Linking Cities and the Climate: Is Urbanisation Inevitable?

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The fight for beauty is not blind opposition to progress, but opposition to blind progress.
Sierra Club Motto, David Brower (Robinson, 2001)

1. Introduction

The links between cities, urbanisation, globalisation and climate change run deep. Continuing globalisation and urbanisation are reducing the resilience and sustainability of our built environment in the face of climate changes.

Urbanisation is forecast to increase city populations in the global South particularly, in some of the most climate-vulnerable regions of the planet. The process of making these cities bigger has huge carbon emissions attached – both through the carbon embodied in construction, and other products and food imported into cities, which are often excluded from ‘place-based’ estimates of carbon emissions. Yet talk of ‘sustainable development’ and a ‘circular economy’ have not changed the overall way in which we are increasing the scale of our construction, production and consumption of resources and energy worldwide. It appears that only lip service is being paid to the realities of the scale of what climate change will do, and what avoiding its worst effects will require.

While urbanisation, globalisation, and significant infrastructure (especially transport infrastructure) investment continue largely unabated, the visible impacts of climate change, such as the melting of the Antarctic, are accelerating. The climatic imperative to change the pattern of our settlements and development is not reflected in strategic planning and economics. Continuing these ‘business-as-usual’ trends will most likely snowball impacts from isolated local and regional disasters to an avalanche of negative interactions with the global economy, leading to a system failure.

This chapter first explores current urbanisation trends and how these impact on climate vulnerability and carbon emissions. It then explores current economic and investment strategies before addressing what a different way forward might entail.

2. Climate change calls for a different urban form

2.1 Continued urbanisation and its development challenges
Urbanisation is predicted to increase the proportion of the world’s population living in cities from over 50% today to 75% by 2050, with over 95% of this growth occurring in developing countries (Atkins, UCL and DFID, 2015). In many countries, there is strong rural-urban migration, in part due to climate and environmental pressures and changing rural livelihoods, as land is taken for more commercial, export-led agriculture, and in part due to the pull of cities, primarily for work. This is to some extent replicating the urbanisation that has already taken place in many more developed nations.

Urbanisation is increasing the size of not just of the largest, but of all cities. Although more and more people are living in mega-cities, urbanisation is most rapid in smaller cities with 500,000 or fewer residents, which constitute half the world’s urban population (Cohen, 2006). In addition, globalisation has, in effect, added an extra tier of specialised cities on top of the network of capital cities, which is extending the traditional size distribution of cities (Evans, 1972). This phenomenon of ‘global cities’ – how cities interface and drive globalisation - has been explored by Saskia Sassen (2012).

Global trade is locking in much of this new urban expansion in the world’s most climate-vulnerable cities. This is because ports and urban areas often combine as transport hubs. Expansion of cities in low-lying coastal zones could represent a combined population of 1 billion by 2060 (Cohen, 2006).

The location and scale of city expansion are increasing both carbon emissions and climate vulnerability, as well as causing wider social and environmental consequences. As the urban half of the world’s population accounts for some 75% of carbon emissions this reflects the energy and resource demands and pollution impacts which cities place on areas outside their boundaries. And the trend towards larger and larger cities requires increasingly global-scale supply chains to feed their appetites for food and energy, raw materials and consumer goods. The huge distances involved reduce the capacity of cities to survive without external links, increasing their vulnerability.

The United Nations Development Programme (UNDP) highlights the fact that the people with the highest vulnerability to climate impacts are the 40% of urban residents – 2 billion by 2030 – who live in ‘informal settlements’, or slum areas (Klugman, 2009). These include many who have migrated from rural areas where they may not have had to pay for their home, food and renewable resources (as these are partly outside the formal economy), so while the new urban poor may be richer on paper than the rural poor, they often live in poorer living conditions in more (climate) vulnerable locations. There is often a local tension between trying to improve existing urban areas and their rapid expansion often through new informal settlements. Klugman refers to the ‘closed city’ policy of Jakarta, Indonesia and evictions and slum clearances in Dhaka, such as the clearance of 60,000 peoples’ homes in 2007, as an example of how the most vulnerable people are not the subject of long-term city plans. Addressing this growing vulnerability requires different national and global, as opposed to just city-scale, planning and policies which restrict, remove or fail to recognise people living in informal settlements. And that is before the impact of more rapid sea-level rise due to polar and glacial ice melt is reflected in decision making going forward.

Finally, as highlighted above, global carbon emissions must peak far sooner than world population is predicted to peak (currently predicted to keep on rising - to around 9.8 billion by 2050, and 11.2 billion by 2100: UN DESA, 2017). Current rates of urbanisation are projected to increase urban populations to an estimated 6.1 billion by 2050, with demand for
food and water rising in parallel. New et al (2011) highlight that faster temperature rises due to climate change by the 2050s or 2060s could coincide with peak population demands for food and water, magnifying consequences. In contrast, far stronger climate mitigation now will lower overall temperature rises and delay more extreme climate impacts until demand for food and water has (potentially) peaked or begun to decline alongside global population.

In response to these challenges, many are calling for changes in urban form - for a combination of improved city resilience, investment in ‘smart’ technologies, plans for cities to be spatially compact, economically inclusive and lower-carbon, and so on. This chapter is not an analysis of how these can together improve existing urban areas – but of how continued urbanisation links to climate change, and what the alternative to this might be.

