid water from long distances, our current institutions and some of social values all contribute to a high carbon growth path.

Under these conditions, the immediate primary concern for India is to ensure that our cities adapt to adverse climate conditions and as such adaptation efforts will be privileged over mitigation actions without co-benefits. In this effort, we are constrained by the poor development of our local institutions and our inability to integrate the various different agencies that would need to respond, if climate change risks crystallised. Moreover, the exclusion of the poor from these decision-making structures considerably reduces their effectiveness.

Over the medium term, however, we must accept that existing urbanisation models are unsustainable at Indian scale and there is no available alternative trajectory. However, our approach in the NAPCC, viz, the Sustainable Habitat Mission, suggests that we have not yet decided to look for alternatives. Charting a new urbanisation path, that is dense, public transport-rich and compatible with the surrounding biome, is fraught with wicked problems for which we do not yet have the answers. What we do know, however, is that the answers do not lie in the urban domain alone and that much of

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the conventional wisdom about decentralisation, fiscal federalism and home-ownership may need to be re-examined. Questions of individual behaviour and political institutions to mediate different domestic perspectives will be required. If our implementation history is any guide, though we will not be able to execute any rigid city planning designs anyway. Rather, we need to discover policies, i e, levers that will drive our organic urban growth process in a more sustainable direction. A critical part is the establishment of mutual trust across urban and non-urban spaces. Mitigation and adaptation thus come with significant co-benefits for the political harmony of the country.

In this context, the climate change negotiations can be seen as an opportunity to create an environment that will help in the discovery of a more sustainable urbanisation. Some level of growth, particularly to the extent needed to eradicate poverty and improve human development indicators, however remains non-negotiable. In this situation of uncertainty, with high economic and political costs, it is important to preserve as much flexibility as possible, especially in the light of anticipated expenditures on adaptation, which may even involve catering to regional, rather than just national populations.

Given this context and framework, a number of issues arise that relate to the boundary conditions, basis of acceptance of responsibility, the scope of negotiations, and the mechanisms that can be contemplated at this time. These include, first, the negotiation of safeguard escape clauses related to poverty levels and human development index (HDI) shortfalls as well as national security. Second, for purposes of equity, it is necessary to base commitments on net cumulative per capita emission. Third, a mechanism for large resource transfers have to be in place not only for mitigation, but also for adaptation, with national control over use of “green entitlements” and a move from additionality criteria of CDM to benchmarks, rather than baselines. Fourth, this has to be accompanied by high levels of commitment to GHG reduction from Annex 1 countries that cover actions as well as outcomes. Finally, actions by India need to be conditioned on outcomes of the Annex 1 countries, i e, an actual reduction in GHG emissions in these countries would be a precondition for actions by India.

We must recognise, however, that for a successful transition, negotiations cannot be limited to the international domain. Restoring mutual trust across communities within cities and across urban and non-urban spaces is equally important. Urban

growth in India is underpinned in no small manner by the enterprise of the urban poor. Despite their exclusion from the formal economy of the city they survive and subsidise the better off through their poor living and working conditions. A significant decline in the productivity of the poor could seriously affect a city’s development and competitiveness. Relief for the primary constraints of the poor lies not in the climate sphere, but in the space provided by better and more accountable city governance, democratic decentralisation and improving the functioning of public institutions, the re-creation of the commons through multiple political and institutional struggles.

At a broader level, climate change-induced disruptions will force Indian cities to alter their extractive relationship with the countryside. *RUrbanism* or “keeping the balance between rural and urban areas” could become increasingly important, as resource and socio-economic conflicts becomes sharper (Revi et al 2006). Maintaining two-way flows of food, biomass, water, energy, livelihoods, products and services across this “rurban” continuum will be crucial to the development transition. Climate change strategy for cities may thus need to encompass areas outside traditionally defined urban boundaries.

But, how will these changes happen? Enabling the wide range of changes that have been articulated will require the development of a deep and systemic innovation system that functions within and across particular cities and regions. The fundamental challenge in addressing both mitigation of adaptation to climate change risks come from social and cultural systems. There are significant barriers that typically come from interests tied to existing institutions and structures. Who or what will initiate the appropriate strategic interventions to transform, sidestep or make these agencies redundant? The answer to this question still eludes us. While the autonomy of technical progress, the traditional Marxian initiator of change, has been compromised, it may still be our best hope. Technology can interface with society as digital communication helps a large number of dispersed but common social movements coalesce into a critical mass. Greater equity, access to entitlements and markets, efficient and sustainable public services and access to commons such as knowledge, space, ecosystem services and biodiversity are values that will need to be nurtured and rediscovered in many parts of the world, but equally so, within our borders. Only then can we expect our urban economic engine to enable the fullest realisation of people’s potential in a sustainable manner.

