Energy, Cities, and Security: Tackling Climate Change and Fossil Fuel Risk

by Peter Droege

> Our ignorance is not so vast as our failure to use what we know.
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> M King Hubbert

The world economy is based on cities: cities are its very home. Global financial flows are structured within urban systems; city networks physically articulate national and international markets. Historically, cities have been built around markets, too. Founded on trade routes, they formed growing economies in themselves; they gave rise to and nurtured the dynasties and institutions that manage the decisions that guide national economies. Cities are settings of political command and control, and centres of culture. Here society's leading images and messages are produced and packaged, shaping social reality and articulating aspirations. The great urban centers of yore were the main stages of their respective political settings. Democracy was developed by urban societies, and it was shaped and supported in the public spaces and institutions of major cities.

Today, most population growth occurs in urbanized areas, with half of the world's population dwelling here. But cities, their form, economies, and growth dynamics have also been very much defined by the energy systems dominating their eras. The manner of this interaction helps define the security profile of an age, a nation, or the balance of global relations. Global trade, sprawling cities, or periods of large-city formation are not new historical phenomena. The stories of hegemonic urban networks involving Babylon of the 18th century BC, Angkor of the 12th century AD, or London of the late 18th century are testimony to this fact. But the speed and sheer mass of the current urbanization wave, and the formation of super and mega-sized cities as a widespread, simultaneous, indeed, global phenomenon is unprecedented; it has only been acknowledged as a significant force during this past half-century. While rampant urbanization had not found wide recognition prior to

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Peter Droege is an international expert on energy and water in development, infrastructure, and urban design. He has served at major universities in Australia, Japan and the United States, and currently holds professorial positions at the Universities of Newcastle, Australia, and Beijing. He is a Chair of the World Council for Renewable Energy, representing Asia Pacific, and directs Epolis, a Sydney-based advisory service active in sustainable urban change. His publications include *Intelligent Environments*, *The Renewable City*, and, forthcoming, *Urban Energy Transition*.

the 1970s, it has also not been particularly well understood in the time since. The massive explosion of the world's urban population is relatively new, gathering momentum in the first half of the 20th century and accelerating from the 1950s on. From the 1970s, a burgeoning research literature genre formed to give meaning and voice to this phenomenon.[1] Since then, these urban centers have been described as world cities, global cities, megacities, or referred to broadly as the global urban system. Regardless of the label used, this conception connotes primacy of global markets, corporate control, seats of national power, homes to regional security apparatuses and, above all, the agency and relevance of technological innovation in surface, air & sea transport, defense, and the advent of advanced telecommunications.[2]

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Cities mushroomed during the 20th century, and this trend has continued into the 21st century, and been recorded across many metropolitan regions. However, broader population increase could not serve as more than a secondary driver for this growth, as urbanization rates far outstrip general population growth rates. Other powerful dynamics are at work, boosting the primacy of cities, including expansion in global trade and the concomitant structural changes in many agrarian states. No other common denominator underlying most, if not all of these, can explain urban growth better than the agency of the all-dominant global fossil fuel economy, and the global network of production, distribution, and consumption underpinning it.[3] Overwhelming oil dependency and abundant, cheap coal power have boosted the drive to urbanization, transforming regional economies, revolutionizing urban supply lines, and increasingly disconnecting cities from the agrarian hinterlands. The circumstantial evidence—the prima facie case—suggests that global city formation is a phenomenon of the fossil fuel age. While this characteristic has remained virtually unsung in either the urban or energy literature, it is self-evident that the major risks to global security, markets, and prosperity faced in the 21st century stem not from the much studied occurrence of urban expansion and primacy, but from the very driver of this expansion: pervasive fossil fuel use at low prices.

Indeed, while the fossil-fuel driven revolution has powered an unprecedented level of prosperity across industrialized—or better, f*ossilized*—states, the finite and geographically limited nature of terrestrial fossil fuel, and uranium, sources poses a major threat to both the viability of markets and global security. 40 large oil fields supply 60 percent of the global oil consumption, with 75 percent of these in risky, contested, or war-torn regions.[4] More than three-quarters of the world's proven oil reserves are in the hands of national oil companies, capable of being used as foreign policy tools or weapons. The United States produces only 40 percent of its domestic consumption. And geo-physically speaking, oil, gas, and coal are preciously limited resources: natural gas and oil only marginally more so than coal. Additionally, high-grade uranium is an extremely limited resource as well; if it were to have to replace oil and gas, it would be depleted within a decade, using current technology.

