Sustainable Cities in the Age of Global Warming and Peak Oil

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Abstract

The megacities are a 20th century invention made possible by the car and cheap petrol. But cheap energy is no longer an option, and the city of the 21st century is challenged in a large number of ways. Peak oil and global warming makes it imperative for the principles of urban development to change profoundly. Zero net energy consumption, durability, recycling, and food production become the order of the day. The walkable city, the city of towns may become the new structure. The world is confronted with some of the most serious crises humanity has ever encountered, and the world cities are challenged too. A new paradigm must be developed – and rapidly. This article states the challenges and outlines some possible directions for that paradigm.

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Introduction

The rapid urbanization of the world's population over the twentieth century is described in the 2005 Revision of the UN World Urbanization Prospects report. The global proportion of urban population rose dramatically from 13% (220 million) in 1900, to 29% (732 million) in 1950, to 49% (3.2 billion) in 2005. The same report projected that the figure is likely to rise to 60% (4.9 billion) by 2030.[1] This urbanization has been possible because of easy access to cheap energy, particularly oil, but also coal and gas. But the carbon age is peaking and the global warming is threatening the life support systems of the modern cities. A new paradigm has to be developed. And there is no time to lose.

Urbanization, especially in Asia, Africa and Latin-America has created megacities out of small settlements in less than a century. The process has been, and is, chaotic and the results are as well. In earlier societies the city was a quite well defined entity. The city was often enclosed by a wall. The people inside the walls were the true citizens with their rights and their duties. Today a shanty town may spring up in weeks or months with thousands or even tens of thousands inhabitants and almost no formal structures. There is no certain definition of the city, and even lists of the most populous cities of the world are very ambiguous for that very reason. A city of fifteen million registered inhabitants may have twenty million during work hours because so many from surrounding areas commute into the city. These migrations vary so much that any census is uncertain.

The Megacities

The city sprawl has also made it hard to define the limits of the city; where does it end and where does the countryside take over? Is New York a city or is it just a part of a super megalopolis[2] of fifty million people stretching from Boston to Washington DC. Greater Mexico city is a huge conurbation of more than 40 municipalities in the Valle de México. Jakarta was once before colonialism a small trading port. When the Dutch took over they founded the European style town of Batavia in 1619. Today Greater Jakarta has swallowed the neighboring cities such as Bogor into a metropolitan area, called Jabotabek, of almost 30 million people. And then you have the enormous conurbation of Tokyo-Yokohama where you can travel for hours and still be inside the city area.[3]

In China the biggest migration in human history is taking place. Over the next few decades some 300 million people, that is approximately one USA, are moving into cities. Hundreds of new cities will be built to accommodate them.

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Peak Oil

Eighty-five percent of the world's energy consumption are fossil fuels; 37% oil, 25% coal and 23% gas.[4] Fossil fuels have been the energy pushing and pulling the industrial revolution and so also the energy behind urbanization. Now it seems

that oil has peaked. World oil production is not increasing any more, new oil fields are few and harder to exploit. In spite of a deep economic recession oil prices have been in the $ 100-120 per barrel bracket (Brent Crude).[5] With so high prices one would think that production would increase a lot, but instead it has leveled off. Lately prices have been falling, but that solves nothing, because it means that the marginal oil fields become even less attractive and that the push for alternatives to oil also becomes weaker.

Peak oil will have a profound and long lasting influence on world cities. Oil does not only go into commuting and transport. Electricity which is so crucial to the city is most places produced by burning oil, gas or coal. Concrete from which the cities are built is highly dependent on fossil fuels. The whole building industry is an oil-guzzling industry never to be satisfied without it. And of course to feed and give water to the citizens, oil is everywhere. Modern agriculture depends on oil in plowing, sowing, watering, reaping, producing, storing and distributing farm produce. The pesticides and chemical fertilizers that made the green revolution possible and by that the feeding of seven billion people, is based on fossil fuels. 17% on average is the world's oil consumption is linked to food production. Fertilizers alone consume 5%. Modern man is a walking SUV.[6] In fifty years agricultural oil consumption has tripled. Taking oil out of agriculture is like taking the central pole out of a tent.

Running a car takes oil. And if you prefer an electric car, consider how your city's electricity is produced and how the car itself is produced. You will find oil and even coal behind the most environmental electric car. To produce one takes about 20 barrels of oil.

Heating and cooling of apartments and houses consume a lot of energy, and since most electricity is produced by burning fossil fuels, it is another carbon agenda.

