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Will market pressures spur enough innovations to let cities such as Las Vegas thrive in a warmer world?

CLIMATE ECONOMICS

Hot in the city

Robert Buckley cautions that financial incentives alone will not fuel urban adaptation to climate change.

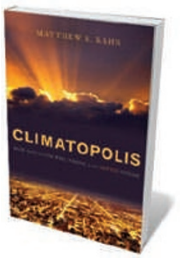
Economist Matthew Kahn is supremely confident that our cities will thrive in the hotter future. Urban areas will adapt, he believes, because the creativity generated by economic incentives will encourage the required innovations and trade-offs. In *Climatopolis*, he argues that economics offers a prism through which we can see climate policy issues more clearly.

Kahn combines economic rigour with a broad knowledge of the parts that science, history and geography play in the threats posed. He writes with passion and includes fascinating stories, many based on developments from recent econometric research. He makes lucid connections between seemingly unrelated topics. Yet in being so unerringly enthusiastic, he comes across as disconnected from the realities of people and politics.

Kahn's optimism stems from his faith that markets can solve all problems, climate change included. Although the book is filled with the various ways in which cities can become more resilient to the threats posed by climate change — such as using zoning to proscribe building in at-risk locations and building stronger infrastructure — its main point is that market incentives will launch "a billion mutinies against climate change". The price signals that induce these mutinies will inspire a cascade of innovations and adaptations that will help our cities to thrive.

Yet some of Kahn's stories suggest that he ought to be less upbeat. For example, he details how almost a century after California began charging less for water than the cost of supplying it, producers who provide only 1% of the state's annual income now receive 40% of its water to grow just four crops: cotton, rice, alfalfa and grass for grazing. He blames this imbalance on a series of baroque, often unproductive, rationing schemes that have been implemented by the state over the years to redistribute the scarce resource, thereby restricting market-driven pricing solutions. California's experience demonstrates how slow and ineffective the policy changes needed to adapt to climate threats can be. Many other adaption decisions will be made similarly.

How a city defends itself against potential flooding, for example, will not be decided by traditional economic theorists. The amount a person is willing to pay will depend on his or her vulnerability: those living higher up a hill will be less keen to finance measures than those who live on the flood plain. Effective answers depend on the political process being able to respond to climate threats more



Climatopolis: How Our Cities Will Thrive in the Hotter Future
MATTHEW E. KAHN
Basic Books: 2010. 288 pp. $26.95, £16.99

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rapidly than those threats are realized.

Beyond Kahn, optimism that political consensus will outpace the threats of climate change is in short supply. There are numerous examples of long-lasting policy distortions that seem inviolate to change. Jared Diamond's *Collapse* (Allen Lane, 2005) offers a litany of disturbing tales of unchanged behaviour in response to fundamental societal threats. It is more probable that we will behave like the proverbial frog that remains in a pot of slowly warming water brought to the boil than like the real frog that jumps out.

Kahn is adamant that the best way to deal with the risks of climate change is to rely on private insurers to decide how to price them. There is much to be said for relying on pricing mechanisms to deal with uncertain risks, and one does not have to look far for examples of failed public interventions in financial markets that have stopped these mechanisms from working. However, one wonders where Kahn has been over the past few years. Few people in Greece, shocked by the lack of transparency in their country's finances, are likely to share his view that "mutually beneficial trades" between cities and Wall Street will result in safer municipalities.

The private sector will have an important part to play in pricing and allocating the risks of climate change. But to suggest that its unfettered pursuit of its own ends will be socially optimal is so simplistic that it could undermine the reader's confidence in one of Kahn's central points — that an economic perspective on climate adaptation has value. That would be a shame, because he has a great deal to offer even if his presentation is incomplete. The question of how to price the risks of climate change has received attention in reports such as the 2006 *Stern Review on the Economics of Climate Change*, which show how small changes in assumptions can have enormous effects on policy. Simply saying that we must allow these risks to be priced by markets is not enough.

