GRESHAM COLLEGE

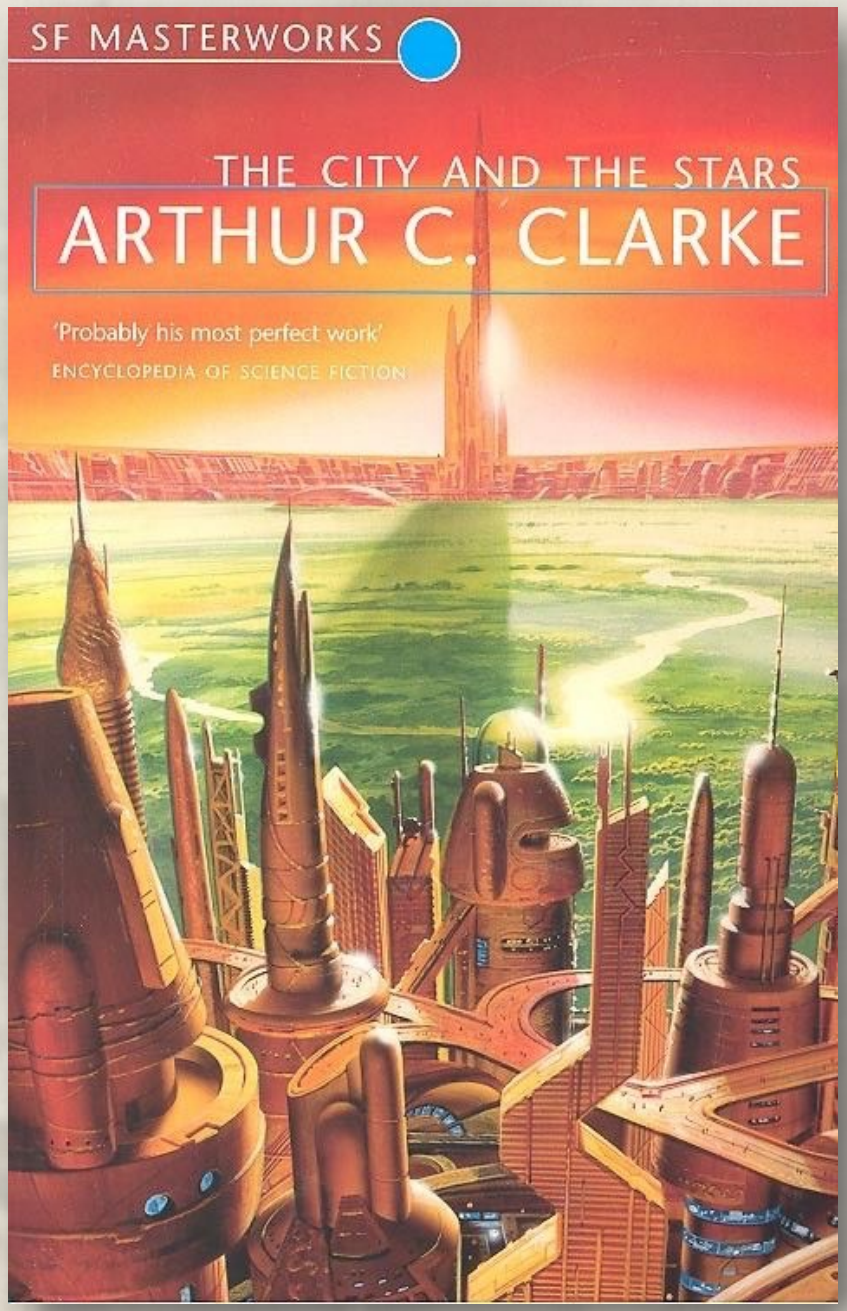
The Environmental Challenges of Megacities

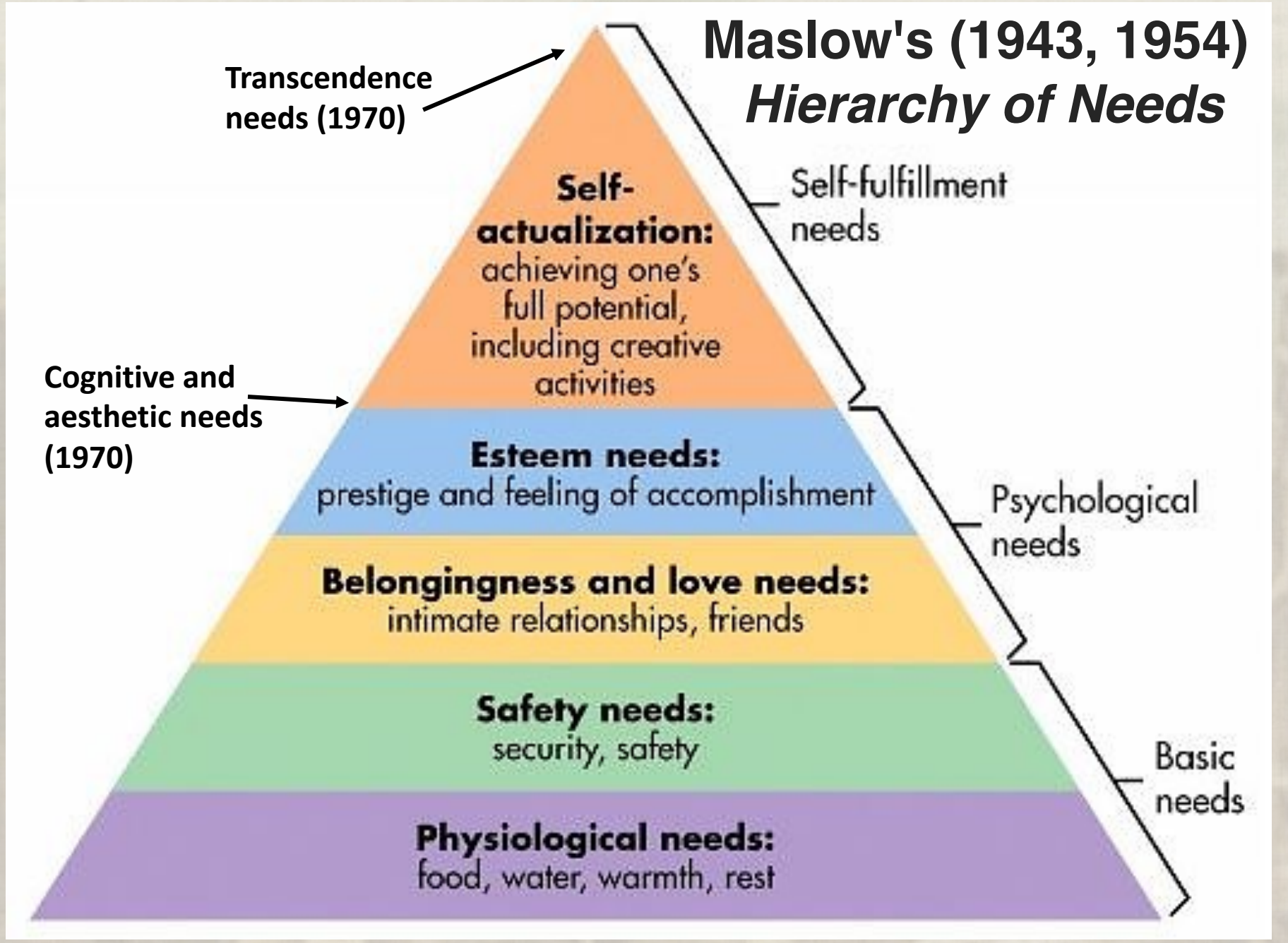
Carolyn Roberts

Frank Jackson Professor of Environment

Gresham College, London,

Water and Environmental Consultant,
Entrepreneur-in-Residence, Keele University


SF MASTERWORKS
THE CITY AND THE STARS
ARTHUR C. CLARKE
'Probably his most perfect work'
ENCYCLOPEDIA OF SCIENCE FICTION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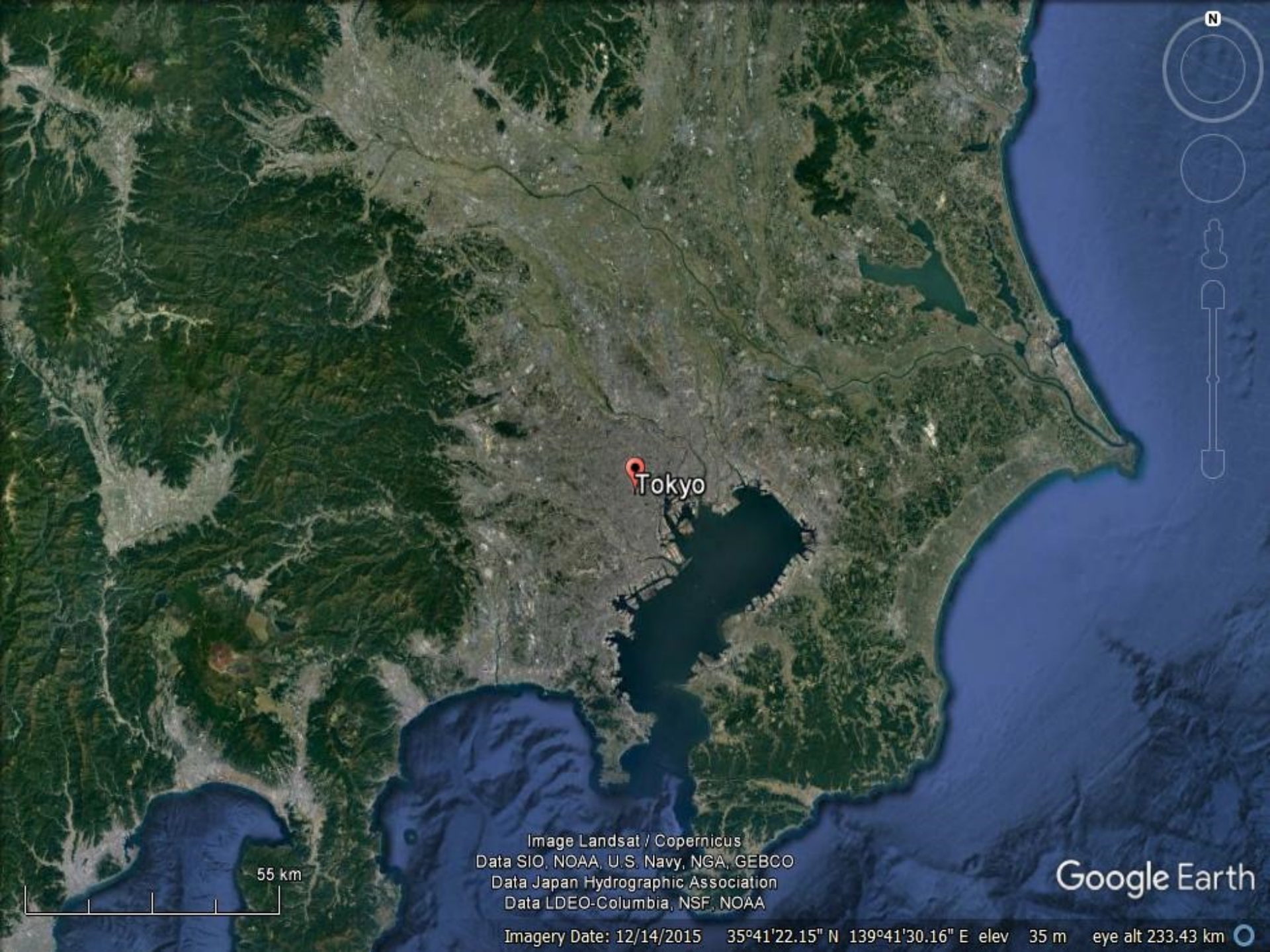
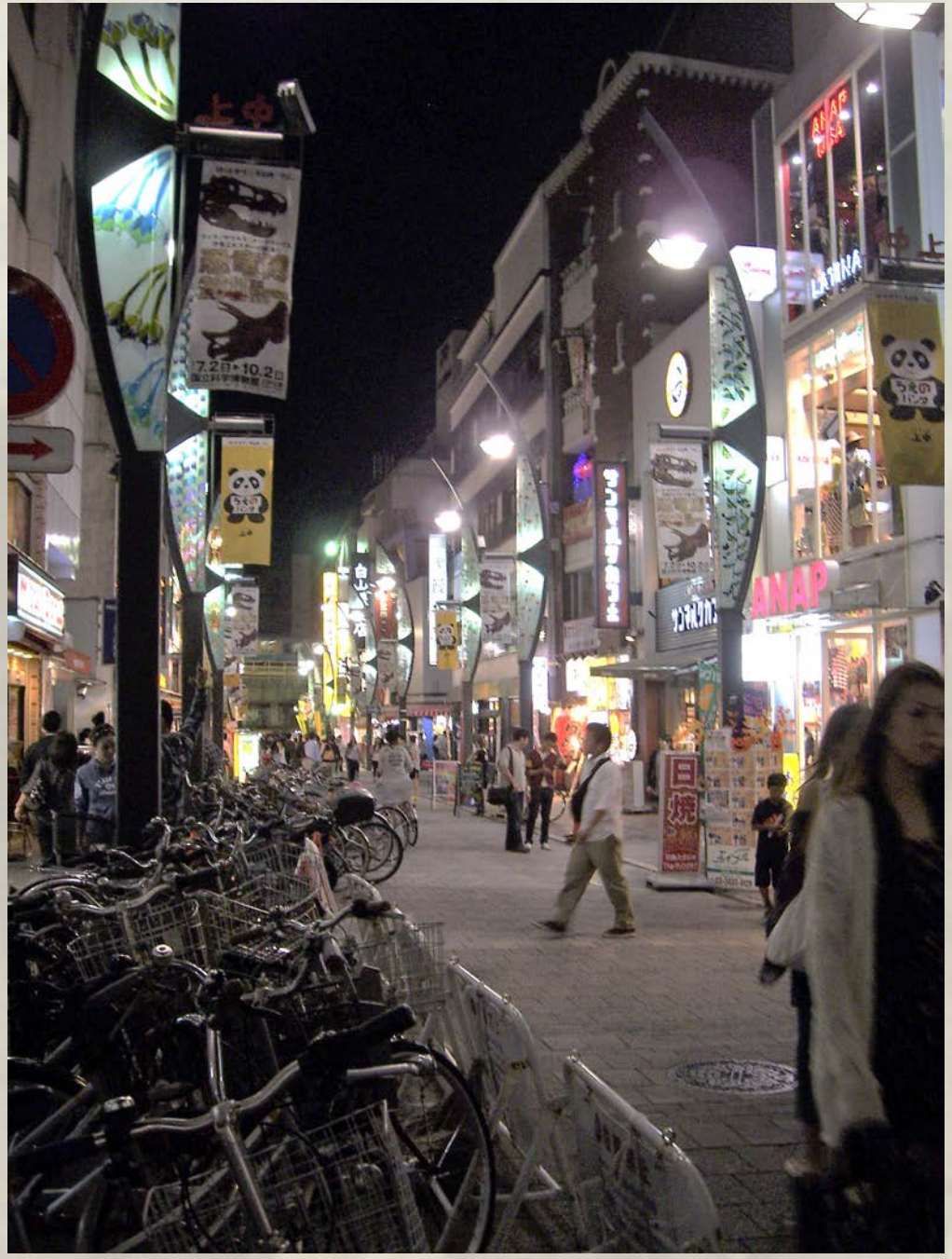
Self-fulfillment needs
Psychological needs
Basic needs