### 2.2 How urbanisation increases climate vulnerability and carbon emissions

Predictions (see section above) note that the world’s population is continuing to urbanise. This is increasing carbon emissions and vulnerability through three separate, yet interconnected, factors: increasing the scale of the built environment and how this increases production and consumption of goods, and how these interact with climate change. These are explored in that order below: firstly, the scale of construction, and where these growing cities are located; secondly, the associated impact on the scale of production and consumption; and finally, how these are affected by (and impact) climate change.

**Firstly**, if 75% of people will live in cities by 2050, and global population increases to at least nine billion, as predicted, then this would double the number of people living in urban areas, from around 3.5 billion in 2015 to more than 7 billion by 2050. Assuming national infrastructure investment (e.g. water supply systems, transport networks and power supply and distribution) is proportional to city growth, as opposed to wider population, that means almost a doubling of physical infrastructure worldwide.

And this is before any consideration is given to continued physical development and building work in countries that have already urbanised. Continued investment in increasing the scale of existing infrastructure and buildings, is what underpins continued economic growth in many countries – investment in such ‘fixed capital asset investment’ is not just a feature of urbanisation but a feature of ‘sustained’ economic growth in many countries (Essex, 2014).

This implies a vastly increased demand for resources: timber, concrete, steel, brick, plastics and so on. Such a scale of urbanisation until 2050 implies new construction equal to all the existing urban built environment. This is reflected in predictions by economists – some suggesting that an additional $90 trillion investment in infrastructure will occur by 2030, which equates to more than everything that exists already (Global Commission on the Economy and Climate, 2018).

Assuming buildings continue to be built as they are today, then the amount of ‘embodied carbon’ (even before subsequent ‘in use’ energy) could be enough to cause runaway climate change – even if the subsequent living is zero carbon, with a circular economy and so on. For example, over 50% of Shanghai’s carbon emissions in the early 2000s was due to the construction industry alone (Baoxing, 2007): the urbanisation process is both creating a lot of carbon emissions directly and locking in significant further increased carbon emissions in the future. This would worsen the plight of many moving to cities now and is placing cities at the
fulcrum of a vicious circle between increasing greenhouse gas emissions and climate vulnerability.

Secondly, the scale of energy and resource use in cities should be considered. A number of city-wide studies explore trends in increased in-use energy demand in cities due to climate change (Hunt and Watkiss, 2011). In China, escalating summer peak electricity use is attributed to air-conditioning in cities (Baoxing, 2007). A 1°C rise in temperature in Shanghai is estimated to have led to a 3.67 Gigawatt-hour increase in daily electricity consumption (Li, 2013). The total energy use should consider not just that consumed in a city itself, but how this draws resources from further afield. For example, London’s overall consumption emissions are around twice those produced directly within the city’ physical limits (BioRegional, 2009; based on data from 2004-7).

Thirdly, the average size of cities is increasing. Clearly, cities will be lower carbon if they are compact rather than sprawling in nature (Global Commission on the Economy and Climate, 2014 and the Electric Wallpaper Company, 2004) but their aggregate carbon and resource impacts will still tend to increase as they get larger. The ecological footprint of London was found to be twice the area of the UK, with the average ecological impact of a Londoner higher than the average of those living across the rest of the UK (Best Foot Forward, 2002). Economic structures, including globalisation, allow cities to grow far beyond the carrying capacity of their rural hinterland, through trade links. Cities are becoming more vulnerable as they become increasingly reliant on global supply chains. This vulnerability was highlighted by Andrew Simms, reflecting on the three-day blockade of fuel supply depots in the UK in the summer of 2000 (Simms, 2008). City states (such as Gaza) and city-scale refugee camps (such as the five camps near Dadaab in northern Kenya) are particularly vulnerable, due to their higher dependence on food and resources from outside. This could be an issue as climate impacts threaten the scale and reliability of global food supplies, whilst climate change itself is increasingly a factor in the displacement of people within and between countries (World Bank, 2018).

Finally, whilst there is significant discussion about the need to divest from what will become 'stranded' fossil fuel assets, the types of infrastructure and places that rely on high levels of fossil fuels to supply energy should also be explored: some major cities and their global supply chains will become unviable. We should question whether it is sensible to continue to invest in climate-vulnerable mega-cities worldwide. This is explored in the next section.

2.3 Climate change is already increasing the vulnerability of cities

A disproportionate number of major cities are in vulnerable low-lying areas. Climate effects are converging to produce multiple impacts on cities, particularly those continuing to expand in the developing world (Atkins, UCL and DFID, 2015). The top five cities in terms of population exposure are all in Asia: Kolkata and Mumbai in India, Dhaka in Bangladesh, Guangzhou in China and Ho Chi Minh City in Vietnam.

Rather than policies to avoid expanding cities in such vulnerable locations, however, the current approach remains an incremental response which prioritises improving the (short-term) resilience of cities and other settlements to climate change impacts, rather than transforming the relationship between cities and climate change. City-wide visions that do combine environmental sustainability and resilience still rarely challenge the notion that
urbanisation should continue, which would conflict with wider politics and economics. This ‘a better business-as-usual’ approach assumes that it will always be possible to address climate risk incrementally – and that this is a credible alternative to directing development away from cities, which have economic importance.

