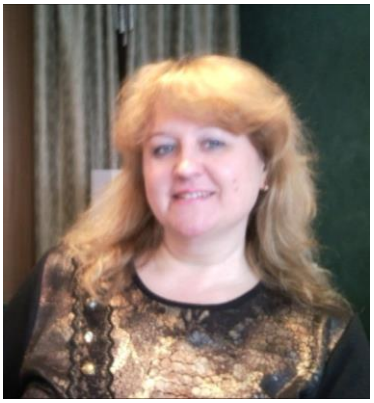
POLLUTION OF BIG CITIES



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Abstract. This article provides an introduction to the connections between two of the most important forces of change in the 21st century. It examines the evolving relationship between climate change and big cities, and asks what the future may hold. The problem under discussion is very urgent because for a long time too little attention was paid to the environment. The article stresses that solving climate change will likely require the development of new technologies for low-carbon energy generation and transport. Many technologies are already available but require the political will and organization to be implemented.

Keywords: pollution; big cities; climate change; environmental problems; gas emissions; carbon dioxide.

JEL codes: R220; R580.

Introduction

The poisoning of the world's land, air, and water is the fastest-spreading disease of civilization. It probably produces fewer headlines than wars, earthquakes and floods, but it is potentially one of history's greatest dangers to human life on earth. If present trends continue for the next several decades, our planet will become uninhabitable. Overpopulation, pollution and energy consumption have created such planet-wide problems as massive deforestation, ozone depletion, acid rains and the global warming that is believed to be caused by the greenhouse effect.

Climate change and the continuing growth of the world` s cities are two major drivers of change in the 21st century. Climate change in turn is happening because of man-made emissions of carbon dioxide and other greenhouse gases, while the growth in cities is driven mainly by migration from rural areas, immigration and population growth. Thus the ways in which these trends interact,

to reinforce or counteract each other, will be of great consequence to the well being of human populations as the century proceeds.

For a long time too little attention was paid to the environment. Today the situation is quite different. People all over the world are worried about what is happening to the environment because of modern industry and the need for more energy. Newspapers and magazines write about water pollution, air pollution and soil pollution. People have been polluting the world around them for thousands and thousands of years. But in the past, there were not many people and lots of room in the world, so they could move to another place when their settlements became dirty. Now many parts of the world are overcrowded, people live in big cities and much of the waste, especially waste from factories, electric power stations, the chemical industry and heavy industry is very dangerous. Fish dies in the lakes, rivers and seas, forest trees die too. Much of this dangerous waste goes into the air and is carried by winds for great distances.

1. Patterns in the development of the world's cities

In many towns and cities the concentration of harmful substances in the air is over ten times the admissible level because with the development of civilization man's interference in nature began to increase. Large cities with thousands of smoky industrial enterprises appear all over the world today. The by-products of their activity pollute the air we breathe. Environmental problems are very acute in densely populated regions.

Every year world industry pollutes the atmosphere with about 1000 million tons of dust and other harmful substances. Many cities suffer from smog. Vast forests are cut and burn in fires. Their disappearance upsets the oxygen balance. As a result some rare species of animals, birds, fish and plants disappear forever, a number of rivers and lakes dry up.

The railway transport is also the source of pollution, especially locomotives. One locomotive exhausts as much harmful waste into air as 40 or 50 cars.

The environmental safety of nuclear and hydroelectric power engineering is beginning to assume paramount importance, because when people build and exploit hydroelectric power stations they change the structure and properties of the soil and water.

Now railway pollution accounts for 9 % of all harmful substances. Railway transport pollutes the air. Every year railway enterprises throw into the atmosphere nearly 40 thousand tons of harmful substances. Railway transport throws out into the atmosphere 300 kinds of harmful substances which change the structure of air. In all countries scientists want to exploit environment-friendly railway transport. In some regions of the world and of our country people have problems with local harmful

substances. These substances get into the water, so many rivers, oceans and lakes are very polluted. When people build and exploit railway stations they change the structure and properties of the soil. People pollute the soil with industrial and communal waste. [1]

The most remarkable feature of English weather, the London fog, has as exaggerated reputation. What makes fog thick in big industrial areas is not so much the moisture in the air as the soot from millions of coal fires. Such smogs (smoke + fog) are not frequent today. Since 1965 as a result of changes in fuel usage and the introduction of clean air legislation, they have become less severe. It is quite natural that in fine, still weather there is occasionally haze in summer and mist and fog in winter.