N
Tokyo
55 km
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data Japan Hydrographic Association
Data LDEO-Columbia, NSF, NOAA
Google Earth
Imagery Date: 12/14/2015 35°41'22.15" N 139°41'30.16" E elev 35 m eye alt 233.43 km

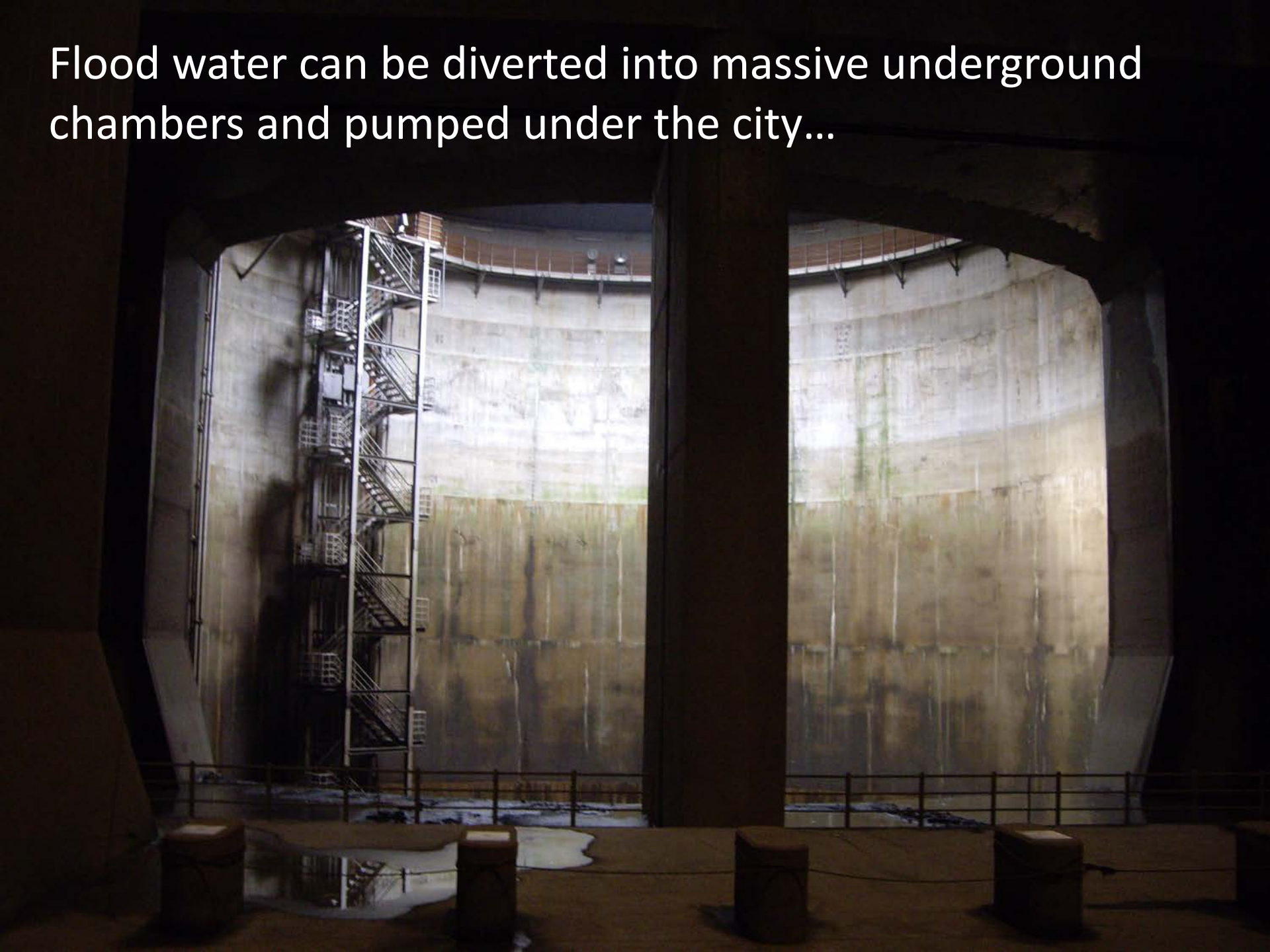

BIG APPLE.
SLOT & PACHINKO
BIG
SLOT
AOKI
SEGA
GIGO
BIG APPLE
PACHINKO
BIG APPLE
AKIBA



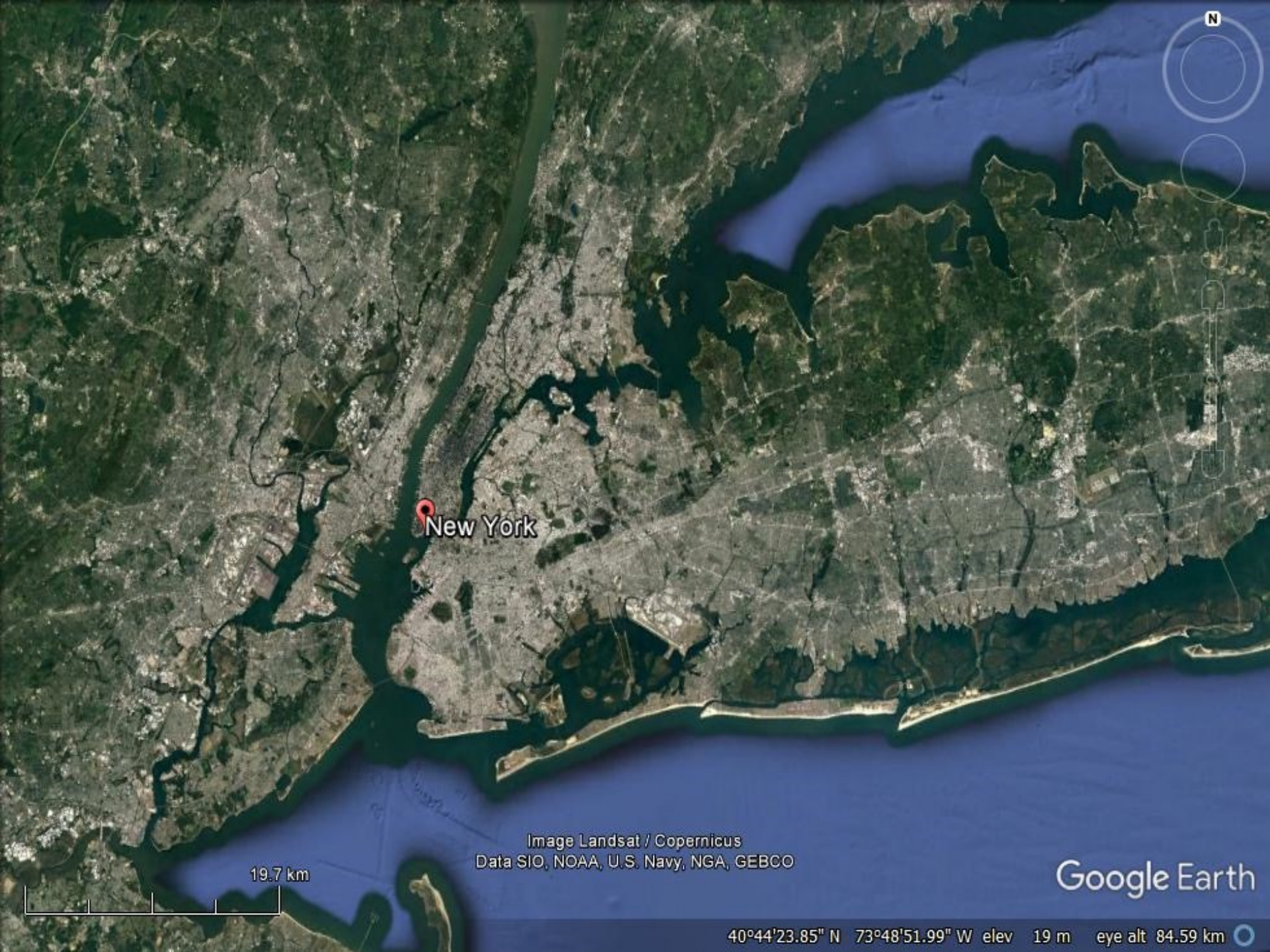
Japan is the third ‘cycling nation’ of the world, after the Netherlands and Sweden. Public transport is good, and many people cycle to the station. Neighbourhoods are often self contained, but there are few cycleways (and pavements are not universal). Conversely, parking a car in city centres costs about as much as renting a small apartment.

Flood barriers protect Tokyo from river flooding after exceptional rainfall

Flood water can be diverted into massive underground chambers and pumped under the city…

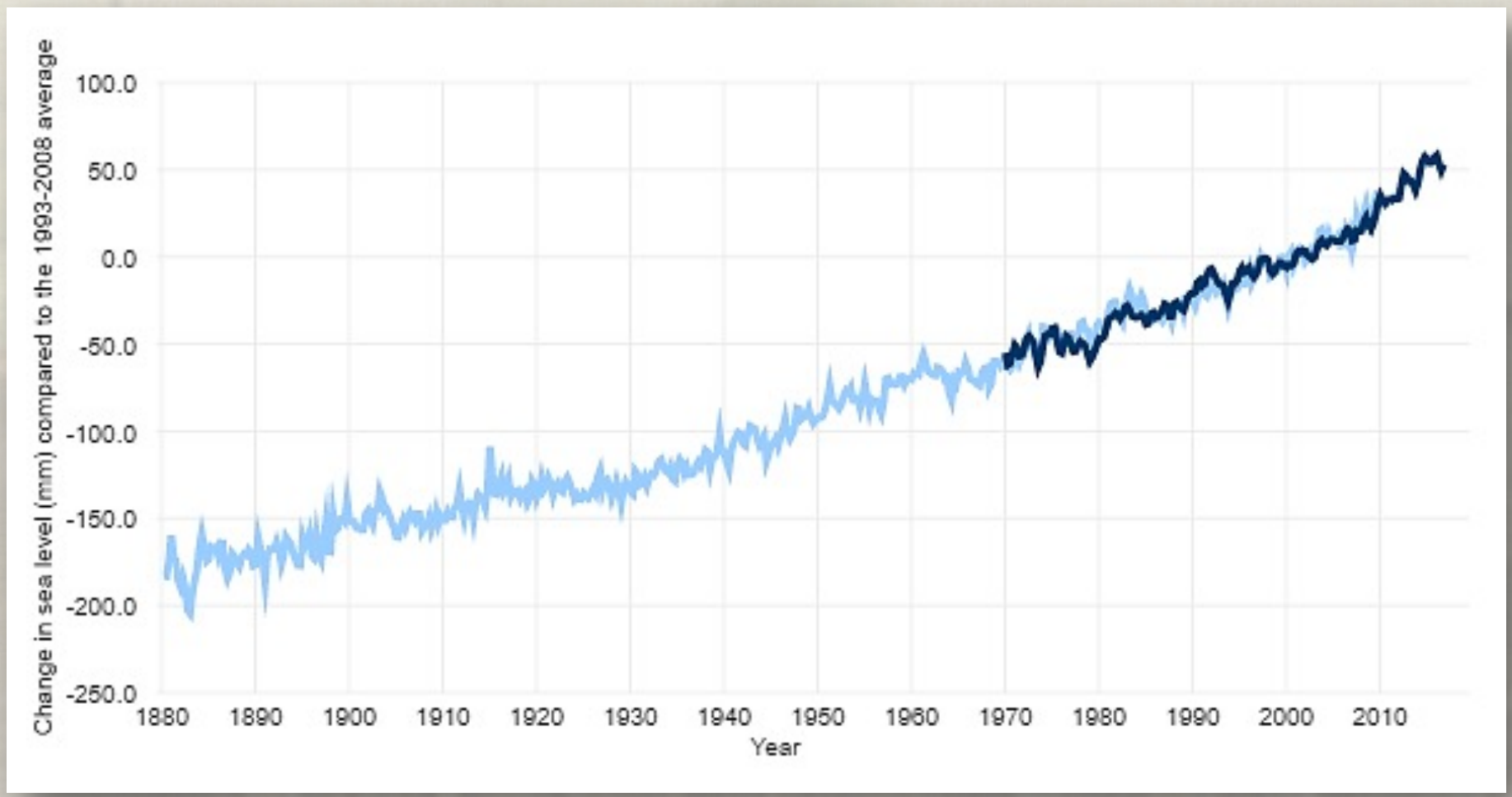



Some apartment blocks in Tokyo Metropolitan Area are positioned on ‘mega levees’, protected against flooding