Cities which are already highly vulnerable to climate-related disasters continue to develop. Examples include Dhaka (Bangladesh), Dublin (Ireland), Karachi (Pakistan), Bangkok (Thailand) and London (UK). These large economically important cities remain main focal points for investment and growth, even though they are already highly vulnerable to climate impacts including flooding, drought and sea-level rise. This may turn out to be a foolhardy approach. A good case study might be the medieval town of Dunwich, once the tenth largest city in England but finally lost to the sea after a series of devastating storms in the 13th and 14th centuries.

What would be the impact of a series of mega-storms today? And what if they were to affect many global cities simultaneously? By the 2070s there is a 99.9% chance of at least one city ‘being affected by a 1:100 return period event’ every five years – which equates to recurring city-scale disasters at the global scale (Hanson et al, 2011). What if business-as-usual climate emissions led to progressive failure of the West Antarctica Ice Sheet and around 7m of sea level rise in a relatively short time? This surely would have a major impact on trade and global supply chains, forcing a radical shift in the pathway for development – albeit a shift that would be possibly too late to avoid dangerous climate change! Might an appreciation of the true scale of these future risks galvanise a sufficiently radical shift in our approach to economics, planning and development today?

One typical aspect of current export-led economies, with development tied to globalisation, is the need to develop key transport infrastructure: principally national road and rail networks, airports and ports. Yet although 13 of the 20 largest cities worldwide are port cities, there has been little preparation for such future climate events (Hanson et al, 2011). Meanwhile, the increasingly airport-led focal points of globalisation (Freestone, 2009), combined with the continued scale of global shipping’s impacts could lead carbon emissions to spiral further out of control.

This lack of foresight is also reflected in international aviation and shipping still being excluded from international carbon agreements, 25 years after the international climate negotiations started in earnest. This leaves the key relationship between urbanisation, globalisation and climate change excluded from strategic economic planning. Climate scientists, Kevin Anderson and Alice Bows-Larkin (2012) describe the challenge for shipping and climate change as requiring a Scharnow turn (that is a man-overboard rescue turn, passing a point previously passed through). But is climate change a consideration in international trade deals, establishment of export processing zones or customs arrangements? Together, these questions point to a need to re-examine seriously the climate consequences of binding together the world’s cities through the current scale of international trade.

2.4 Enhancing ‘disaster resilience’ - prioritising short-term risk over longer-term sustainability?
One response to the increasing frequency, severity and unpredictability of disasters has been the growth of a new discipline: disaster risk reduction. The potential strategies for improving resilience are, in theory, many and varied. The approach taken varies from financial (disaster risk insurance) to focusing on improving the physical resilience of communities or assets, including through better maintenance, strengthening community resilience and that of overall infrastructure systems (including strengthened participation, early warning systems, disaster preparedness). However, the tendency is still predominantly to increase the resilience of settlements and infrastructure where they already are, in ways that do not challenge the direction of future development.

Firstly, risk insurance puts aside money in case a disaster hits but does not automatically lead to planning or actions to reduce the likelihood of disaster. This approach tends to sit alongside continued economic development, changing the direction of development only incrementally, if at all.

Secondly, improving the resilience of the built environment tends to invest further in what is already built, often reinforcing existing infrastructures and behaviours, using the same materials and solutions. For example, using common building materials such as reinforced concrete, welded steel and bricks bonded together with Ordinary Portland Cement (which is stronger than traditional lime mortar) in disaster-prone areas limits how much can be reconstructed after a disaster. Similarly, disaster risk is often reduced by increasing the size of existing bridges or sea defences, with wider economic activity largely unchanged.

Such an approach might improve resilience in the short-term but could be catastrophic at some point in the future. For example, the current practice of adapting to climate change in Bangladesh includes progressively raising road embankments for national roads to sit 0.5m above the historic maximum flood level. This means roads running east-west increasingly constrain flood waters in the rivers flowing north-south. Similarly, raising sea walls can protect inland areas from coastal flooding (e.g. in Guyana, the Netherlands, eastern England), which might reduce the likelihood of extreme events in the short term but may not suffice in the longer term.

Kolkata, India: The danger of optimism and incremental change

One increasingly common approach is to integrate climate resilience into planning, at the city scale. The approach currently being taken by Kolkata, India – the city considered the most vulnerable to climate change globally by 2070 (Doig and Ware, 2016) – is typical. The recent Road Map for a Low Carbon and Climate Resilient Kolkata (Price Waterhouse Coopers, 2015) is based on a predicted sea level rise of 0.27m by 2050, which is based in turn on science already a decade old. Even on this basis, the annual expected climate-induced flood damage in Kolkata could be US$5 billion by 2050 (Dasgupta et al, 2013 based on modelling by IPCC, 2007). But what would be the human cost if the true extent of already locked-in sea level rises were factored into city planning? The last major floods in Kolkata in 1978 put much of the city several metres under water – what might happen in the future?

Kolkata is not unique in basing its planning on decade-old data. Most policy is based on IPCC reports, which lags behind peer-reviewed papers, which lag behind the most recent research. This means there is still a lack of sufficiently long-term, realistic planning, and little to redirect urbanisation away from making mega-cities even larger, increasingly in climate vulnerable locations.
Bangladesh is among a growing number of countries (including many small island states) where the impacts of climate change on physical infrastructure and people’s livelihoods are already critical and are reflected in increasing vulnerability both in rural areas and major urban centres, as well as through current urbanisation.