Petroleum-Dependent Cities: The Civic Face of Global Security Risks

If the global urban system is the skeleton of the world economy, then fossil fuels are its lifeblood. With a share of 85 percent, the global commercial energy supply largely consists of fossil fuels.[5] Within the Organization of Economic Cooperation and Development member states, three-quarters of this flow is consumed by cities for stationary and transport use.[6] Global transport is essentially fossil fuel-based, with almost all commercial transport in the air, on sea, road, or rail petroleum driven.[7] The global dependence on urban systems in itself constitutes a massive energy risk, but the present energy crisis is deeper than infrastructure dependencies. Global poverty levels are structurally tied to the global fossil fuel regime; a mounting nuclear crisis is looming due to an opportunistic and misguided call for an atomic renaissance; a global water depletion crisis exacerbated by the primary thermal power generation systems; a global health crisis brought about by fossil-based air, water, and soil pollution; and an agricultural crisis brought about by the global dependence on petrochemical fertilisers, pesticides, and wider processing systems—these only add to the twin risks of petroleum peaking and climate change.[8]

Oil peak and fossil fuel depletion

While all constantly consumed, finite resources follow the classic bell curve of depletion, the architecture of oil and gas wells and their deposits explains why fuel production peaks across Europe, Asia Pacific, and the Middle East have occurred in such a sequential nature. While liquid fuel supply reserves may stretch to the middle of this century, the historical plateau of global oil production—the composite super-peak of all wells' life cycles—could well occur within the next decade. Price hikes now make steam injection, tar sand, and oil shale production financially feasible, as environmentally costly and/or water—and energy—intensive practices are increasingly utilized. Indeed, projections of global oil production plateaus have not shifted significantly since American geophysicist Marion King Hubbert publicized his compelling model fifty years ago,[9] correctly predicting that US oil production would peak by 1970. Furthermore, he predicted that the horizon for a global peak would occur by 2000,[10] though a recent estimate has placed it at 2010.[11]

Regardless of the precise year, this is the era of the looming super-peak, while fossil fuel consumption continues to increase, and the global population has become accustomed to the illusions of limitless supply. The clear and present risk is the opening up of a massive and rapidly widening gap, triggering price hikes and adding further to military confrontations around the globe. The present drive toward more costly, risky, and polluting recovery methods in so-called non-conventional and speculative areas, made attractive by rising prices and profits, only confirms that we have entered an unsettling era, in the shadow cast by the looming super-peak.

If current trends could be projected forward, then 85 percent of the increase in global energy demand to occur by 2030 would be attributed to oil, gas, and coal. However, this is unlikely, given impending supply costs and risks. Nevertheless, this myth is still used to keep alarmed minds placated, as evidenced in the 2004 World Energy Outlook, issued by the International Energy Agency.[12] Oil supply is so preciously limited that, had any strategic planning taken place in lieu of merely "managing strategic oil reserves," it would be treated as a rare commodity and not squandered at such a precipitous rate. Instead, modern civilization has been lured onto a dangerous path, through its linear, ad-hoc, incremental pursuit of thriving "energy markets," the euphemism for unfettered oil, gas, coal, and, to a lesser extent, uranium flows. Indeed, most estimates on the size of "conventional" global oil reserves—those that are known and reasonably accessible—average around two trillion barrels. This figure has remained essentially unchanged since the 1960s. Furthermore, the era of oil discovery is waning as well: the annual number of new discoveries has declined steadily since the 1970s.

At the present degree of fossil fuel dependency, the risk of catastrophic supply disruption to cities and urban markets is sizeable. The vast bulk of oil resources is limited to a shrinking number of brittle regions: the Middle East, Africa, and the Caspian Sea. And like natural gas, coal is geographically limited: 90 percent of coal reserves exist in only six countries. The literature supporting the likelihood of an imminent global fossil fuel supply peak—especially of natural gas and oil—and its consequences is as large as it is persuasive.[13]

Urban risks from climate change

Even if fossil fuel supplies were to be unlimited, their end is nevertheless in sight, due to the need to slow climate change. Neither the speculative and at best distant "clean-coal" technologies, nor costly new nuclear power systems—two dangerous illusions—can change this fact. The epochal phenomenon of fossil fuel technology has brought modern cities to life and, at the same time, to the brink of unprecedented calamity. One risk is posed by the ephemeral nature of supply alluded to above; the other, by the devastating effects of its combustion. It is accepted by many that human activities, largely fossil fuel burning and, to a lesser extent, deforestation, are the cause of the current warming trend of the earth's biosphere.[14] It took an astonishing 111 years to come to this realization, after Swedish physicist Svante Arrhenius published his theory of the greenhouse effect as resulting from the widespread venting of carbon dioxide through fossil fuel incineration.[15]