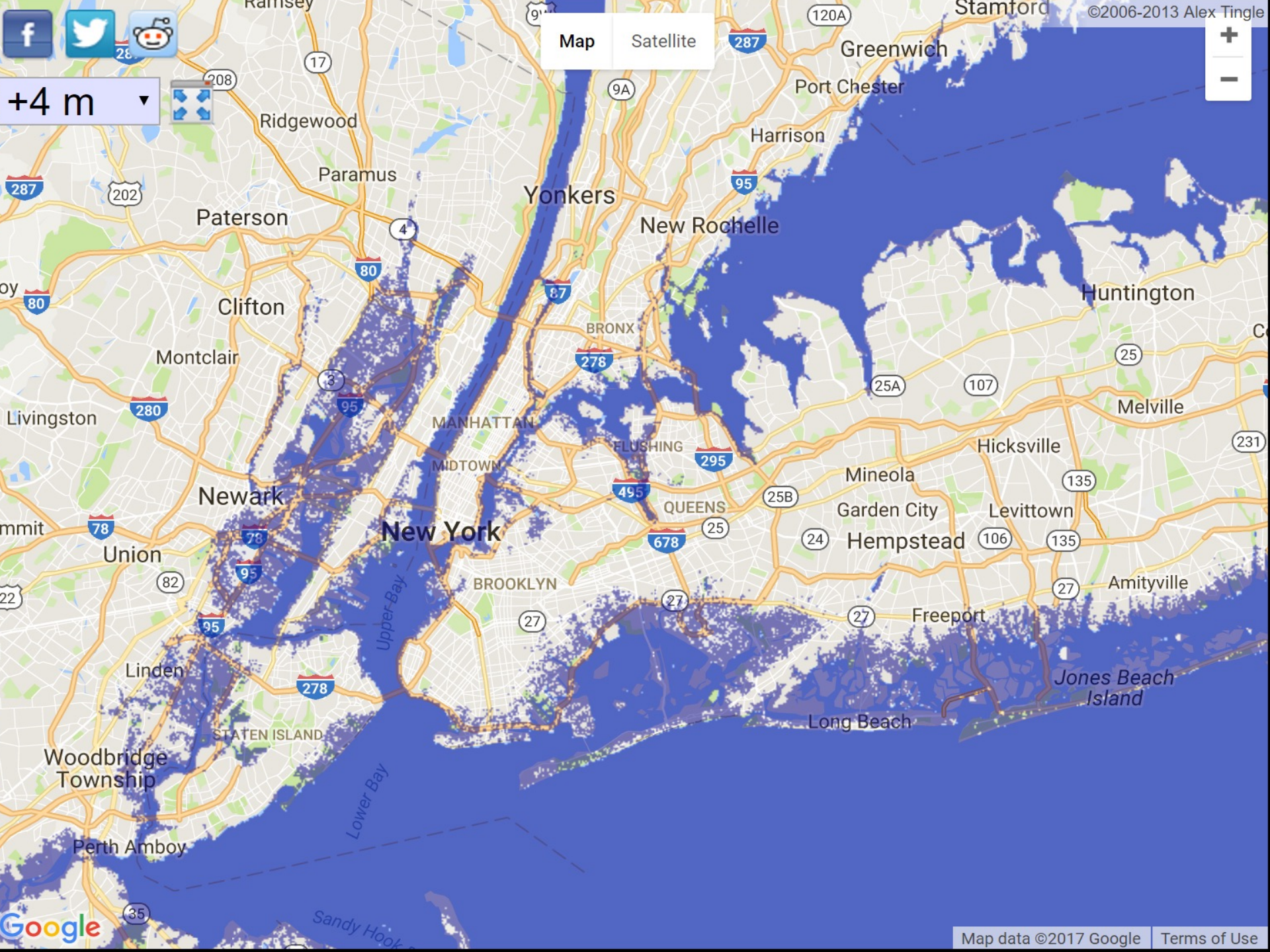

N
New York
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
19.7 km
Google Earth
40°44'23.85" N 73°48'51.99" W elev 19 m eye alt 84.59 km

American megacities depend on technology for survival….power hungry and drawing in resources from a large hinterland

Manhattan, with a proposed new skyscraper



The light blue line shows seasonal (3-month) sea level estimates from Church and White (2011). The darker line is based on University of Hawaii 'Fast Delivery' sea level data. NOAA


+4 m
Map
Satellite
©2006-2013 Alex Tingle
Ridgewood
Paramus
Paterson
Yonkers
New Rochelle
Greenwich
Port Chester
Harrison
Stamford
Huntington
Clifton
Montclair
Livingston
Newark
Union
New York
MANHATTAN
MIDTOWN
BRONX
FLUSHING
QUEENS
BROOKLYN
Mineola
Garden City
Hempstead
Levittown
Hicksville
Melville
Amityville
Freeport
Long Beach
Jones Beach Island
Linden
STATEN ISLAND
Woodbridge Township
Perth Amboy
Upper Bay
Lower Bay
Sandy Hook
Google
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Greenwich
Port Chester
Harrison
Ridgewood
Paramus
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MIDTOWN
FLUSHING
QUEENS
BROOKLYN
Upper Bay
Lower Bay
Linden
STATEN ISLAND
Woodbridge Township
Perth Amboy
Sandy Hook
Google
Map data ©2017 Google
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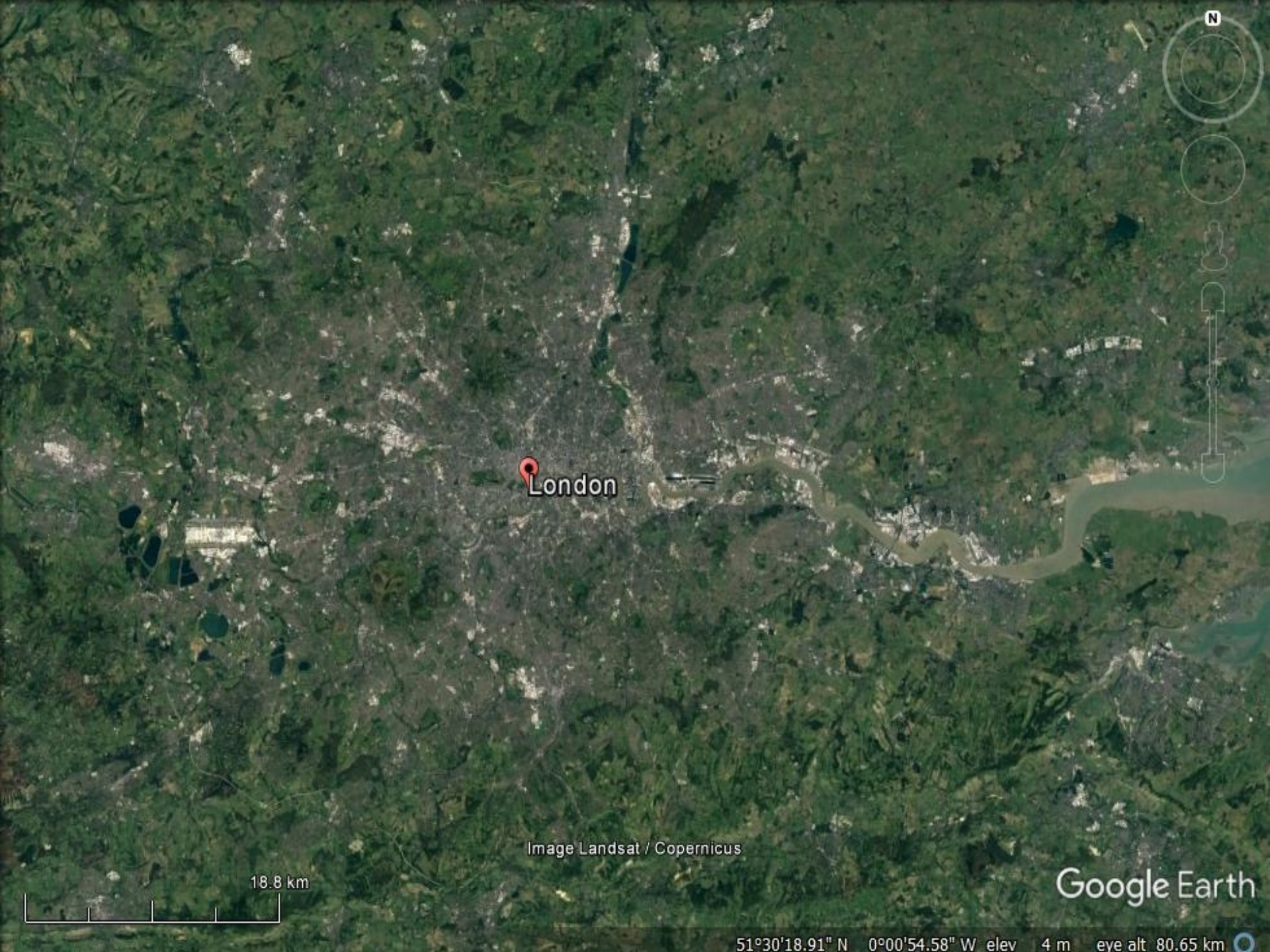
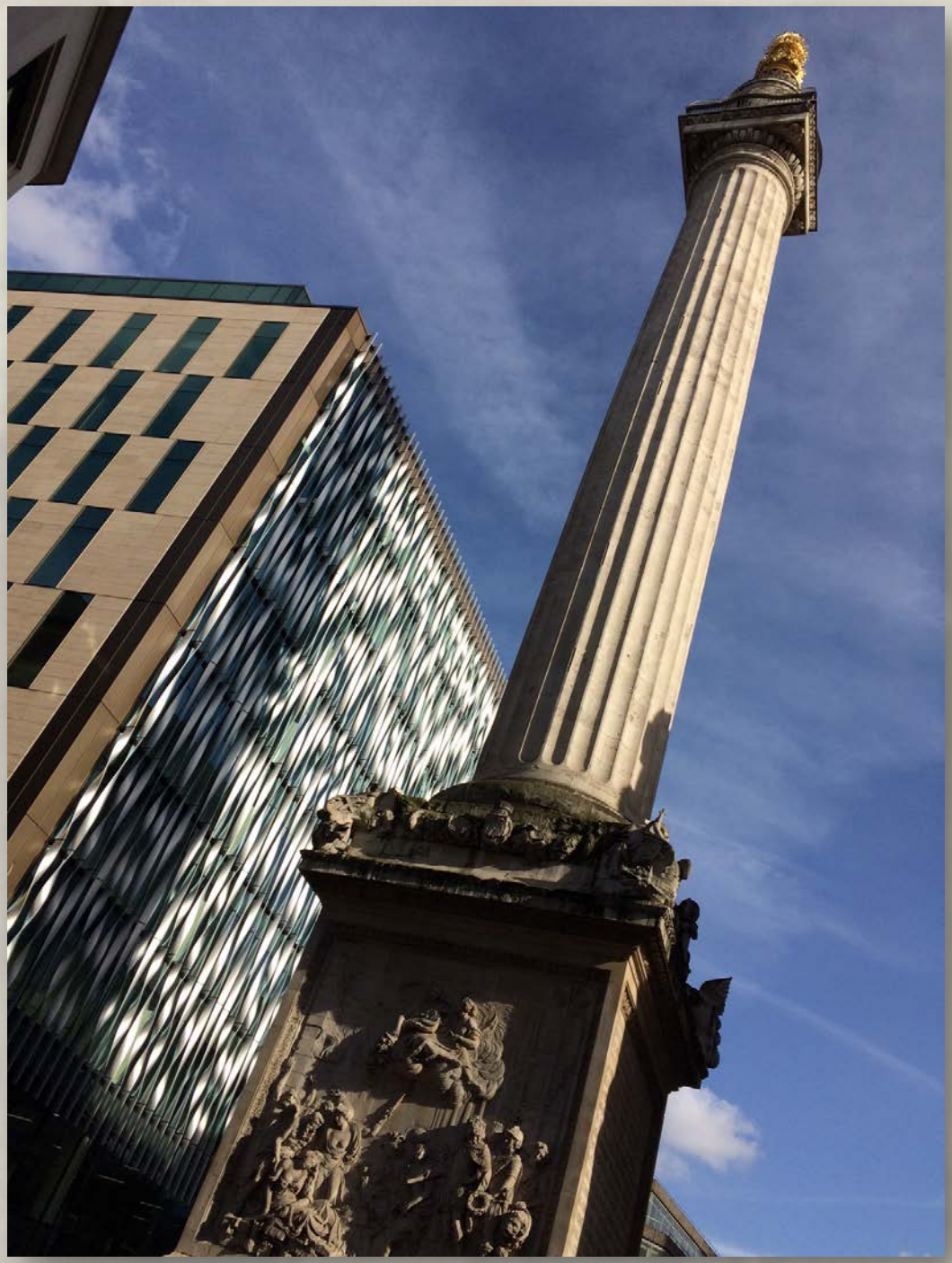
Trump International Hotel and Tower, New York

December 2013: Holderness Coast storm surge estimated to have a one in 568 year return period (precision??) according to Yorkshire Water. Pumps worked to full capacity in Hull


N
London
Image Landsat / Copernicus
18.8 km
Google Earth
51°30'18.91" N 0°00'54.58" W elev 4 m eye alt 80.65 km