Climate change appears to be accelerating migration to informal slum areas in the capital city, Dhaka. While it is clear migration underpins urbanisation, which has led to growth in the Bangladeshi economy, it is not clear what has driven this migration – is it the pull of the successful garment sector or the push of climate change?

Some suggest that Bangladesh’s ‘development surprise’ is driven by the successful ready-made garment industry, which has expanded at over 15% a year since 1990, driven by rural-urban migration as a means of delivering upward mobility for economic migrants (Mahmud, Ahmed and Mahajan. 2008). Around 70% of the 4 million garment workers on whom Bangladesh’s garment trade depends are migrant women. However, some challenge this causality and argue instead that it is climate displacement and not the pull of cities that drives migration into the city slums of Rajshahi, Khulna, Chittagong and Dhaka (Shadsuddoha et al, 2012; Kniveton, Martin and Rowhani, 2013). Sassen (2014) goes further, tagging these migration trends not so much as positive choices but as being about the expulsion of people from vulnerable rural areas, due not least to climate impacts.

The process of displacement is often triggered by major disasters. Displacement Solutions in Bangladesh (2012) recorded that of the 60,000 people internally displaced by Cyclone Alia in 2009, 25,000 were unable to return to their houses and, with little access to new land, tried to live on a 25km long, 2m high and 3-4m wide embankment. For these people, a cyclone shelter is insufficient: they need somewhere to safely build a house and secure a livelihood. Many instead chose to leave a precarious rural existence and head to cities. Research by Shamsuddoha and Chowdhury (2009) highlighted that even a 1-2°C increase in temperature (which could still equate to avoiding dangerous climate change) would force physical dislocation of more than 35 million people in Bangladesh alone.

But the current main destinations for Bangladeshi migrants, Khulna and Dhaka, are both close to sea level. Expansion of the built environment in Dhaka into its lowest lying area, which was previously set aside as flood plain, will increase future disaster risk (Haque, Grafakos and Huijsman; 2012). Migration to these cities which, like 90% of Bangladesh’s land area, are less than 10m above mean sea level, will increase overall vulnerability. The last storm surge over 10m high in Bangladesh was in 1970 and killed around 300,000 people.

### 2.5 Conclusions for Section 2

Bangladesh’s continued rural-urban migration to fuel the garment trade highlights the risk of a short-term economic strategy. Similarly, the inadequate sea level rise projection used in Kolkata’s urban planning highlights the risk of focusing on short-term resilience at the expense of long-term sustainability.

Reduced agricultural production due to climate change could mean migration from heat- and drought-stressed areas in Africa and coastal areas at risk of flooding, as explored above. But what if the people moving in this growing mass migration find themselves increasingly
hemmed into large, resource-insecure and climate-vulnerable cities? One possible future will see Bangladesh’s major cities (and those of many other low-lying countries and small-island states) increasingly functioning as export processing zones, where internally displaced people are exploited as cheap labour by financial interests mainly based elsewhere in a globalised world.

So, while people can, in the short term, relocate from rural to urban areas, or across borders, as crops fail and deserts advance, this could escalate the number of fragile cities and states and hence increase conflicts in the longer term. The direct consequences of climate change (e.g. flood, storms, extreme heat) also have knock-on effects, notably food and water insecurity, turning natural disasters into complex emergencies. Climate change is already having an impact on conflict, security and fragility, for example in Darfur (Sudan) and in across the Sahel. Climate has also been identified as playing a complicating role in more recent conflicts following the Arab Spring, though no conflict has a single explanatory factor (Peters and Vivekananda, 2014).

Responding to climate change from an adaptation point of view alone tends to be short-term, and insufficient, as unless the world collectively eliminates global carbon emissions there will come a point when adaptation is woefully inadequate and the resource capacity to sustain humanity will plummet. Relocation alongside competition for scarce resources presents an undesirable future for many.

However, an alternative still exists, and this is sufficient adaptation and mitigation of climate impacts together – and for this to apply to strategic planning beyond the scale of the city. Alternative approaches to reduce the exposure of a city to climate impacts could include upstream catchment management or coastal mangrove regeneration – widening the ‘area of influence’ to be considered when exploring alternatives. The question of how much more inclusive decision making should be is explored in the next section.

3. Current economic planning encourages urbanisation

3.1 Urbanisation – driven by infrastructure-led, not climate-led, investment

Most infrastructure investment decisions do not prioritise addressing the gap between climate science and current actions: instead investment is often proposed to meet a so-called ‘infrastructure gap’. This means continuing to scale up infrastructure investment overall to enable continued urbanisation and globalisation of the economy. For example, the Programme for Infrastructure Development in Africa (PIDA)’s priority action plan is valued at $65-70b, over 50 times the scale of the African Development Bank’s Pilot Programme for Climate Resilience. Similarly, the UK’s National Infrastructure Commission’s plan (HM Treasury, 2014) focuses on the so-called ‘gap’ in infrastructure investment. They do this because capital assets are crucial to sustain increases in production and consumption levels, thereby sustaining economic growth. But investment in long-distance transport infrastructure and fossil fuel energy extraction capacity directly increases carbon emissions, thereby reducing long-term climate resilience globally (Essex, 2014). This approach sees climate resilience as a constraint on investment. Such planning and investment decisions are not governed by the UK’s national five-year carbon budgets, even when they directly increase carbon emissions. Instead, the UK has a strategy to ensure that infrastructure is resilient for a
changing climate, an approach which, if combined with inadequate climate mitigation globally, will underestimate the scale of climate adaptation required in the long-term (UK Government, 2011).