NOTES

- 1 Urban population projections at the city level are notoriously fickle. See, for example, Table 7.1 in World Bank (2009).
- 2 This is done in a relatively crude manner by comparing the top rural quintile to the penultimate urban quintile. The expenditure ratios for the 40th, 60th and 80th rural percentiles, as a proportion of 20th, 40th and 60th urban percentiles are 1.02, 0.92 and 0.87, respectively.
- 3 These have a high Light-to-Solar-Gain (LSG) ratio, which is the Visible Transmittance (VT) value divided by the SHGC (Solar Heat Gain Coefficient). The higher this ratio, the better it is for hot climates. See <http://www.fsec.ucf.edu/en/consumer/buildings/homes/windows/films.htm>
- 4 There are 28 projects under GRIHA totalling 0.13 million sq m while the number of registered under LEED is 375 (26 million sq m). See http://www.teriin.org/events/DSDS/Sus_bldg_paper.pdf
- 5 There were 968 observations gathered at workplaces and 707 at home. The respondents were asked to describe what actions they took to feel more comfortable when they felt warm.
- 6 A study of construction workers in Delhi found that 67% of men and 87% of women were illiterate, with only 3% having a senior secondary level of education. None of the skilled workers, e g, masons, carpenters, etc, were females. See SEWA Bharat (2006).
- 7 For the uppermost income classes, the share is lower, at around 12%. These are somewhat problematic in the NSS, since it is widely believed that they are undersampled.
- 8 Even for this generally accepted presumption, Holden and Norland (2005) offer an intriguing exception. They argue that residents of compact cities tend to be more likely to take vacations in distant places than people who have houses with gardens. They thereby consume more airline travel and generate more GHG emission. The point of this example is not the prevalence or otherwise of this phenomenon, but to illustrate the myriad ways in which behavioural responses may disturb perfectly sensible relationships.
- 9 Para-transit, especially those offered by low-capacity vehicles can often play a critical role in reducing the cost of access to public transport by

linking mainline corridors to residential areas. Moreover, by virtue of being low-capacity, they are able to offer higher frequency, which is essential to attract users to public transport. Similar frequency using high-capacity public transport like buses, would nullify their carbon advantage, due to low capacity utilisation.

- 10 Approximately 3% of total US electricity is used in the municipal water and wastewater sector, which forms a significant share of electricity used by most city governments. Though the treatment of wastewater is significantly more energy intensive than the treatment of raw water for potable use, the amount of electricity to collect, treat, and dispose or reuse municipal wastewater is slightly less than the amount used to collect, treat, and distribute drinking water. <http://water-energy.lbl.gov/node/16>
- 11 Retrofits have rarely been implemented outside OECD cities, but China has recently begun to move aggressively. During the Eleventh Five-Year Plan, it plans to retrofit 150,000,000 m² of existing residential buildings in three areas, viz: building envelope, heat metering and heat source and systems. The intent is to realise an energy saving of 16 million tons of standard coal (33 mtCO₂) by the end of the plan period (Zhao and Wu 2009).
- 12 An open question is the mix between own resources of cities, state level funding and national funding. The JNNURM provides one example of how the financial envelope of cities can change, though it remains mired in the existing three-layer hierarchy of governments.
- 13 The tax cannot be increasing in total consumption because it would discourage density. Furthermore, this assumes, reasonably in our opinion, that the effect of per capita intensity in the use of space on energy demand is negligible.
- 14 This may increase the energy intensity of water, depending on the distance of water transfers. However, California, which uses 19% of its electricity and 30% of its natural gas (non-power plant) to deliver, treat, and dispose of water, has determined that the balance would favour reuse. Within treatment too, a number of options are possible, with biological treatment, e.g. using artificial wetlands that may prove more energy efficient than chemical and mechanical methods.
- 15 Nivola (1999) also argues that to the extent that the US invested in public housing, it was for the most impoverished, concentrating the poor, turning the neighbourhoods into "breeding grounds of social degradation and violence", leading to the sense of insecurity that drove upper income flight into suburbia.
- 16 Recently in New York, the state legislature overruled the mayor's decision to levy a congestion charge in lower Manhattan, demonstrating the limits of actions over which even strong local governments have control. See http://www.nytimes.com/2008/04/08/nyregion/08congest.html?_r=1&hp
- 17 Of course, even without property taxes, it is possible for people to organise themselves into like-minded communities. The growth of "Common Interest Housing" in the US and of apartment condominium complexes in urban India indicate that certain classes of people are quite able and willing to pay for services considered to be municipal responsibilities and consume them at unsustainable levels.
- 18 Discretionary transfers, a la JNNURM can prove to be useful for specific actions and perhaps to advance the time when such actions are adopted, but are unlikely to affect long-term structure, owing to their intrinsically temporary nature.
- 19 To achieve Barcelona's metro accessibility (from 99 km of tracks and 136 stations), Atlanta would need to build an additional 3,400 km of metro tracks and about 2,800 new metro stations.
- 20 The flypaper effect refers to the empirical finding in intergovernmental finance that exogenous grants-in-aid leads for specific items leads to proportionately greater public spending on them than would be expected from a general increase

in income, i.e. recipients do not adjust their earlier spending on the item taking advantage of the fungibility of money.

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