Heritage and modernity: 30 St Mary Axe, London

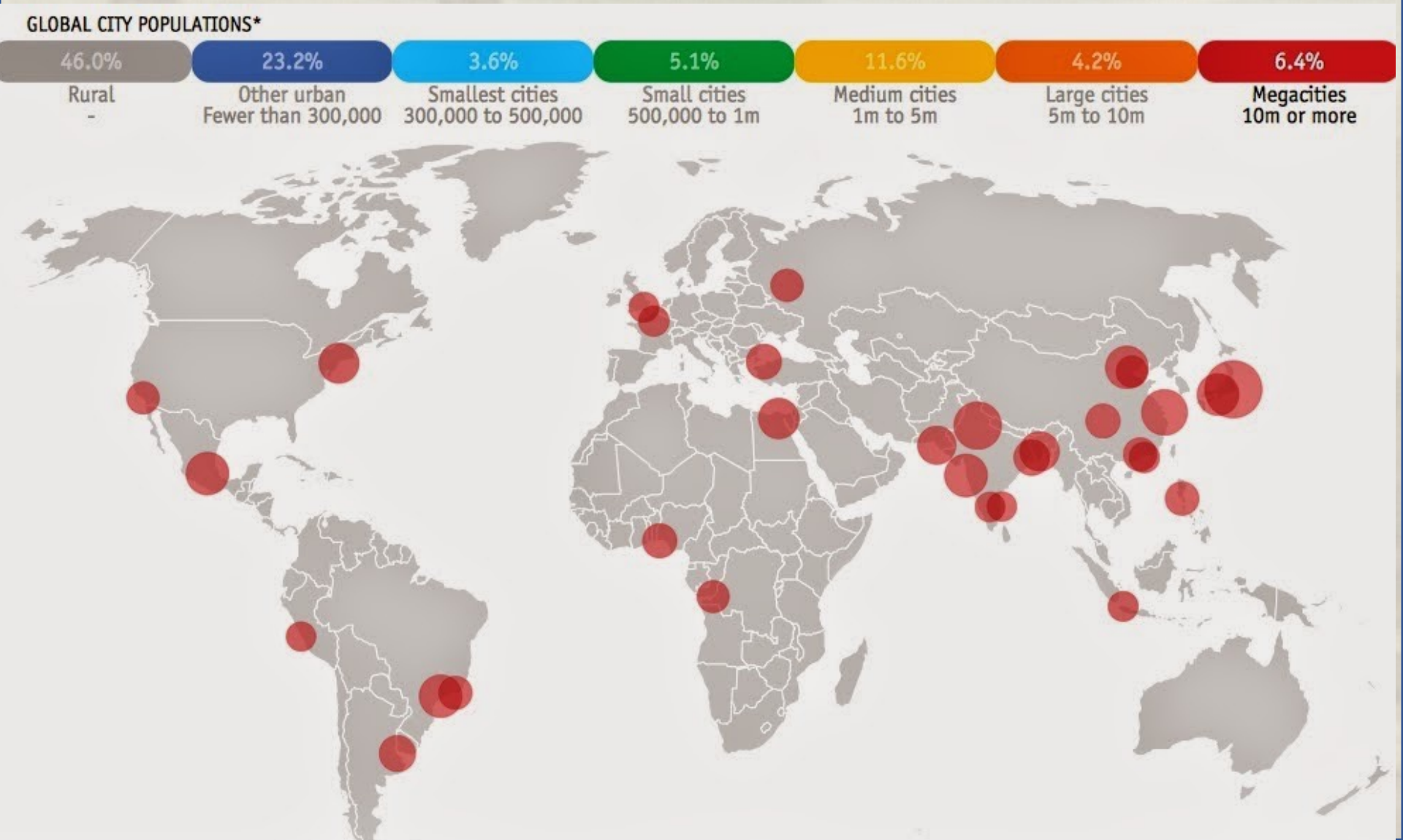


Heritage and modernity: The Monument, London, and office blocks


The Thames riverfront

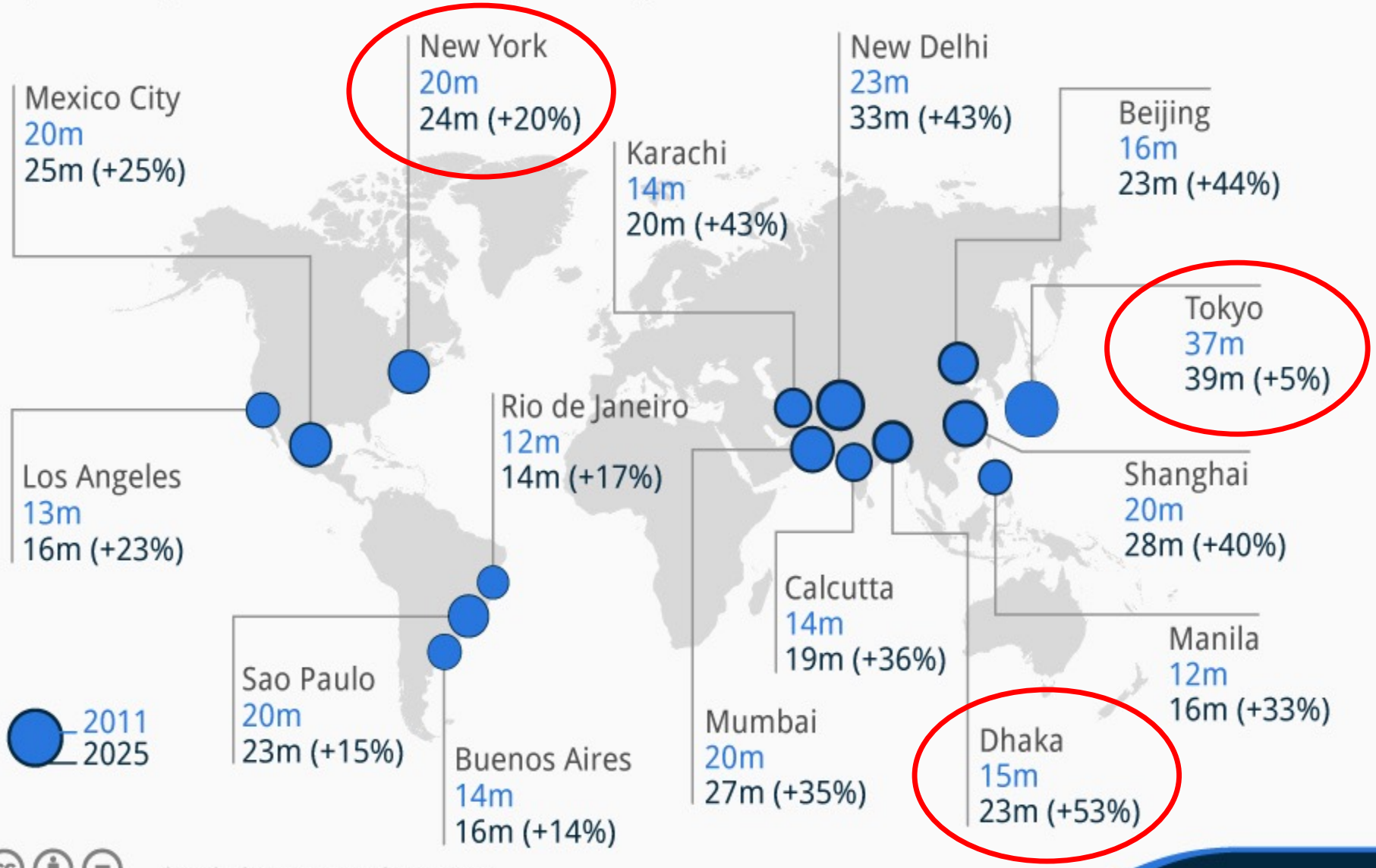

Heritage of Innovation

Map of megacities



The World's Megacities Are Set for Major Growth

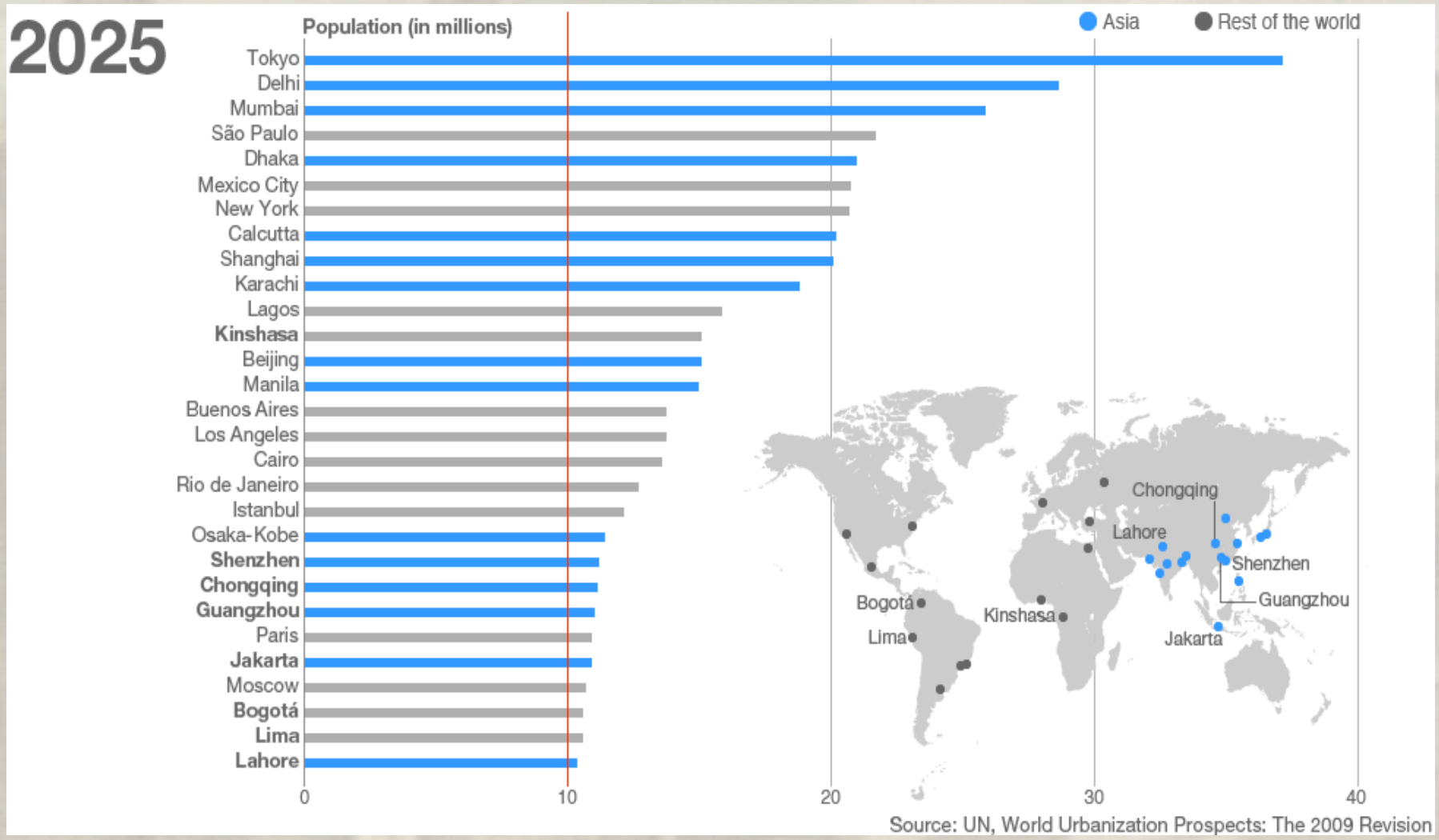
Population growth of the world's top 15 megacities (millions, 2011-2025)



* including metropolitan areas

Source: UN Population Division, World Economic Forum

Asian megacities (in blue) are set to dominate by 2025



Planned megacities: Shenzhen, China

Shenzhen’s planned new gleaming towers

IFEZ South Korea

Unplanned megacities.

Dhaka, Bangladesh, is one of the fastest growing megacities, and has the highest population density of any urban area, perhaps reaching about 45,000 people per square kilometre. By contrast London has about 1,510 and Gibraltar about 5,000 people/sq km. Half a million new migrants arrive every year, to add to the 18 million already living in this historic city.

Dhanmondi (left) is an area of universities and businesses.


A more typical
scene elsewhere
in Dhaka

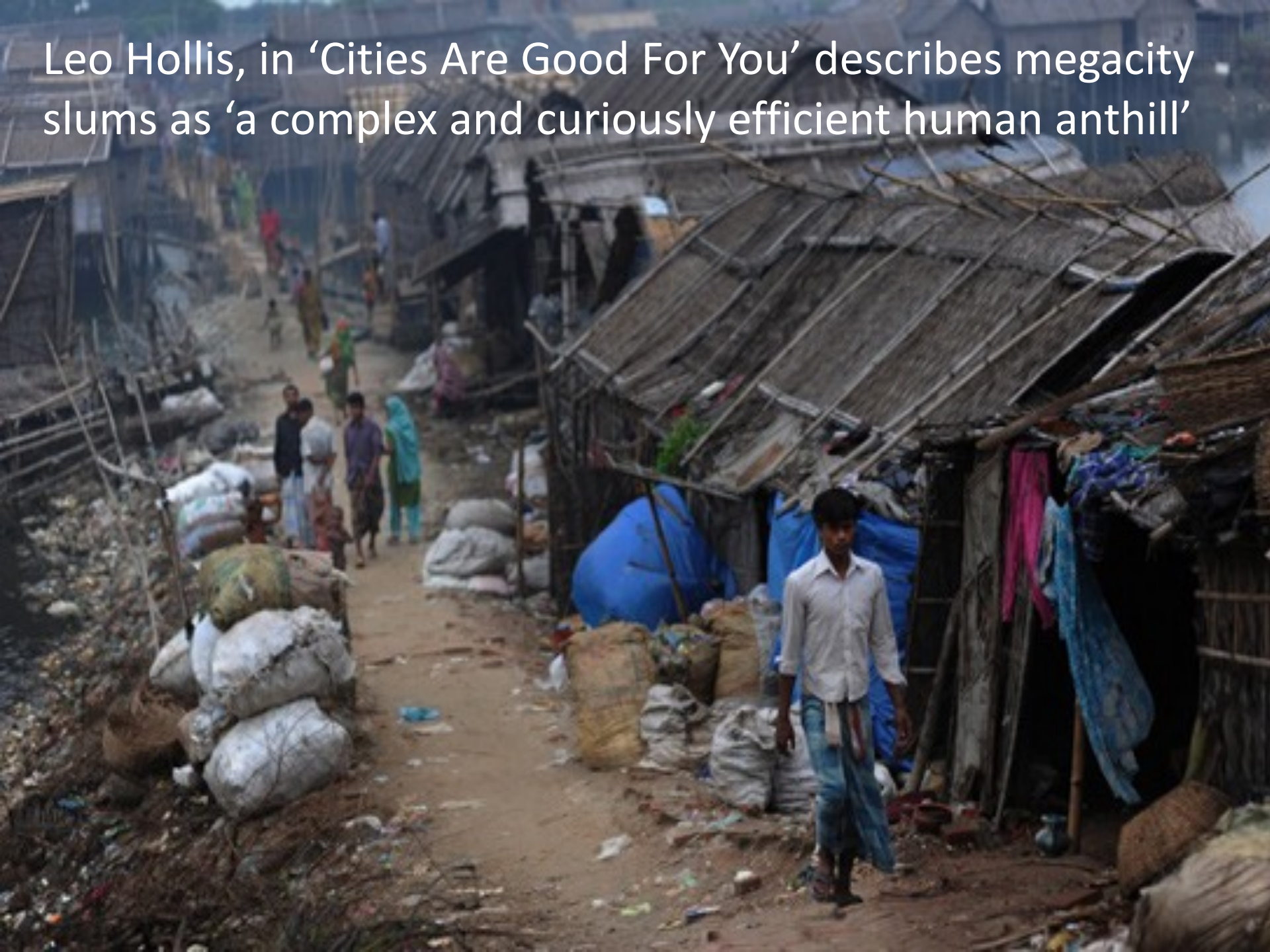

ATN
BRTC
TO-LET


Inter City


Have A Nice Tour
R.M.P
সুপার
সৃষ্টির সেরা উপহার হচ্ছে "মা"
"নামাজ বেহেস্তের চাবি"
ঢাকা মেট্রো-ব
১৪-৫৩৮৬
ভাড়ায় চালিত