In the UK, a National Infrastructure Plan and Industrial Strategy now inform how infrastructure can grow the scale of the UK economy (HMG 2014, 2017). The former contains over 100 large infrastructure projects, including adding third runway at the UK’s busiest airport, totalling £377 billion of public and private investment. Alongside such large schemes investment in the UK energy sector is shifting to smaller, decentralised generation, but subsidies are encouraging this sector to speculate on exploring for unconventional oil and gas extraction rather than investing in large-scale deployment of onshore renewables. Although there is now a shift to electric car sales (up from 3,500 registrations in 2013 to 150,000 by May 2018), this is not matched by a modal shift to public or active transport, or by any reduction in freight impact.

In contrast, research for the Organisation for Economic Co-operation and Development (OECD) argued that the focus of investment should extend beyond the climate resilience of infrastructure to investing in infrastructure for low-carbon and climate-resilient development (Corfee-Morlot et al, 2012). This research states that we have a unique opportunity to shift investments towards low-carbon and climate-resilient infrastructure, to finance the transition to a low-carbon, climate resilient economy. Similarly, research by Hagemann et al (2011) states ‘there is a need to bridge the gap between tools for adaptation, mitigation and development (…) to integrate adaptation, mitigation and development at different levels and across geographic regions.’ Therefore, zero carbon and climate resilience should be embedded when investment choices are selected, rather than added to traditional investment plans that scale up existing, particularly transport, infrastructure.

Estimates for the scale of ‘green’ investment requirements are still substantial. In 2010, Ernst and Young estimated that the UK needs to invest some £450 billion in low-carbon development until 2025, split evenly between £225 billion in the energy 'supply side' and £225 billion in the energy efficiency 'demand side' (TUC, 2011). The Global Commission on the Economy and Climate (2014) estimated that $93 trillion of infrastructure investment is needed in transport, energy and water systems, much of it in cities, to meet global infrastructure needs in the next 15 years, while also ensuring the transition to a low-carbon economy. This reflects the mainstream focus on continued growth alongside efforts to make existing cities more sustainable, inclusive and lower-carbon. Similarly, the OECD (2015) notes that to meet the 2°C climate target, energy efficiency investment needs to increase eight-fold by 2035 compared with 2013 levels. This suggests that investment in low-carbon and climate-resilient infrastructure, as opposed to overall ‘infrastructure’ spend, should be accelerated.

But this is not happening. The tendency worldwide is to focus on the infrastructure-gap, to include resilience in this, but to limit the focus on mitigation to low-carbon energy and not to consider the lock-in of carbon emissions from infrastructure investment in general.

3.2 Economics first, climate change (and people) later or absent

The general distortion of investment detailed in the previous section is occurring because climate change is:
firstly, not the priority of most strategic economic planning; and secondly, often under-estimated or excluded from economic models that underpin such investment decisions.

Nicholas Stern (2013) contended that economic models further limit risks by assuming ‘only modest damages from climate change and narrow distributions of risk,’ and he recommended that new models are required. The most commonly used economic modelling underestimates economic impacts due to unrealistic assumptions. Dietz and Stern (2014) highlight how the widely-used Nordhaus model of climate cost-benefit predicts that 18°C of warming (yes, that is what it predicts!) is required to reduce global output by 50% – a massive underestimation of explicit and large climate risks – as 1.5-2°C warming is considered extremely dangerous by climate scientists.

Another problem is that investment rarely considers the full carbon emissions and climate impacts over the whole lifespan that infrastructure is predicted to last, and how long cities are expected to remain in their current location, but instead focuses on a ‘return on investment’ period. The latter tends to be incredibly short. For example, the World Bank’s typical benchmark return period for transport infrastructure investment decisions is a 12% internal rate of return. This means that globally significantly infrastructure investment is typically designed to ‘pay back’ financially in 6-7 years – so climate impacts are rarely a governing factor. Similarly, investment to create new ‘economic corridors’ tends to connect cities, rather than cities to their rural hinterlands (for example in UK, Europe, Nigeria and Asia: HM Treasury, 2018; EU, 2015; World Bank, 2018; Brunner, 2013). Upfront investment in infrastructure is then justified in terms of economic returns from rising land-price values realised through subsequent real estate investment and continued urbanisation. Such projects are not constrained by climate impacts – short or long-term. Economic discount rates make matters worse. For example, cost-benefit analysis using the net-present-value approach that accounts for climate impacts can show increased viability of many projects, which cannot even be justified based on current weather data (such as in Kolkata: Dasgupta et al, 2013).