What about the computers that run your city, or the one on your desk or lap top? No oil in them, to be sure. But to produce one they use at least ten times its weight in fossil fuels. To produce one 32MB microchip they use 1.7 liters of oil. And when you discard it, it turns into hazardous waste. China is the fastest growing economy in the world, but it is also the fastest growing landfill of hazardous garbage.

And what about our wonderful global internet? It helps us find information from the other side of the globe without moving from our desk or café table. Sure that must be eco-friendly? May be, but running the web consumes about 10% of all energy that is used in the US and close to 6% globally. For most of the people in the world that means oil and coal; and now and then nuclear power.[7]

Producing cement consumes oil in quantity, 1000 kilos equals 1.13 barrels of oil. China alone consumes 1.7 billion tons of cement – and counting. India is following suit. Paving of roads with asphalt takes at lot of oil, of course.

The suburbs were unthinkable without cheap energy, read oil. With the increase in Chinese growth alone, the world will not have enough energy long before 2030. Our entire city model is heading directly for a fundamental crisis.

- Synthetic fibers that are used in textile industries is nothing but oil. Plastics are oil. Toys, bottles, machine parts, sports' equipment, building materials: oil, oil, oil.
- 95% of global trade is based on oil. Globalization equals oil.
- With peak oil we enter into very uncertain terrain and continued urbanization becomes very dubious indeed.

But the trouble doesn't stop there.

Climate and Global Warming

The modern city is a CO_2-producing unit. Forests can be carbon sinks, but not cities. The atmosphere already has too much CO_2 for the future good of the Earth. Soon we will pass the 400 ppm limit, and that is at least 50 ppm too much as even if we could stop immediately, our CO_2 emissions will cause an increase in the global temperature by 2 degrees centigrade above our pre-industrial level. But at our current rate of emissions, 450 ppm is much more likely that will push the planet past the 4 degree level and lead humanity into a very unpleasant future.

Weather will be warmer, wetter and wilder. There will be more violent storms, more flooding of low-laying areas so typical for most big cities in the world and more deluvial rainfalls.

The modern city is contributing strongly to global warming and the climatic disasters, and it is also a local hot spot itself. City temperatures typically differ from their surroundings by being five degrees centigrade higher. The city is a thermal repository with its huge thermo-mass of concrete and pavement for storing solar heat and the activities in the city itself produces a lot of heat as well.

So it is to be expected that the cities are vulnerable to climate change, and particularly the megacities in Asia, Africa and Latin-America.

Food and Fertile Top Soil

The modern city is highly dependent of food production that typically takes place outside of the city itself. The city is a parasite. Without the fertile land outside of the city the inhabitants would die. But in spite of that the city destroys arable land as it grows. The level fields of the agricultural valleys of rich top soil is so much more convenient for building than the barren hills, and the market price for development real estate is so much higher than it is for farm land. The end result is that precious fertile soil that has taken numerous generations to create is destroyed under the push of urban growth. There is no romanticism from me in underlining this, it is a fact. The city destroys the land that it feeds upon. In the long run this is of course lethal.

Water and Sewage

Hanoi has seen its population swell to almost 7 million over the past few years, yet there is not a single sewage treatment plant in the entire city. Wastewater from toilets and showers ultimately ends up in the region's rivers, from where it makes its way, dirty as dirty can be, into the ground water.[8]

Residents in Mexico city get most of their drinking water from aquifers under the city. But because of waste and poor water treatment that water is contaminated with cadmium, chromium and other metals that are hazardous for humans. Over-exploitation of aquifers has contributed to the continued subsistence within the city (5-40cm per year), increasing the chance of catastrophic flooding.[9]

In the port city of Karachi in southern Pakistan, around 30 000 people die due from the effects of contaminated drinking water, while in Kolkata (formerly Calcutta), there are both traces of faeces in drinking water and high concentrations of arsenic in ground water.

In the rivers of Buenos Aires there are high levels of dumped toxins making the Argentine river Matanza-Riachuelo "one of the world's most polluted waterways." And millions of people in the city lack safe access to drinking water and are not connected to sewer systems.

In Kenya, the capital city of Nairobi lacks capacity to manage the increasing demand for water. And 60 percent of the city's inhabitants live in informal settlements with inadequate access to quality water and are forced to buy their water at kiosks at a higher price.[10]

The Oceans

Most of the megacities lie on the estuaries of big rivers. Their sewage, their excessive nitrogen and phosphate overload goes into the nearby sea and add to the dead zones in the world's oceans. This in its turn destroy the feeding ground for fish and other sea organisms, and then of course threaten the food chain of the city dwellers.