Climatopolis documents the thinking of a first-rate economist on one of the most pressing issues of our time. It is breezy but robust. I recommend it to those who would ensure their scientific and environmental perspectives on climate change are accompanied by a sound economic perspective. Kahn shows the range of linkages between science, geography, the accidents of history and behaviour. Although he takes some liberties with his prescriptions, he does so with verve. I hope he keeps at it, either on his blog or as a more-precisely argued text for university courses. ■

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SYNTHETIC BIOLOGY

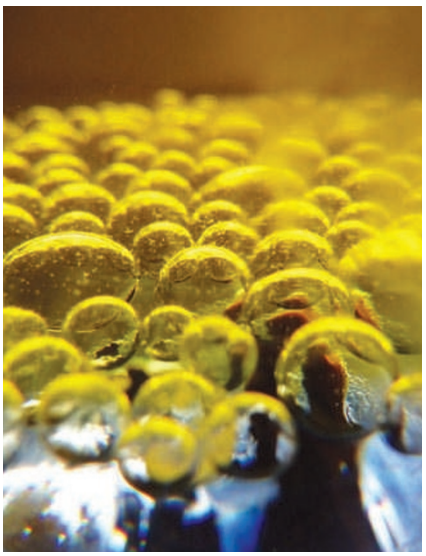
Living quarters

Synthetic biology could offer truly sustainable approaches to the built environment, predict **Rachel Armstrong** and **Neil Spiller**.

Architects have long drawn inspiration from the forms and functions of natural systems. Yet biological cells and organisms have requirements — such as nutrition and growth-support structures — that limit their use in construction. Synthetic biology offers new ways to combine the advantages of living systems with the robustness of traditional materials to produce genuinely sustainable and environmentally responsive architecture.

In the context of climate change and urbanization, there is a pressing need to replace construction methods that are harmful to our habitat with sustainable ones. Architecture is currently responsible for 40% of the urban carbon footprint, mostly due to emissions from fossil fuels burned during the various stages of materials manufacture and building construction. As global populations rise — approaching 9 billion people in 2050, 70% of whom will live in cities — carbon emissions from the built environment will increase. If we continue to build with steel and concrete, even the most stringent energy-saving measures will not curtail greenhouse-gas production. Even green roofs and walls need energy-intensive support systems to maintain them within an artificial setting.

Strategies will be required to achieve 'carbon negative' buildings, including innovative retrofitting, energy harvesting, recycling of materials and the use of elements that interact with and respond directly to the environment. Chemically active interfaces could alter microclimates around surfaces and act as 'environmental pharmaceuticals'. For example, coatings could absorb carbon dioxide on building surfaces, adsorb pollutants or trap dust particles electrostatically.



R. ARMSTRONG

Surfaces containing artificial 'cells' that absorb carbon dioxide could make buildings greener.

BIOLOGICAL BUILDING BLOCKS

The tools of synthetic biology are galvanizing the development of new forms of architecture that respond to environmental change by incorporating the dynamic properties of living systems, such as growth, repair, sensitivity and replication. Still at an early stage, diverse interdisciplinary collaborations are springing up to find new uses for top-down genome engineering and bottom-up chemical self-assembly techniques, including trapping carbon dioxide and producing energy-efficient materials. Challenges to be overcome include the sustenance and support of biological systems within the built environment, bioethical concerns and ensuring public safety.

Researchers are developing promising examples of biological systems that can fulfil architectural functions. Bacteria commonly found in the environment — such as *Micrococcus*, *Staphylococcus*, *Bacillus* and *Pseudomonas* species that also linger in air — may be adapted for use as biosensors. A new centre at the University of Oregon in Eugene plans to coordinate research that links architecture and microorganisms, both existing and designed. The university's Biology and the Built Environment (BioBE) Center, awarded funding this summer from the Alfred P. Sloan Foundation in New York, will investigate the 'microbiome of the built environment' — the complex bacterial ecosystems that occur within buildings and their interactions with humans and the environment. Such relationships are important, for example, for maintaining indoor air quality.

Species of another airborne bacterium, *Brevundimonas,* show promise as an indicator of indoor pollutants: some can metabolize toxins such as arsenic, and could be genetically