And this approach risks not just failing to address the challenge posed by climate change, but locking-in the status quo. The 2014 Intergovernmental Panel on Climate Change (IPCC) working group 3 chapter on human settlements, infrastructure and spatial planning (Seto et al, 2014) noted that:

"The global expansion of infrastructure used to support urbanisation is a key driver of [greenhouse gas] emissions across multiple sectors. Due to the high capital costs, increasing returns, and network externalities related to infrastructures that provide fundamental services to cities, emissions associated with infrastructure systems are particularly prone to lock-in ... especially for energy and transportation infrastructure.

Avoiding this requires all strategic investment plans to prioritise both climate resilience and low/zero carbon investment - together. This requires an entirely different pattern of investment, and subsequent development.

The reality is that current investment trends amplify the risks of runaway climate change. This is rarely reflected in the economic models and national-level spatial planning that guide economic investment decisions. If this was the case it would be transformative – as investment would then be limited to that which explicitly reduces carbon emissions. As these numbers are not translated into rules-of-thumb or modelling that informs mainstream
economic decision making (e.g. level of concrete, steel and brick use in national carbon reduction targets; impact of 1-2m sea level rise on combined storm surge and sea level rise flood risk), climate considerations tend to be entirely excluded from decision making, or at best limited to carbon reduction targets that lag behind current climate science or estimated impacts that underplay long-term impacts.

So, it is fair to assume that urbanisation is inevitable unless economics is changed. Current economic development strategies tend to create jobs and higher value-adding economic activities in cities, particularly those with global transport connections – whilst increasing inequality as migrants move into poorer living conditions in informal settlements that are often highly vulnerable to climate change. Globally, current patterns of development will lead population growth to still be focused on existing, including highly climate vulnerable, cities – either expanding principal economic hubs or expanding the population of commuters living in satellite cities and towns. There is a need to shift investment from increasing resource use, inequality and climate change to prioritising the creation of a climate-resilient, sustainable and fair future. This will require different economic tools, processes and decision making.

**Automation and Financialisation won’t help address climate change**

So how might widely mooted plans for increased automation, from driverless cars to industrialised agriculture, affect this? Most automation also requires continued or expanded infrastructure investment. Tim Jackson (2018) argues that digital and robot technologies may turn out to be in direct competition for investment with measures essential for the transition to a zero-carbon future. Jackson notes that investment in automation may remove the need for whole sections of the working population, while likely having a higher carbon and resource footprint (as more capital assets are required).

Paul Mason (2015) is optimistic that a technology-driven ‘sharing economy’ will empower workers to fight financial capitalists in new and powerful ways. However, Rana Foroohar (2016) is far less optimistic, noting how Apple itself can invest to sustain its own financial pre-eminence and how Uber’s research into autonomous vehicles would benefit tech-giant owners at the expense of employees. Similarly, the expansion of renewable energy, including across Africa, is dominated by corporate interests, including oil and gas companies (CB Insights, 2018) – but this has tended to sit alongside existing fossil fuel investments, rather than transform overall development pathways (including urbanisation).

Another trend, exemplified by the level of debt up to and since the economic crash in 2008, is an increased financialisation of the global economy. Increasingly economic growth is in non-tangible assets, or asset price inflation (such as reflected in housing and real estate markets). Similarly, one climate insurance fund in the Caribbean recently returned over a third of the premiums paid as profit to the insurers – financialisation does not tend to put current, let alone future, generations’ interests first (Jubilee Debt Campaign, 2018).

This increased financialisation of the economy is also reflected in more traditional sectors. For example, BP now makes over 20% of its profits from its financial trading division Foroohar, 2016). This trend is increasing the importance of cities, and notably global financial centres in the world economy, and is likely to increase pressures to urbanise the economy. The IMF (2015) views infrastructure as an investment strategy to ‘avoid stagnation’. But what if the scale of environmental pressures and climate change locally mean that an end to real growth is inevitable? Tim Jackson (2018) argues that the drive to seek
economic growth (including through infrastructure-led investment that leads to further urbanisation and globalisation) is currently backfiring – widening inequality and locking-in carbon emissions instead.

As government keeps interest rates low there is increased investment and wealth accumulating to the richest, and increased investment in financial assets and speculation. This is increasing inequality and diverting finance from addressing the climate challenge. This in turn is suppressing spending in the productive economy, prolonging austerity and so the vicious cycle carries on. Therefore, relying on automation or financialisation is not likely to address the way urbanisation impacts on and drives both climate change and inequality. Therefore, facing up to climate change requires different approaches at a national and global level. It is insufficient to expect a clear climate-resilient pathway locally to be achieved while ‘rules of the game’ that externalise the climate and environment and don’t factor in economic distribution are left to drive decision making.

4. Taking a different way forward

4.1 Climate-led strategic planning

Attempting to reduce resource consumption and the related climate impacts whilst prioritising economic growth through further infrastructure investment and urbanisation is difficult, if not impossible. This is reducing the resilience and livelihoods of the poorest households, geographic areas and countries, and increasing inequality, social tensions and global instability (Sassen, 2014). Instead of city economies being increasingly externally dependant as they get bigger, there is a need to localise investment to city-regions, making them more resilient. So, what if instead of investing in infrastructure that primarily strengthens connections between urban areas, the focus was on strengthening links from cities to their immediate rural surroundings?

This section explores a different and longer-term plan for how societies can sustain drastic cuts to greenhouse gas emissions and thereby limit the increase in the scale and magnitude of future climate disasters.