Cities, towns, and villages along the base of mountainous regions, across the Alps, Andes, Rockies, and Himalayas, from Afghanistan to Canada, to India and Peru, all exhibit unmistakeable symptoms of fresh water depletion, exacerbated by rapidly retreating glaciers and snow cover. Elsewhere, urban areas face an uncertain future as well; aquifers and surface water resources have begun to fail because shifting precipitation patterns stress fresh water resources, which are already stretched by generations of inefficiency, pollution, and abuse. The early victims of this pandemic include cities in regions of the world as diverse as Australia, China, and the United States. Unsustainable modes of consumption, evident in agricultural, industrial, and mining practices, have only compounded the underlying freshwater challenge posed by the fossil fuel and nuclear power regime. The immense demand for water from electricity-generating plants—coal, oil, and nuclear—epitomise their inherent wastefulness. As a rule of thumb, the freshwater uptake of a standard 500-megawatt coal fired power plant equals that of 100,000 households.

Some urban regions affected by climate change risk slow decline through the gradual erosion of their economic base while others face more dramatic and cataclysmic damage. Inundation, flooding, storm damage, and coastal erosion—these are some of the already visible effects of climate change on cities. Indeed, greenhouse impact costs are not merely a distant possibility, but a historical fact, long chronicled in the statistics of many reinsurers, such as Munich and Swiss Re. Severe weather-related damage has increased globally ten-fold since 1950, with much of the recorded economic damage occurring in urban areas. Insured damage rose 60-fold in the United States, during the same period, to $6 billion annually.[16] Islands like Tuvalu have begun to disappear, while compensating measures for sea-level rise have focused on urban assets, from China to the Maldives and Italy, absorbing significant capital planning and construction budgets. By contrast, poorer, exposed island nations, such as the Philippines, or low-lying countries such as Bangladesh—and their populous cities and towns—are financially incapable of such adaptation measures. Those least able to adapt are also those least culpable for the climate's destabilization, as their emission levels are the lowest.

Indeed, cities in coastal regions, on low-lying islands, and in river deltas around the world are most immediately at risk, with extreme weather, storm surges, and hurricanes posing the most tangible threat. The spectacular drowning of New Orleans in late 2005 throws a spotlight on the most recent victim of hurricane-driven storm surges. Such failures in infrastructure are bound to inundate large cities in the future, and not only the easy prey, like the Big Easy, weakened by poor engineering and even worse environmental management. Most low-lying, even inland cities are under short- and long-term threat.

Climate Risks to Urban Markets and Global Security

Physical changes such as retreating shorelines are most frequently mentioned as urban and infrastructure threats. However, these do not represent the gravest impending danger to the fragile balance of urban life. While many adaptation programs for climate change focus only on the most obvious emergency response techniques, the risks, and costs already incurred, of the social and economic impact is far more profound. Examples of the potential economic impact include the chance of dramatic shifts in oceanic, agricultural, trade, and industrial productivity. Social costs would include health threats, such as heat stress, dehydration, malaria, dengue fever, and other tropical diseases. Furthermore, psychosocial damage and disruptive demographic shifts, such as migrational pressures from the hundreds of millions of climate-change refugees, must also be taken into consideration. The precise dynamics and range of these potential global shifts are not known. Much will also depend on agency of feedback mechanisms and the behavior of warm ocean currents—the thermohaline conveyor—considering the massive amount of cold, fresh water released into the Atlantic. For example, it is feared that this may be bound to trigger an abrupt climate change to more Arctic conditions in the northern hemisphere, with the result of equatorial drying and a further shrinking of rainforest cover.[17]

Although many urban priorities and threats have been discussed since at least the mid-1980s and early 1990s, the urban planning community is only slowly becoming aware of the dangers. Planners have begun to develop notional adaptation measures, but many still studiously avoid climate change mitigation as *the* millennial adaptation challenge. It is clear, however, that all climate change adaptation must involve mitigation: the immediate and sustained move from coal, oil, and even natural gas to the massive deployment of renewable energy.

The question is sometimes raised of whether petroleum decline may be, in fact, good news, as its combustion is the main culprit in climate degradation. Nevertheless, the limits in the global supply of oil and natural gas do not promise to lead to rational action: following the logic of the market, dips in oil supply are followed by price hikes, which then allow for increased marginal-oil resource production and coal conversion. Furthermore, nuclear power is neither a good short- or long-term option, as high-grade uranium in known reserves could serve as a substitute for global fossil energy production for only a few years. There is also a risk that rising carbon costs will not sufficiently restrict fossil fuel in order to successfully combat climate change. Nor is there sufficient evidence that carbon trading and clean development agreements alone will lower emissions significantly.[18]

Renewable energy means security

The only persuasive response to the twin threat of fossil fuel depletion and climate change is world-wide, focused action to de-fossilize and de-nuclearize the global economy, urban infrastructures, and regional development dynamics, and embrace a framework of freely available and distributed renewable power. The most significant urban development challenge is to boost the supply of sun, wind, water, and biomass energy, while simultaneously improving efficiency and conservation practice in both stationery energy use and transport. Urban regeneration impulses will be triggered by a broad emancipation from fossil and nuclear dependence. Regional industrial and agricultural assets have been put to the service of a globalized marketplace in which the energy cost of production is grotesquely discounted in a regime of risk-externalization, paired with massive hidden and overt subsidies.