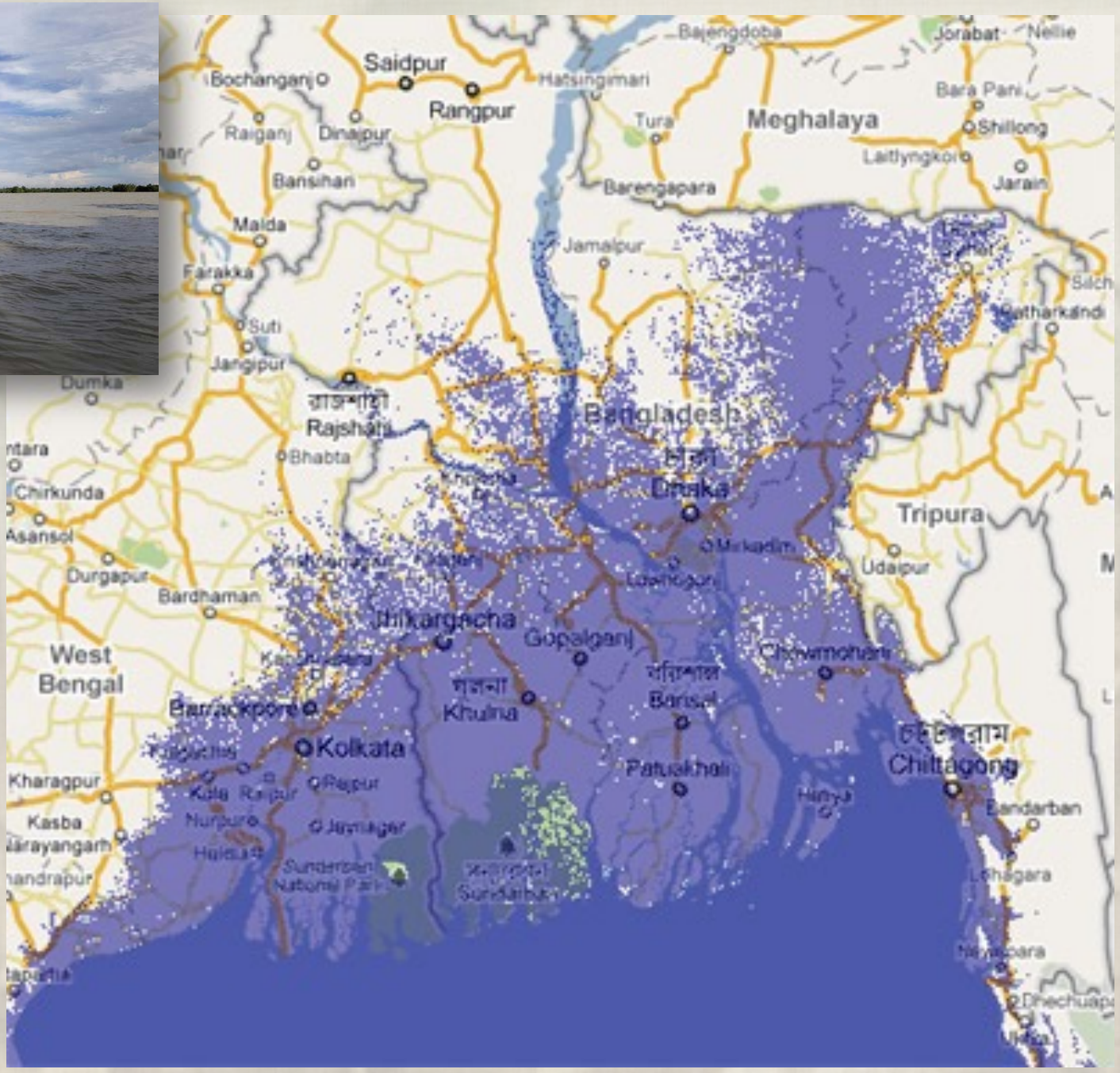

একতা
ঢাকা মেট্রো-ব
১৪-০৬৩৩

Leo Hollis, in ‘Cities Are Good For You’ describes megacity slums as ‘a complex and curiously efficient human anthill’



Slumdog Millionare? Inequality in the Dhaka megacity

12 metres of sea level rise In Bangladesh



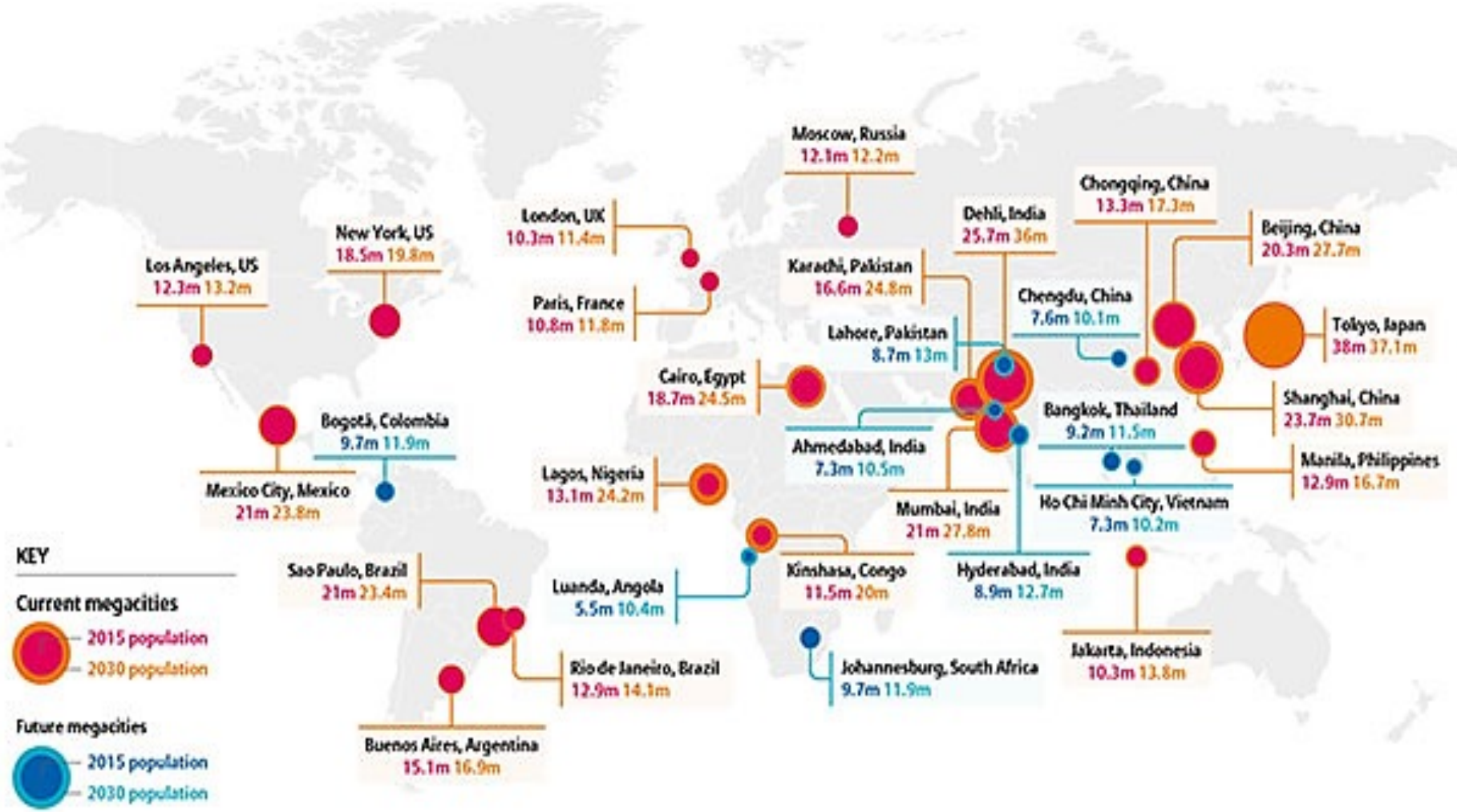
Inequality: Post apartheid Cities in South Africa.
Photo by Johnny Miller

Earth at Night

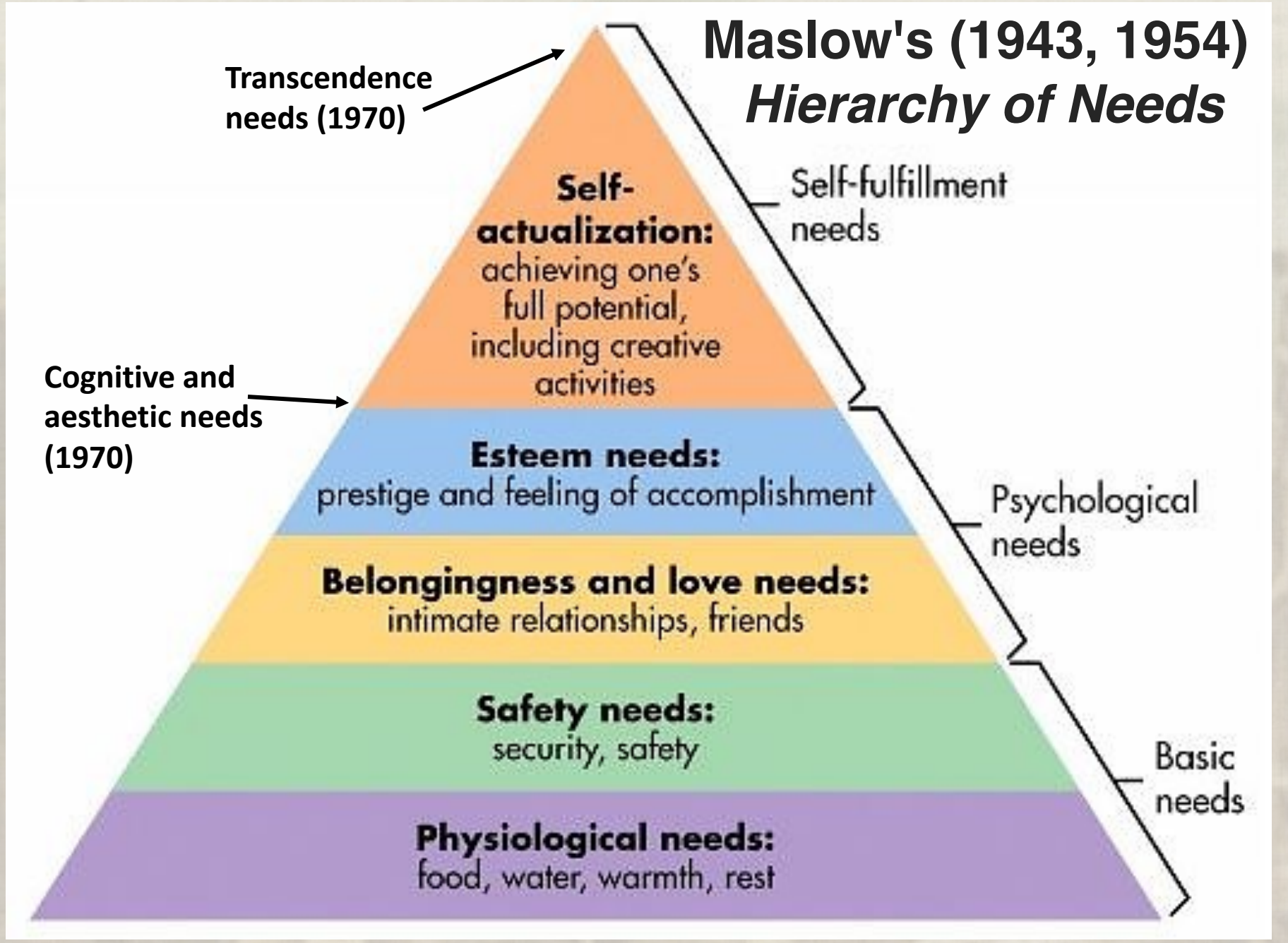
Earth at Night 2012 imagery obtained from NASA Earth Observatory
Main image showing the data displayed on an equal population projection
(gridded population cartogram)