Climate scientists say we need to avoid 1.5°C of post-industrial revolution warming to avoid dangerous climate change (IPCC, 2018). This requires a radical change to our approach to urbanisation, transport infrastructure investment and wider economic development. We have just 12 years to turn things around and reach zero fossil fuel emissions by between 2040 and 2055 at the latest. Some might say that this level of transformation is not possible. Instead we should start by asking whether living with dangerous, runaway climate change is any way acceptable or desirable.

Current climate trends will already lock in short-term impacts even if long-term drastic emissions reductions still take place. This is simply not factored into what we plan to build and where. The result could be catastrophic. Addressing small short-term climate impacts, such as incremental increases in sea defences will provide a false sense of security – while being completely inadequate in the face of more extreme disaster events and in the longer term. And if we make decisions about where and how we expect to live for future generations
we should also consider the even longer-term consequences. For example, Stern (2007) concluded that:

Recent estimates suggest that, even if emissions peak in the next decade or two and then fall sharply, the impact on global temperatures will still be very large” as “many greenhouse gases, including carbon dioxide, stay in the atmosphere for more than a century and the effects of climate change come through with a lag, temperature and sea level will continue to rise during the twenty-second century, even if we stabilise emissions soon.

The positive feedback effects within the climate system and the increased energy and unpredictability in a warming climate means that greater damage and climate shocks are increasingly likely with continuing global warming. Therefore, it is irresponsible to continue to increase carbon emissions now and gamble on greater reductions (including negative emissions) at some point in the future.

The aim should not just be to stay within a certain carbon budget, but to limit our exposure to climate risk by reducing carbon emissions to as far as possible and as soon as possible. This points to a planned approach.

4.2 Socially and Environmentally Sufficient Planning

Kennedy and Corfee-Morlot (2012) propose that comprehensive national strategic plans are coupled with national climate change goals to prioritise investment differently. This requires completely different investment decisions – not just at the city level but crucially by countries and internationally (particularly as lower-lying and hotter countries become increasingly precarious and/or inhabitable).

The Green New Deal Group (2013) advocated investment to revitalise and transform local economies, including to rejuvenate declining rural and ex-industrial areas. Similarly, considering the future of the EU, Ulrike Guérot (2017) suggests moving away from a centralised economy and instead looking below nation states to decentralise politics as well as economies and energy systems. Such a transformed scale of energy and resource use could raise the wellbeing, equality, self-reliance and resilience of communities and economies (Scott-Cato, 2012; Illich, 1973). This approach underpins the transition towns movement in the UK and elsewhere – which links the notion of energy descent with community resilience (Hopkins, 2008).

So, what if this approach focused on social and environmental objects together? The World Wildlife Fund (WWF) compared the different social and environmental outcomes of different countries, highlighting that it is possible to be sustainable environmentally whilst having good social outcomes (WWF, 2012). And this can happen quickly. Examples include Costa Rica, which generated 99% of its electricity from renewable sources in 2015 and Cuba, which five years after the oil embargo of 1997 had halved obesity and halved deaths due to diabetes whilst establishing 26,000 community gardens in Havana alone (Simms and Newell, 2018).

The pattern of development required for the poorest nations to be sustainable is entirely different from richer economies: the former must improve the livelihoods (and resilience) of the poorest whilst not increasing their (minimal) carbon emissions, whilst richer countries, urban areas and households must reduce their (still increasing) levels of consumption of
environmental resources and carbon footprint whilst sustaining wellbeing. Dercon (2012) argued that it is best to reduce poverty first and consider climate and environmental issues later, but this risks locking-in climate emissions through infrastructure choices, as considered above.

So, facing up to climate change globally turns the challenge of making development (as a continuing process) more sustainable into one of finding different pathways towards the twin goals of environmental (resource and biodiversity) sufficiency and social (equality and quality-of-life) sustainability. The ‘pathways’ which Bangladesh and the UK must take (for example) are totally different, although the destination is shared.

If one were also to compare the social and environmental sustainability of human society at different scales (instead of in different places) we would see that it is easier for smaller communities and city-regions to become sustainable than mega cities. Reducing the scale of the ‘area of interest’ – localisation – makes it easier to become more sustainable. This needs to combine with political, economic and ultimately cultural change – to define how we will be sustainable enough to avoid runaway climate change. Infrastructure investment would then be limited to that which returns a sufficient reduction in carbon emissions whilst reducing inequality and transforming the resilience of communities to withstand future disasters and climatic changes. This is a massive shift. It requires planned choices that deliver equality and wellbeing using far fewer resources and resilience.

One of the greatest challenges will be how to deliver such simultaneous climate adaptation and mitigation, whilst ensuring benefits are shared more equally. Research by the UK Climate Impacts Programme (Lonsdale, Pringle and Turner, 2015) concluded that we must shift from preparing for impacts predicted by old climate data – separate from climate mitigation plans that lack adequate ambition – to mitigating and adapting to climate change together. They call this transformational adaptation. In the long term a complete transformation of society, not just adaptation of existing activities, will be required.

This is reflected in the IPCC’s special report into the implications of a 1.5°C rise in post-industrial global warming (2018). This considers the implications of climate change on poverty alleviation and development. It calls from a shift from such incremental approaches to ‘transformational adaptation’ through ‘ambitious and well-integrated adaptation mitigation-development pathways that deviate fundamentally from high-carbon, business-as-usual futures’.