Current fossil fuel costs have begun to rise for three powerful reasons: (a) actual petroleum prices rise due to mounting shortages, particularly worrisome for global security due to the massive pressure exerted on the poorest countries—some 40 nations already spend more on petroleum imports than their export earnings; (b) structural outlays increase due to higher prospecting, production, and processing costs in increasingly marginal fields; and (c) inexorably rising carbon penalties and the long-awaited internalization of fossil fuel's enormous health and environmental costs, such as cancer, cardiovascular disease, and oil spills, in analogy to the partial cost internalization that occurred with tax increases on tobacco and alcohol products. There are powerful reasons for this; for example, China's air pollution has given rise to $50 billion in annual health costs.[19] Both conventional energy-cost increases and risk internalization measures can help create local renewable energy production markets, regional development of renewable energy infrastructure, and a widespread boost in conservation and efficiency if paired with regulations and incentives. The move away from fossil fuel systems triggers powerful growth in local and regional employment in renewable, more labour-intensive energy industries.[20] A liberation from fossil fuel dependence boosts regional economic strength, as is beginning to be evident in a growing number of countries. Nevertheless, such forces and trends will require a careful allocation of local and regional renewable-energy production space and food supply systems.

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On the spatial planning front, a number of important improvements will reduce the risk of climate change. These involve regional planning measures, agricultural reform, and institutional changes, in order to prepare cities and regions for an era in which extreme weather events will become an everyday occurrence. Notoriously ineffective crisis response modes will give way to strategic planning, and will result in dramatic, though necessary, institutional reform. This is a time when enhanced regional autonomy in energy, water, food, and trade capacity will be rewarded by long-term viability and prosperity. To avert an epic calamity, urban civilization must be steered from its short-lived single-resource energy addiction toward a path of innovation in sustainable diversification, including energy independence and emission-mitigating forms of climate change adaptation. The key is to cut reliance on high-risk global fossil fuel supply lines and begin to foster local and regional systems of resource autonomy instead.

Twenty-seven years ago, the US Federal Emergency Management Agency issued a report calling for transcending the fossil-fuel regime for reasons of national security.[21] It was quickly ignored, and profound security concerns were sacrificed to safeguard vast, if short-term, profits for a relatively small but powerful group of beneficiaries. During a generation of relative inaction, these national security concerns have now escalated into global threats, and expanded from fuel import-induced economic and military risks, to far-reaching climate change hazards, more deeply entrenched global poverty problems, and a host of other security challenges. All of these can be traced back to continued fossil fuel dependency, while misleading and inappropriate technological answers are being offered, in the form of terrestrial carbon sequestration or boosted nuclear generation.

In cities and towns around the globe, new policy and practice frameworks are beginning to be shaped, in the hope to steer urban economic, social, and technological development toward a more secure and promising path of innovation. Such developments almost always imply a move toward more autonomous, locally powered forms of development, founded on renewable energy supplies, sourced locally or regionally. Increasing numbers of community leaders begin to pursue such paths. They understand that this is not a conventional engineering challenge or urban planning problem; it is foremost an issue of social equity, community development, and economics. Indeed, the prevailing system of subsidies favored monopolistic fossil fuel regimes over the broadly shared, incomparably more secure, and less costly sources of the sun, wind, water, biomass, and geothermal power. There is no insurmountable physical, technological, or logistical barrier to overcoming fossil fuel dependence. This change is a cultural and political task: the hope for achieving a global energy transition rises most strongly within a human innovation that has manifested global cultural achievements more than any other: our cities.

Notes

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11Association for the Study of Peak Oil, Newsletter 74 (February 2007) Figure 1. Available at: http://www.peakoil.ie/newsletter/en/htm/Newsletter74.htm#794 (accessed February 20, 2007).

12 International Energy Agency, *World Energy Outlook* (Paris: IEA, 2004).

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14 Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis – Summary for Policymakers* (Geneva: IPCC, 2007).

[15] Svante Arrhenius, "On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground," *Philosophical Magazine* 5, no. 41 (April, 1896).
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