Benjamin D. Hennig
www.viewsoftheworld.net

Figure 1 Selected current and future megacities 2015 to 2030



Source: World Urbanization Prospects: The 2014 Revision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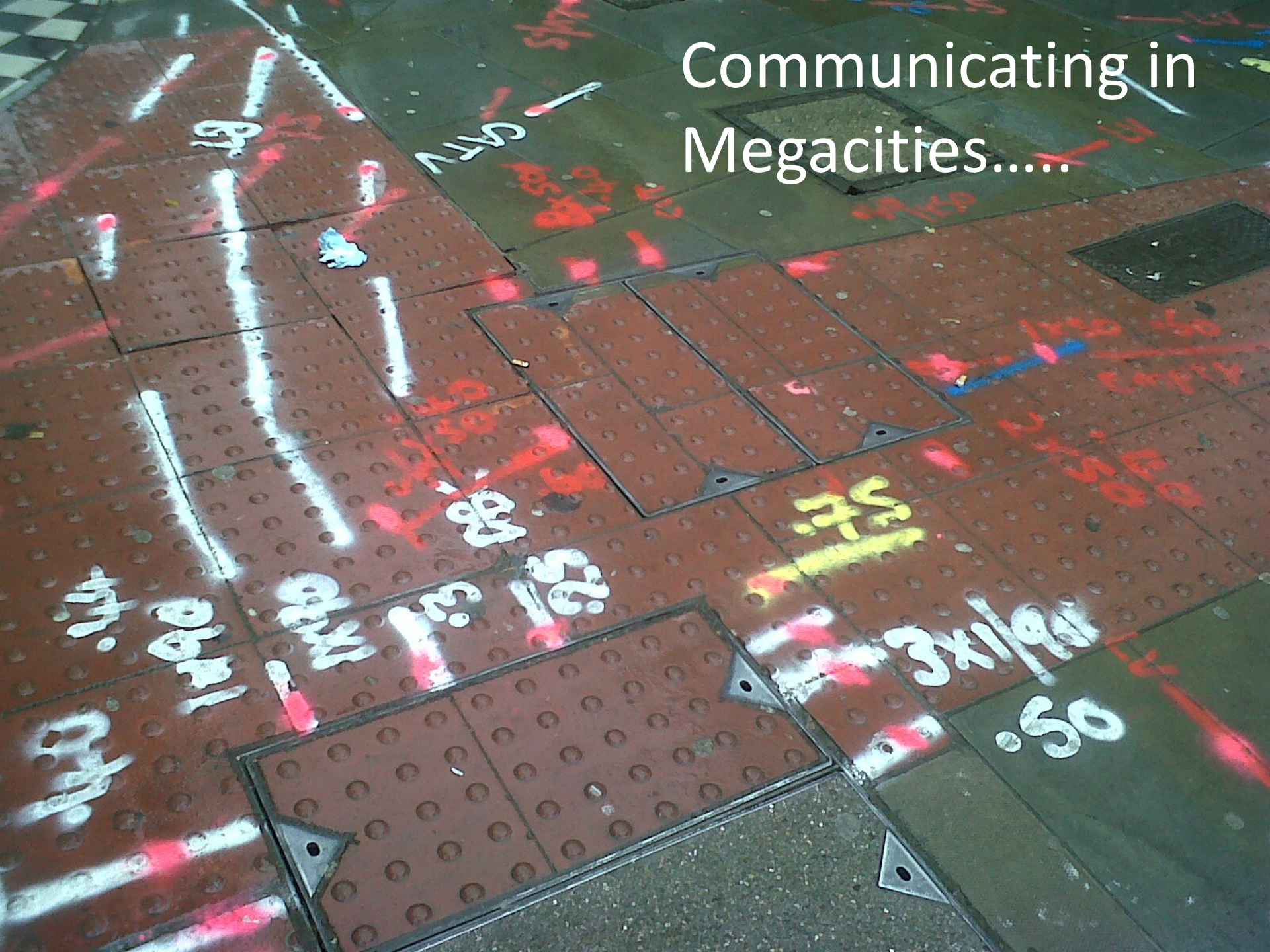

Communicating in Megacities…..

'Friendship Visualisation' shows links between 10 million randomly-chosen pairs of Facebook friends, using anonymised data taken from their massive Apache data warehouse. Inter-megacity communications are evident.


LOGIC LANE


TURN AGAIN LANE
OXFORD CITY COUNCIL
8am


Café & Sandwich Bar
Via-Agra
82 GOSWELL ROAD
TEL/FAX 020 7235 1118
HOT & COLD BUFFET • SANDWICHES • BAKED POTATOES • SOUP

Moving goods and people around the city….

Moving goods and people around the city….

Personal Rapid Transit system in Morgantown, West Virginia, from 1974 onwards

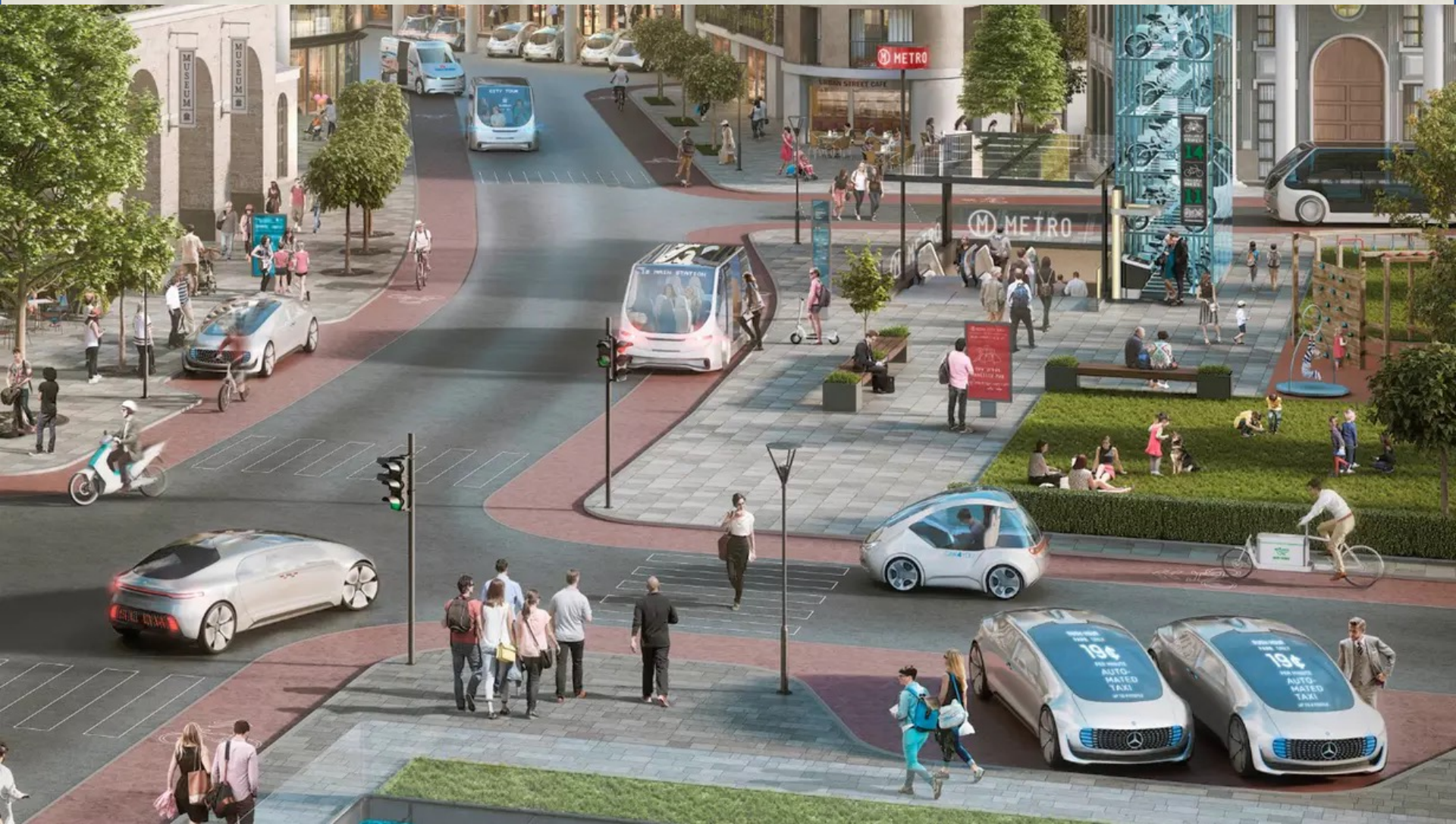
- 98% available
- Carries c 2.25 million people per year
- 14 km track, 5 stations
- Fare 50 cents
- Max 20 people per cab (record 97 students)
- One minor accident in November 2016

Chinese megacity public transport

Coming shortly to you at 4mph…and already in the Netherlands and Germany…Domino's Pizza

7-Eleven delivers your candy and 'slurpees' in Nevada by drone

Daimler, with Bosch, imagine a future where the vehicle comes to the driver, not the other way around…..and autonomous cars on the road by 2020.

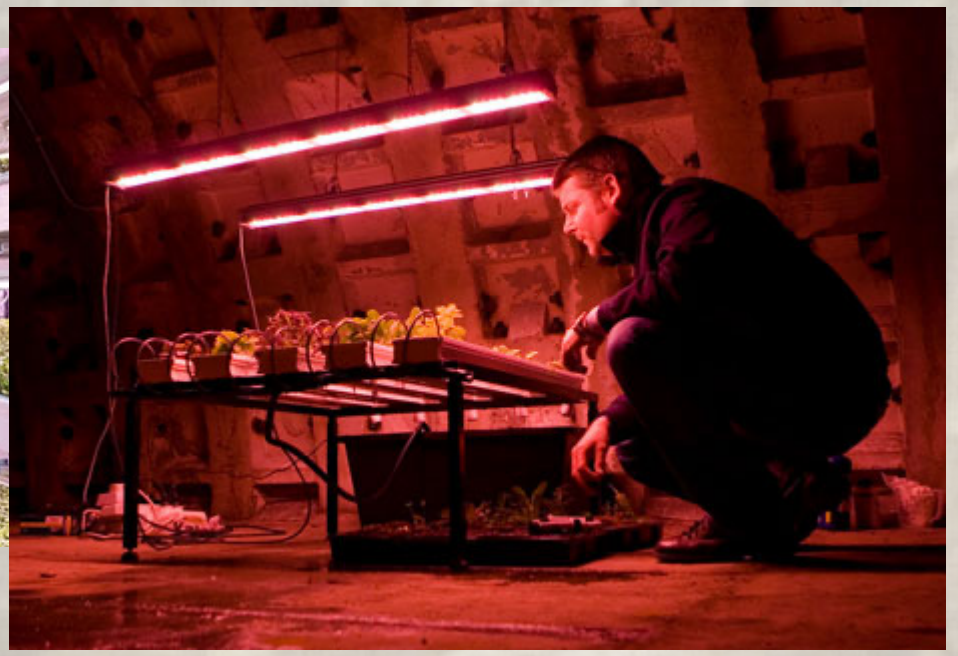


A render of what Airbus' multi-passenger commuter drone, scheduled for 2027, could look like but….


SHUN TAK

Meeting the megacity’s environmental needs….

Food from tunnels under south London supplies Clapham restaurants and retailers with herbs and vegetables: farm to fork in under four hours. ‘Growing Underground’ is beneath London Underground's Northern Line in tunnels originally built as air-raid shelters during the Second World War. The hydroponic farming involves growing plants on (growing) platforms in a nutrient solution under controlled temperature and lighting conditions.




Battery Urban Farm gardening project in New York City is a one acre educational farm in Manhattan

Valcent Products' VertiCrop – a vertical hydroponic system producing 500,000 lettuces p.a. in a 250m^2 greenhouse, using less water and energy, without pesticides. Water and nutrients are recirculated. Moving hangers give the plants air flow and light using the full height of the building. Plant growth can be optimised, with more crop cycles per annum.