The pollution of the air and the soil can lead our planet to a global catastrophe. So people of the whole world must take urgent measures to keep the environment clean.

Globally almost 50% of the Earth' s inhabitants now live in cities - and the UN predicts this will rise to 60% by 2030. We live in a world that is increasingly urban. In 2000, the world population passed six billion people, and (according to UN statistics) is now growing at a rate of 1.2%, or 77 million people per year. Within this growing population are three key trends of relevance to this briefing sheet:

An increasing proportion of the population is in developing countries: 68% lived in developing countries in 1950 and this will rise to 85% by 2030.

The world’ s population is ageing: By 2050 the number of people older than 60 years will more than triple from around 606 million today to nearly two billion.

More and more of us are living in cities: In 1800 only 2% of the population lived in urban areas; by 2000 this figure had risen to 47%. The current trend is equivalent to the addition of a city of one million inhabitants (the size of Glasgow or Birmingham) every single week!

A large proportion of the growth in urbanization will occur in the developing world. Here the population in urban areas is projected to grow from 1.9 billion in 2000 to 3.9 billion in 2030 — that's a staggering two billion more people moving to cities during just 30 years!

The United Nations Human Settlement Programme (UN-Habitat) has estimated that of the world’ s billion poorest people, over 75% live in urban areas without adequate shelter and basic services. There is a widespread belief that the growth of cities in the developing world will be part of a process of increasing standards of living. But it will also make worse many problems related to urban poverty, as Kofi Annan pointed out in launching the UN’slatest report of the state of the world' s cities (UN Habitat, 2014):

«Many cities face pervasive and persistent problems, including growing poverty, deepening inequality and polarization, widespread corruption at the local level, high rates of urban crime and violence and deteriorating living conditions».

The report details a number of worrying trends in the way that cities are developing worldwide especially in developing countries. For example, it highlights that many of Africa's cities are undergoing a process of 'over-urbanization' in which so many people are moving into the cities that they are completely unable to support their populations in terms of, for example, transport, water and sewage infrastructures.

In developed countries there will be a markedly less drastic increase, with projected growth to around one billion in 2030 (from 0.9 billion in 2000). For developed countries a different set of challenges need to be addressed from drugs to the break-down of traditional social structures, and ageing infrastructures that will require massive investment to replace.

Thus the future story of climate change and cities will unfold through the impacts of climate change exacerbating already unsustainable trends.

2. Greenhouse gas emissions from cities

Climate change is caused by emissions of carbon dioxide and other pollutants from a variety of human activities. In this section we take a brief look at the main emission sources associated with the city.

London, a city of some 8.1 million people, consumes more energy than Ireland and about the same as Greece or Portugal. The modern city could not function without vast quantities of electricity to power everything from light and heat to transportation and electronic equipment and machinery. Huge quantities of gas, oil, coal and biomass are also required for heating, cooking and industrial purposes.

The City Limits Project looked at the total resources consumed by the city, including energy. [24] They used the idea of an ecological footprint' (the equivalent geographical area taken up by the city to supply all energy and resources consumed) and found that the City’s residents produced an ecological footprint 293 times the geographical area of the city: that’ s roughly twice the size of the whole UK (with a population of ca 60 million). This illustrates the way in which the city uses vast amounts of energy and resources from its hinterland.

Emissions derive from a wide range of sources, for London the breakdown looks like this:

21% from transport

43% from domestic emissions

07% from industrial emissions

29% from commercial emissions.

These figures are for the total emissions related to activities undertaken in the city. The rather low figure for industrial emissions reflects the typical trend of a long-term decline of heavy industry in a European city such as London. Averaged across all sectors: 22% of all energy consumed in the city is electricity; 56% is in the form of direct supplies of gas; 17% is petrol and diesel; with the remainder being made up of oil, aviation and solid fuels. The electricity supply used by the city is generated from: gas 38%; coal 31%; nuclear 21%; and 10% from other sources including oil and hydro (figures for 2000).

What we are seeing now is the testing and exploration of innovative solutions that will, in the coming years, inform more fundamental decisions about major shifts in the way that energy is generated and consumed in our cities.

In this context studies which explore the public's attitudes to renewable energy are an important aid to decision-makers in London: recent work in London that fed into London's renewable energy targets in the Mayor's Energy Strategy have found that:

75% of Londoners have said they would be in favour of solar panels in their local area. Nearly 50% said they would pay more for green electricity.