The built environment must be designed to last and be more adaptive, both cutting emissions more quickly and reflecting a more pessimistic climate future. However, unless we carefully plan and constrain infrastructure investment (and hence urbanisation), focusing on increased adaptation alone could result in a huge up-front expenditure of carbon embodied in new ‘built environment’ – which will both make climate change worse and could alone tip us into catastrophic climate change.

Some rural and urban areas will become untenable due to sea level rise, increasing disasters and/or changes in food productivity or water availability due to climatic changes (see above). A planned retreat, initiating relocation from some are required. This will mean shifting building from areas that will flood or otherwise become uninhabitable in the longer term. It will entail migration from precarious livelihoods such as on increasingly inundated land in south-west Bangladesh. And it will require changing what is normal, such as changing
approaches to farming as weather patterns lead to escalating crop failures in sub-Saharan Africa. Transformation will require joining up issues that are often considered separately: equality, resilience (of communities and infrastructure) and sustainability (including climate mitigation). This requires a step-change, taking approaches that aim to benefit all of humanity.

This needs a plan: spatially, economically and strategically. So, instead of reinforcing existing settlement patterns, increasing city size and vulnerability – investment should strengthen ties to the local economies around urban areas. This will enable more people to stay living and working in smaller settlements instead of migrating to larger centres. This will help to placate the drivers of existing shortages of affordable homes that lead to informal settlements (particularly in the global South) and over-occupancy of housing (where land prices preclude affordable rents, such as in London, UK). However, significant magnitudes of migration will need to be anticipated and planned for. New homes and ways of life will need to be supported without the massive embodied carbon typically invested in current cities.

The countryside underpins the sustainability of cities as this is where most food, resources and energy are supplied from. If city dwellers’ needs are met from areas immediately around cities, rather than across the world, transportation and packaging will be reduced. Alternative economic strategies shifting from investments that continue to enlarge and link global cities to recreating city-region economies (also referred to as bioregions) could transform rural livelihoods and improve resilience, reducing vulnerability to climate change. Plans to address this include that proposed in Rwanda, to shift the focus of growth away from the capital city, Kigali (GGGI, 2014).

Our infrastructure must be reimagined today such that it can be re-purposed and even moved as our society and economy are restructured and localised. Investment must be limited to very low and zero carbon technologies, energy efficient enough and designed-for-deconstruction (Addis, 2008). This means designing for a truly circular economy, not just in terms of what we reuse and recycle at home, but also in terms of our overall homes, infrastructure and wider built environment. We need to apply the principles of permaculture (permanence) so that we can sustain our ways of living with renewable resources alone - redeployed, again and again. For example, any new homes should be negative carbon (Rodionova, 2016) and if we do choose to build in flood vulnerable areas, such as the UK’s Thames Gateway Development (why would we?), these homes must be able to be relocated within their lifetime.

A different future requires that we face up to two separate, yet interconnected, societal challenges, together. Currently we are not acting sufficiently to avoid runaway climate change, which risks skyrocketing inequality and societal breakdown. To cut climate change we must radically reduce resource inequality, as over half emissions are due to lifestyles of the richest 10% of the global population (Anderson, 2018). This would require an alternative to the economic trends of automation and financialisation, and through these, continued globalisation of the economy. In place of often unplanned urbanisation we might then radically re-localise how we live.

5. Conclusion

Urbanisation is not inevitable. Facing up to climate reality requires us not to take urbanisation and globalisation as parts of our almost certain future, but see these as choices. This requires a radical shift in political, economic, and physical planning with different priorities and
politics, tools and approaches. But more than that – it needs a vision of a future that is not increasingly reliant on infrastructure investment, automation or financial services. As noted above, the IPCC (2018) calls this transformative adaption:

> Climate resilient development pathways that transform societies and systems to limit global warming to 1.5°C and ensure equity and wellbeing for human populations and ecosystems in a 1.5°C warmer world ...require ambitious and well-integrated adaptation-mitigation-development pathways that deviate fundamentally from high-carbon, business-as-usual futures.

Or to put it simply, we must take as our starting point the assumption that facing up to climate reality requires us to rethink, reimagine, change - everything.

Climate change is a messy problem: it cannot be tackled simply by the sum of seven billion people acting individually, according to enlightened self-interest, guided by the invisible hand of the market. Climate change challenges a rethinking of systems, from centralising and urbanising our economy to re-investing in our sense of place and definition of community. We need to restrict what we physically invest in to that which cuts our carbon emissions down to zero, whilst enhancing how we work together – and meanwhile not abandoning those facing climate disasters. Together there must be a massive transformation – a great flourishing and multiplicity of local solutions, economies and ways of living without oil that ultimately make us more reliant on each other instead.

So, facing up to the reality of climate change together, means that we commit that the sum of our collective actions turns out to be enough to stop runaway climate change. And therefore, sufficient to turn fear, insecurity and apathy into genuine hope. Foster (2017c) talks about finding deep hope in the space between our almost certain future with climate Armageddon locked-in and a future that is still paved with climate disasters, but not apocalyptic. If we fail to stop climate change's worst rampages, we will need to replace some of our physical infrastructure with reliance on our local and global environment and each other. That must ultimately be where we find ourselves, become more resilient, and build our hope.

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