BB&T
WELLS FARGO
Sheraton

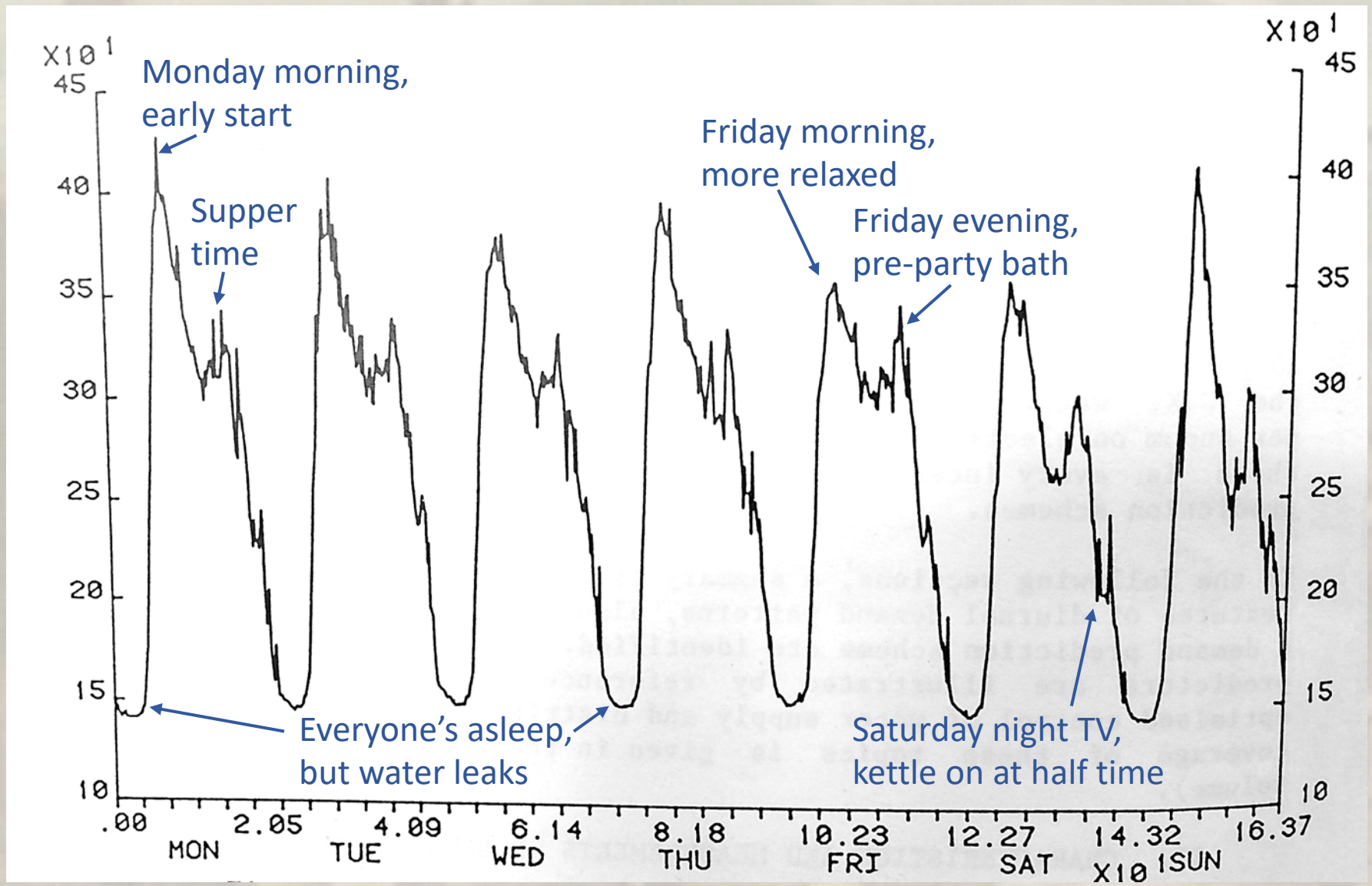

LK57 FUW

Aqualta by Clouds Architecture Office: New York adapting to rising waters.
Photograph: Clouds AO

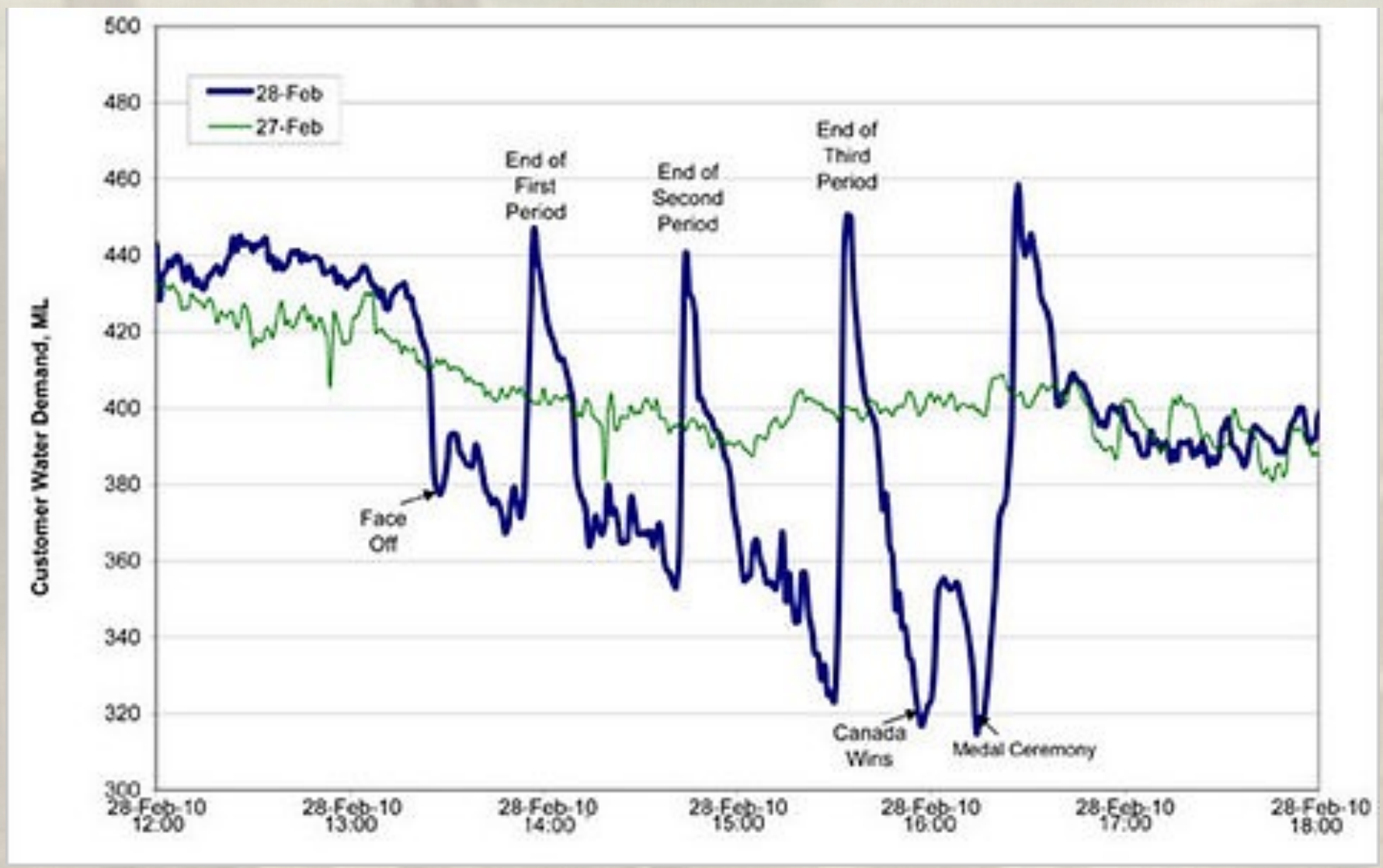
Propelair air flush toilets installed by London Borough of Redbridge in forty five flats in Ilford, and by King's College London

84% less water; 80% less energy for water and waste processing; less airborne infection

Typical Weekly Water Consumption in UK, after Coulbeck and Orr (1986)



Water Consumption in Edmonton during the Olympic Gold Medal Hockey Game




Air quality problems with NOx, SO2 and fine particulates in the Chinese city of Changsha

Alternative transport scenarios

- People get around using highly planned, green and efficient public transport
- Petrol and diesel-fuelled cars dominate, and rich people pay extra to beat the jams
- Transport is personalised, and people move in a range of small electric vehicles, souped up bicycles, scooters and ‘pods’

NERC and Forum for the Future Scenario 1: "Greater Harchester"

Large UK cities are politically and culturally powerful. These cities have restructured their financing and closely integrated systems at the city and regional level - such as transport, water and waste.

There is a strongly utilitarian ethic that aims to provide high quality, extremely efficient mass solutions. Policy in all areas - transport, energy, food - is structured around improving public health and lowering carbon emissions.

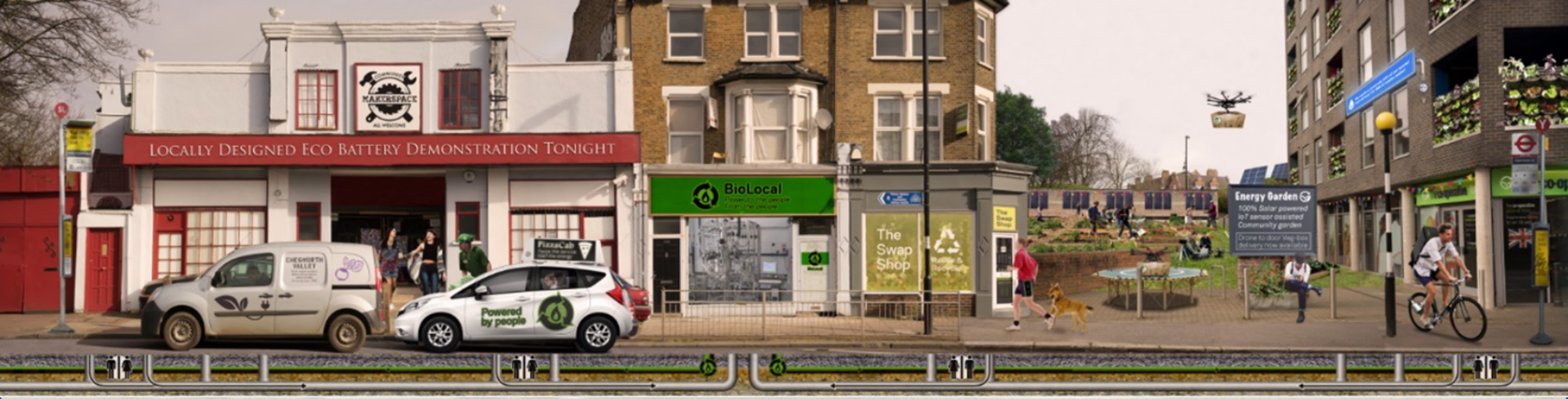
Ubiquitous technology saturates urban environments and is taken completely for granted, giving a real-time detailed picture of the city and allowing for complex coordination of services. Data-sharing is widely accepted as a necessity for high-quality services; Big data and behavioural 'nudging' are liberally deployed to solve complex urban challenges and maximise public health and wellbeing.

NERC and Forum for the Future Scenario 2: "Market Newton"

This is a high-tech, highly integrated world. The internet of things is everywhere, and virtual reality is commonplace and widely used for work and leisure. People wear devices that gather data about their health, eating habits, and leisure, and then sell this information to private companies.

There are high levels of automation and correspondingly high rates of unemployment and inequality; a large section of society survives on a small basic income topped up by sporadic work in the virtual economy.

Cities are private sector led and 'pay to play' – there is huge choice in terms of products and services on offer, all with the aim of selling as much as possible. Public services are minimal.

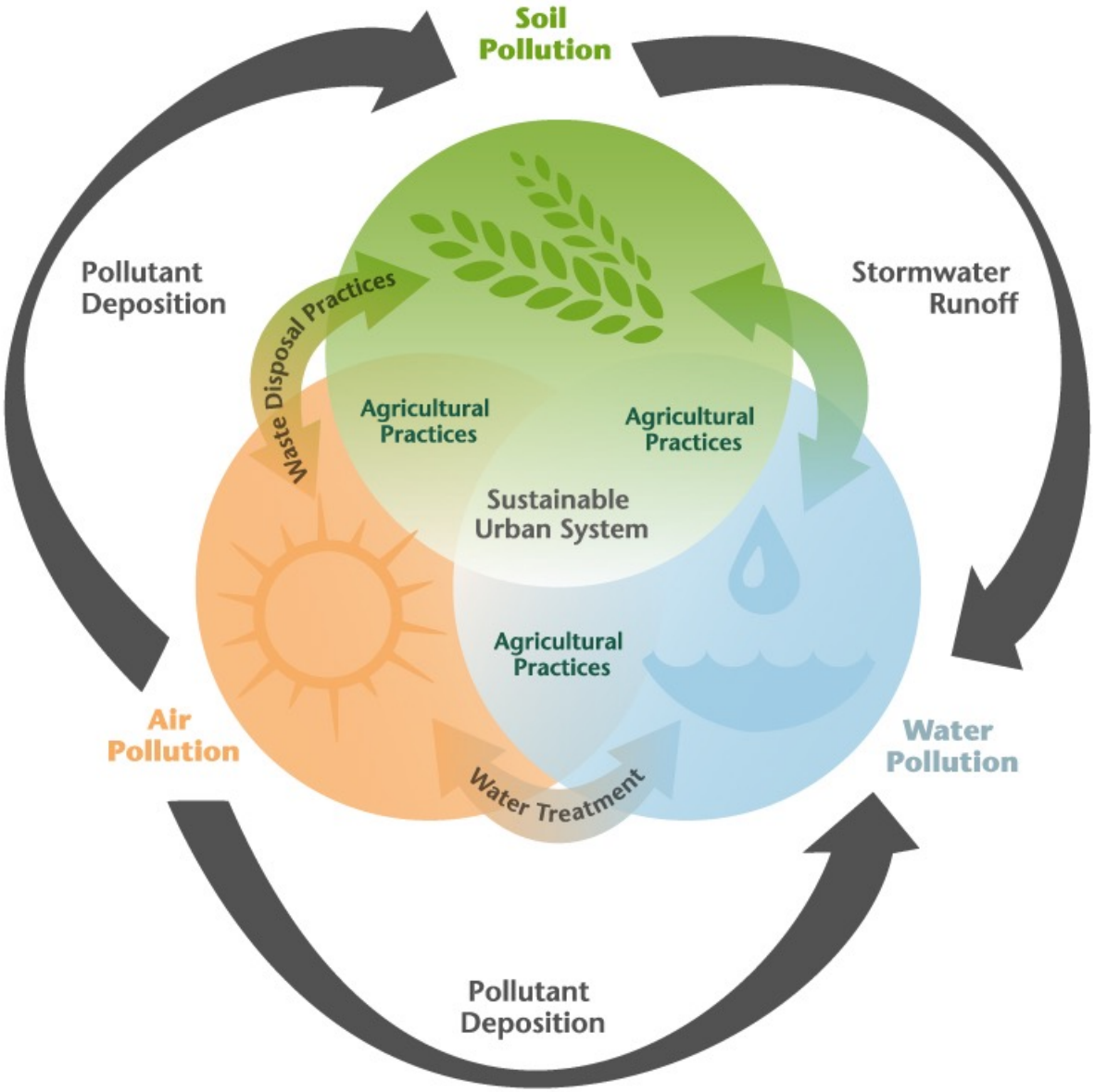


NERC and Forum for the Future Scenario 3: "Little Langbrook"

Despite a low-growth global economy and continual low public spending, many UK communities have found a way to flourish through a philosophy of living better with fewer, more durable goods. Life is facilitated by technology but very much grounded in physical spaces; people value the ability to connect with each other in person without technology at the centre.