84% of stakeholders consider it important that local authorities use planning powers to secure renewable energy in new buildings.

59% of stakeholders consider commercial house builders as an important group to help meet renewable targets.

Improving energy efficiency in buildings is another key challenge for London, and a number of innovative housing developments such as BedZED in Sutton are providing a practical vision of how energy-efficient design can be combined with renewable energy production to deliver zero-carbon-emission buildings with attractive living environments.[23]

The current policy environment facing London illustrates well the way in which the governance of climate change has to occur at multiple levels. Thus the UK Government plays a major role in negotiating international climate agreements, which then, in part, sets policy targets for the UK as a whole. National policy frameworks then define the rules within which any city-level initiatives will need to maneuver.

However, it would be a mistake to conclude that the city cannot be a significant player in responding to climate change. The congestion charge is a case in point — vehicles travelling into a central area of the city must pay a daily fee or risk a substantial fine. It was widely predicted to be a

failure, but has surprised many by being successful in reducing traffic flow, increasing the use of public transport, and having reasonable levels of public acceptance. There are now plans to copy the charge in many other UK cities. It is one of the best examples of how an innovative policy at the city level can make a significant contribution to combating the global problem of climate change.

3. Adaptation to climate change in cities

At one level adaptation is about ensuring that the infrastructure of a city, from buildings and industrial facilities to road and sewerage systems have as low a vulnerability as possible to likely future climate changes; and that they are as flexible as possible, providing scope to cope with the high level of uncertainty over the actual nature of future changes in the climate. At another level it involves putting institutional frameworks in place that are adaptation 'friendly' i.e. able to build adaptation requirements into a wide range of ongoing planning activities. The Intergovernmental Panel on Climate Change identifies the following major options for adaptation in cities:

Take advantage of rapidly growing populations by designing new infrastructures to be 'climate change proofed' from the start. For example, it can sometimes be less costly to design and build flood works 'oversized' in the beginning than to rebuild them later to add capacity.

Take advantage of replacement schedules on shorter-lived assets such as vehicles and heating/cooling systems.

Reduce heat island effects through the use of vegetation and light colored surfaces.

Build flood defenses and better coping systems for flooding.

Use suitable design techniques to reduce cooling demand in many buildings.

Develop institutional frameworks that are more 'friendly' for adaptation strategies. For example, giving rights to inhabitants of informal settlements to allow them to develop better infrastructures; and building institutional capacity in environmental management.

Sustainable energy solutions require measures to address both the energy supply and the demand for energy. Ultimately, solving climate change is likely to require a global reduction in greenhouse gas emissions of greater than 60%. Achieving these levels of reductions will have to be underpinned by a fundamental transition in the ways in which we generate electricity and other forms of energy. Unfortunately cities in general do not have direct control over the supply of electricity they use.

However, there is a potential for this to change in the future. For example, a number of companies are now developing solar roofing tiles thus opening up the possibility of creating large areas of urban buildings that actually generate their own electricity supply.

On the demand-side, energy can be saved by making buildings more energy efficient (as discussed below) or through life-style changes of city dwellers. Huge savings in energy use could potentially be made if the inhabitants of western cities adapted their lifestyles in relatively minor ways to adopt more energy efficient practices. For example, by simply using the appliances in their homes more sparingly; joining car share schemes for travel to work, using bicycles or walking more.

In Europe buildings are responsible for between 40% and 50% of energy consumption and carbon dioxide emissions. Hence addressing emissions from this sector is a key challenge in tackling climate change.

Buildings have average lives of between 50 to 100 years: so what we build now will be with us for most of this century, and our existing buildings will also last many more years. It is therefore imperative that we both ensure that new buildings are built in a way that has an optimal impact on reducing carbon emissions, and that we find ways to improve the energy efficiency of existing buildings.

New buildings need to be designed with the likely impacts of climate change in mind: will they be comfortable in a warmer climate? Will they be affected by increased flooding if built on or near a flood plain? Increasing use of air conditioning as we enter a warmer climate is a particular problem as it leads of course to further energy use and emissions; thus building solutions that can minimize the need for powered cooling systems will be an important future design criteria.

For existing buildings there is usually a huge potential to increase the energy efficiency of the buildings through a wide range of measures from the ubiquitous low-energy light bulbs to cavity wall insulation and the fitting of energy efficient appliances and heating systems. Municipal governments can provide leadership in this area by ensuring energy efficient improvements in their own buildings and offices.