Scientists have measured higher acidity in the oceans and a shocking level of plankton death over the last few decades. Most of it may be linked with CO_2 being dissolved in the ocean water creating carbonic acid which is highly detrimental to all life in the oceans.

In the mid Pacific there is a sludge of plastic particles creating the *Great Pacific Garbage Patch*.[11] As it disintegrates, the plastic ultimately becomes small enough to be ingested by aquatic organisms that reside near the ocean's surface. Thus, plastic waste enters the food chain. Estimates of the size of the Patch vary widely, but there is no doubt that it represents a huge problem.

Paradigm Shift

These ecological problems and the problem with getting sufficient energy are some of the biggest challenges to the future of the cities. The Henry Ford paradigm, that is the car and petrol city, is outdated. But that was the paradigm that fed the city growth, and so far there is no other paradigm in sight that can turn the table and make way for the sustainable city of the future.

But there is a lot of research going on in this field, and this is obviously the way to go to turn the city from a parasite and a problem into a contribution to a sustainable society.

There is no energy source in the pipeline of the foreseeable future that can match the versatility and energy richness of oil. The consumption and ultimate depletion of the oil resources is a once in a life time opportunity for a planet. Alternative energies like wind, tide and solar panels contribute but a tiny bit to world energy. And their production and maintenance takes a huge amount of oil. Nuclear doesn't seem such a bright option after Fukushima and fusion energy remains a mirage very far from the practical world.

So the big picture is that we have to use less energy, per person and in sum total.

The walkable city: Before cheap oil cities were built for slow and local transport. Commuting over long distances was not an option. We will soon be back there again. Cities must be built or restructured so that people can reach most of their daily activities, including work and play using their own muscles, that is by walking or biking. That means that work places and services must be within a short walk from home.

City cells: To be walkable, all basic needs must be within walking distance. That means that the city must become a multi-node, multi-cellular city. A city of towns. Some needs that are not daily necessities could be found farther away, like an over-laying grid.

Quality of life: The city nodes must have a sufficiently rich cultural life to satisfy a wide range of needs. Cultural consumption is normally less energy and material demanding and also gives life and attractiveness to the city environment. Here I think not only of culture for the people, but also of culture by the people. The city must give ample room for the creative activities of the citizens.

Self sufficiency: The city must become self sufficient and self sustaining to a very large degree. Buildings must produce as much energy as they consume. A certain amount of food production must take place in the city. Sewage must be treated so that phosphates and nitrogen is contained and circulated back to farming.

Durability: The modern tendency of use-and-throw away is creating waste mountains that threaten to strangle the big cities. Durability and reusability are the new modern. Energy, water and other material resources are stretched thin today. There is small room for growth. So economic use of resources will be crucial.

Urban qualities in the countryside: To contain a too great influx of new millions into the megacities, it is crucial to give the countryside some urban qualities. Those qualities that go for the city cells should also be developed in smaller rural centers, when it comes to jobs, housing, culture, recreation etc.

Start Now!

The economic and ecological crises in the world today mean that there is no time to wait for change. The problems are only getting bigger and more difficult to solve as we wait. There will not be any one-size-fits-all solution. What we will be looking for is a complex and multifaceted web of solutions, local, regional, national and global. A huge number of people all around the globe are thinking about and working for this. They need resources and sufficient leverage to make results. Also some governments have seen some of the drama in the present situation. China, which has some of the gravest environmental problems, not least in its ever expanding cities, has declared its new five year plan *The Green Leap Forward*.[12] The Chinese have also made plans to develop eco-cities. So far most of these plans remain on the drawing board and the real results are few. One of the problems is that so far these ideas have been top-down technocratic ideas. To succeed I believe such projects must belong to the people, to the grass-roots. People must be deeply involved and have a realistic feeling of ownership to the project. So empowerment, mobilization, real democracy are essential. That is not to say that planners, specialist and scientists do not belong. Their expertise is crucial, but it must be matched with a conscientious popular movement for ground-breaking change. From the Tahrir square to Madison Wisconsin, from the streets of London to Wall Street people demand power over their own future. The mismanagement of the earth by the rich elites have gone all too far.

Conclusion

Am I naive; is this an utopian vision? I don't think so. The most unrealistic plan of all plans today is business as usual. It is business as usual that drives us to destruction. That goes for countries and regions and it goes for the cities. Be bold, be realistic, change the world!

Endnotes

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