However, historically energy efficiency programs have met with mixed success. In general it appears that although many energy efficiency improvements may have a payback period of just a few months to a few years, they run up against a variety of behavioral and organizational barriers preventing their implementation.

For transport the same distinctions apply between solutions based on the supply-side versus demand-side. For the energy supply-side, it is generally agreed that in the medium to long-term the only solution for transport is to find an alternative to the use of petrol and diesel. For many the current favorites is hydrogen. Hydrogen can be stored in a vehicle and used with a fuel cell to generate electricity that can power a car through an electric motor. Either during combustion, or in

the fuel cell, hydrogen combines with oxygen to release energy and a single harmless by-product—water.

Clearly, the idea of having cars that produce only energy and clean water is an attractive prospect for city dwellers. However, the catch is that the hydrogen is not extracted from the ground as with fossil fuels but must be made in some way, usually using a supply of electricity. The electricity could come from nuclear power, from wind turbines, or even from fossil fuels (with the carbon dioxide released from the burning of the fossil fuels being sequestered underground as described above). Developing an infrastructure to supply vehicles with hydrogen would be an enormous undertaking, and at present it is by no means clear who would pay for this: governments, the oil industry or vehicle manufacturers?

However, there are a number of really exciting initiatives around the world that are experimenting with hydrogen fuel-cell vehicles. Ah interesting example is Iceland, which has declared an intention to develop 'the world’ s first hydrogen economy'. At present buses fitted with hydrogen fuel cells are being tested in Reykjavik, but in the future there are plans to run cars, and even Iceland[1] s fishing fleet from hydrogen. And there may be a potential to use Iceland’s vast geo-thermal energy resources to produce hydrogen.

Finally, although it will not be addressed in detail here, it should be mentioned that most cities in the developed world are associated with massive aviation transport infrastructures which transport us from one city to another. Jet planes use huge amounts of aviation fuel and this is a major issue that will need to eventually be addressed in reducing emissions of greenhouse gases.

Conclusion

The main conclusion of this article is that the link between climate change and cities is a crucial one. Climate change is already happening and will become increasingly severe in the coming years and decades. Because a majority of the world population will soon live in cities it will be impossible to halt global climate change without achieving a fundamental transition in the structure and functioning of our cities. Viewed in this way the low-carbon city is not a Utopian idea but rather an imperative that must be achieved by mid-century!

Solving climate change will likely require the development of new technologies for sustainable, low-carbon energy generation and transport; but this briefing sheet has also shown that there is already a great deal that can be done. Many technologies are already available but require the political will and organization to be implemented.

Networks between cities, such as Energy-Cites, have an important role to play in facilitating the exchange of information, ideas and tested solutions. We saw how the successful implementation of a congestion charge in London provides a significant example of an innovative approach to tackling urban congestion and emissions from transport. If the idea can `catch on` and is replicated and adopted by other cities with similar problems then the carbon savings are multiplied many times over.

Cities with broadly similar problems and governance structures may be able to learn rapidly from one another` s successes and mistakes through networks dedicated to the exchange of information on climate change and sustainability issues. The idea of replication is thus an important one, and perhaps a key to implementing solutions at an accelerating rate in the coming years and decades.

Research will have a crucial role to play, not only in providing technological solutions, but also in supporting the design of the governance structures that will need to be developed, and by providing insights into the social and cultural implications of such major changes in our cities. For example, in the UK, the Tyndall Centre is developing a long-term study of how London can develop a sustainable response to climate change.

Tackling climate change will result in both winners and losers. In the past some academic studies have emphasized the costs of climate change mitigation and the resulting negative impacts on the economies concerned. However, there is currently a heated academic debate going on around the likely future costs of climate change mitigation. A consensus does seem to be emerging among many scientists and economists that in the longer term the costs over the whole of this century could easily be absorbed into an overall growth trend in the world economy.

The challenge lies rather in the early phase of a transition to a low-carbon economy. Here it will be very difficult for governments to unilaterally instigate severe constraints on carbon emissions because it may damage economic competitiveness with other countries or cities that have not imposed such severe constraints. However developing climate change solutions can also definitely be a source of economic growth, for example, through the development of new industries supplying renewable energy technologies or low-carbon transport systems.

Thus at the city-level there is, right now, an extremely exciting opportunity for municipal governments to capitalize on first mover advantages by developing a climate-friendly image or branding for their city, while at the same time exploring ways to stimulate economic growth by encouraging mitigation measures that can aid the development of new industry and business.

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