UK cities are dense and centred around small, self-contained communities. Urban services are integrated on a small-scale and by repurposing existing infrastructure. They are often locally-run, and include everything from health to energy to food supply. Innovation is citizen-led and enabled by distributed manufacturing technologies and digital platforms.

There is an egalitarian ethos, but inequalities remain – some communities are wealthy and resilient, and others lack access to resources and struggle with economic and climate shocks.



The Food-Energy-Water (FEW) Nexus

Integrating waste, food production and water management, at Grow Up Farms

Integrating approaches: Recovering nutrients and energy from waste water

European Commission

Nature-based solutions

"…we define nature-based solutions to societal challenges as solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions."

Albion Water – managing whole systems

- Albion provide water and wastewater networks, and onsite treatment with natural wetlands and reed beds, using ‘green’ but non-potable water for toilet flushing, SuDS and management of land
- Specialising in UK areas of relative water shortage, designing houses, the facilities and equipment and site layouts
- Water efficiency and biodiversity benefits
- Collaborating with major UK water companies with real (ie not ‘demonstration’) housing areas and industrial sites
- Popular with residents

Albion WATER

The Rapid Re(f)use project supposes an extended New York reconstituted from its own landfill material.
Photo: Mitchell Joachim

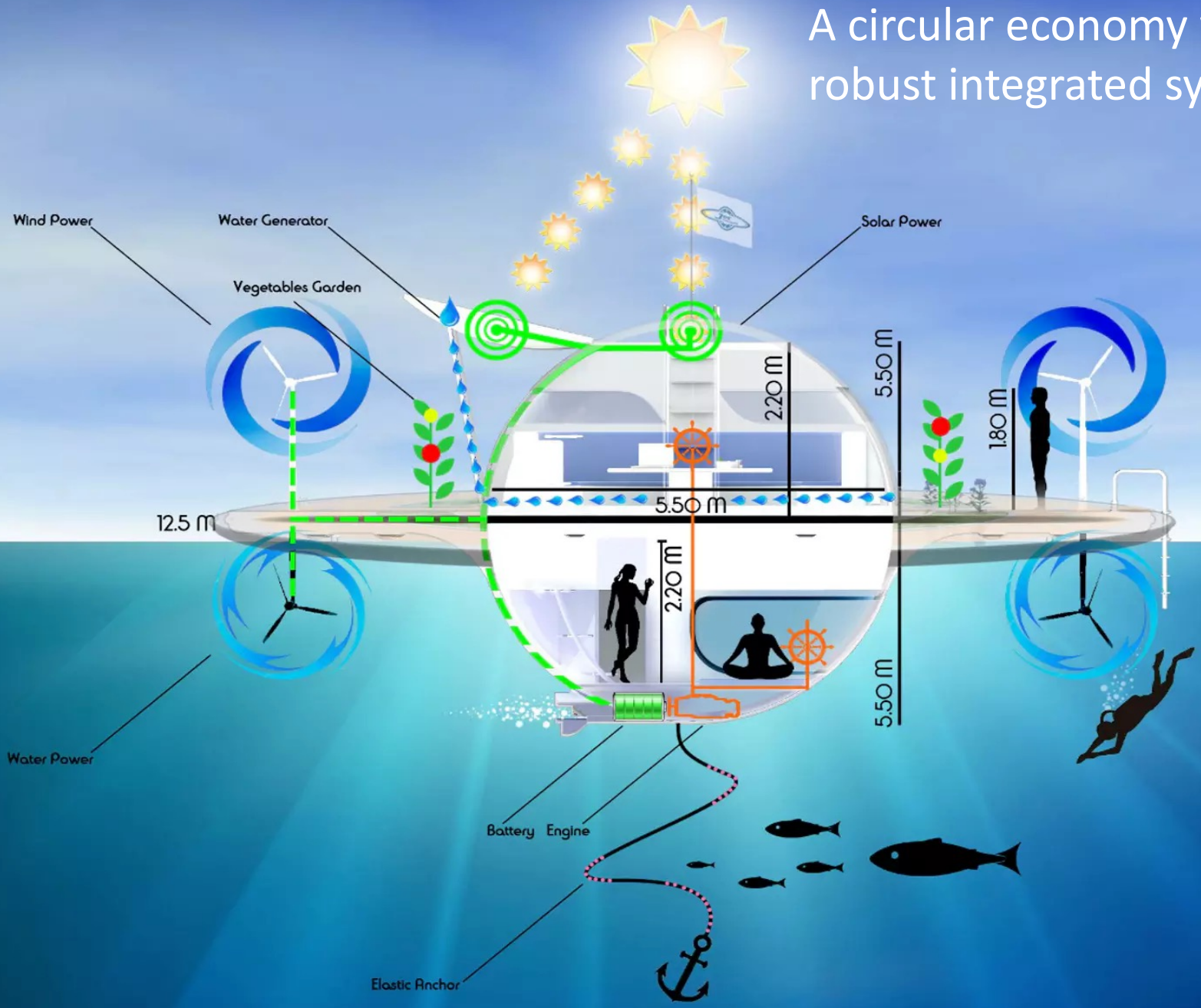
Vertical Forest, Nanjing, China (render)

Terreform One’s vision of New York as a smart city. Photo: Mitchell Joachim

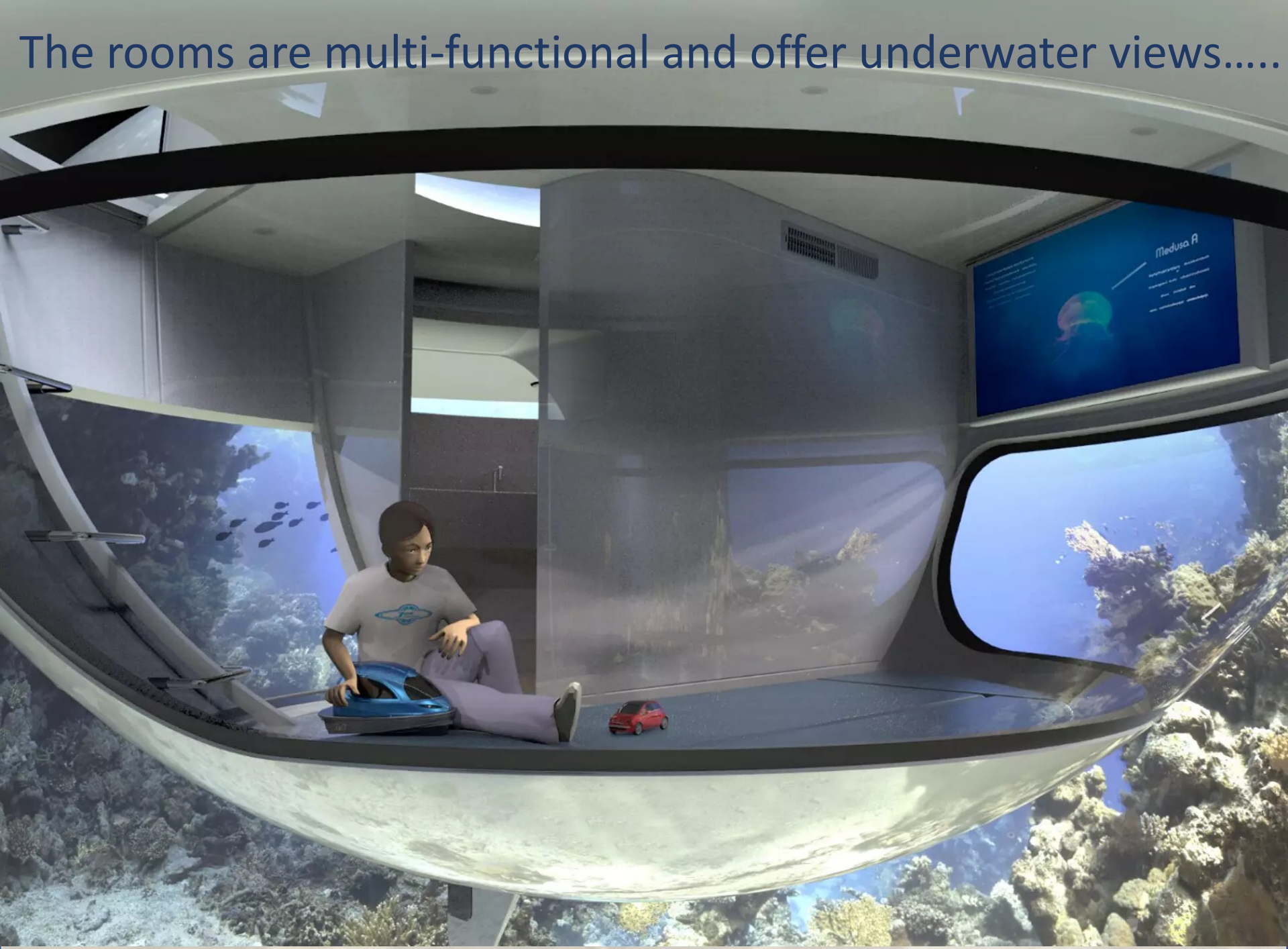
Alternatives to Megacity life? The UFO floating home concept from mini yacht-maker Jet Capsule offers a completely off-grid existence…

The UFO receives its energy through solar panels in the hinged roof, with wind and water turbines optional extras

A circular economy with robust integrated systems…?



The rooms are multi-functional and offer underwater views…..



The Mini ‘Breathe’ installation in Milan – squeezing more people in, and filtering the air

Mini says the house creates "a feeling of connectedness and togetherness" and also "grants residents a sense of privacy"


The Westminster Bubble….more
space for the Westminster bubble

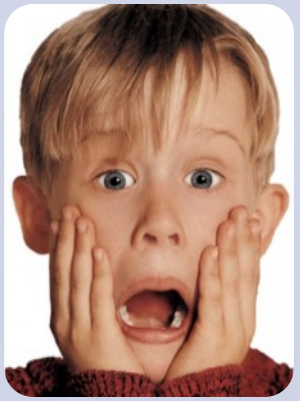
Key elements for Megacity innovation

‘Organic’ cities with integrated systems such as transport, food, water, energy, waste managemen t, soil

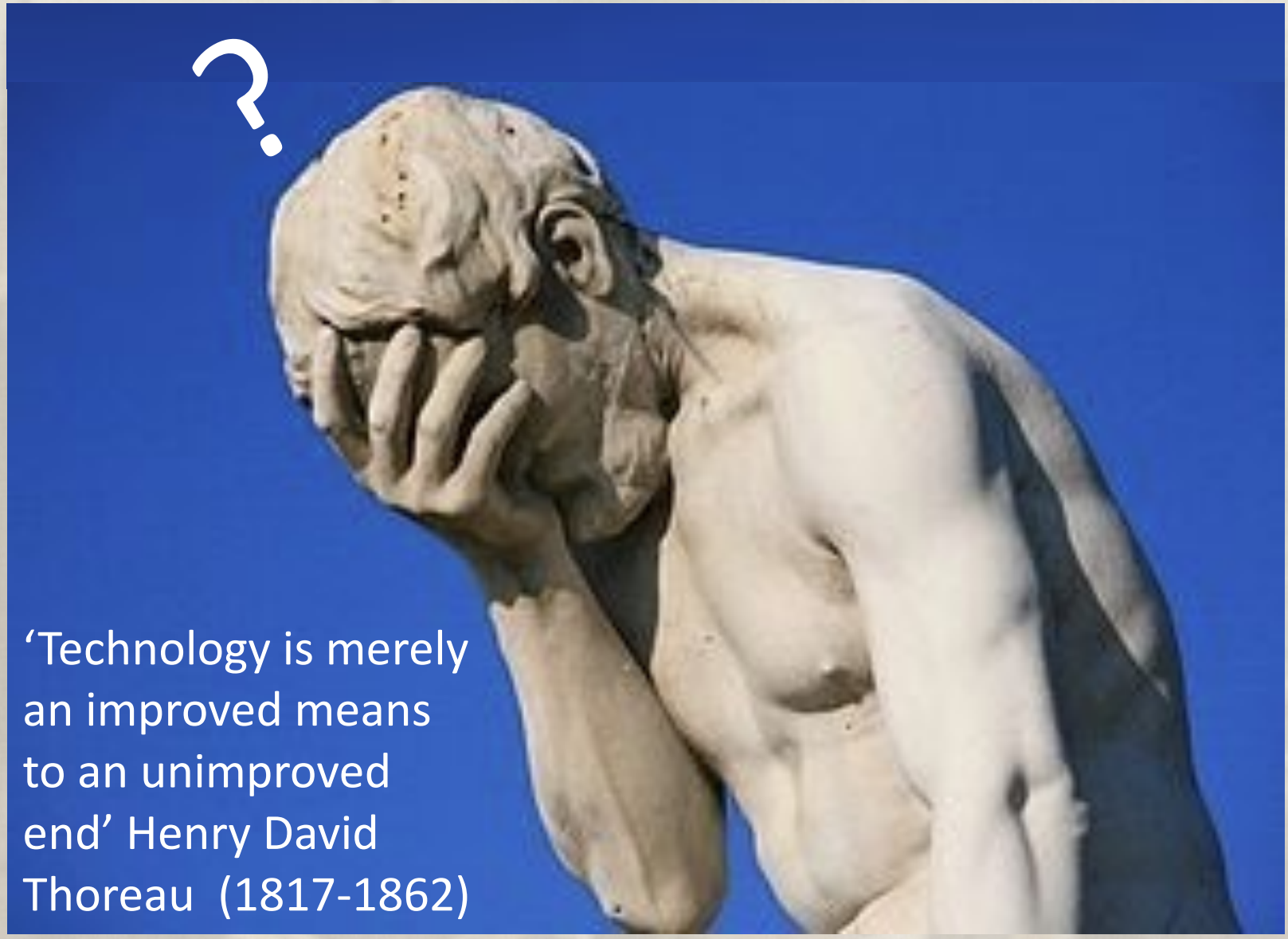
Circular systems that recycle water, other resources and nutrients

Low energy and resource efficient, systems

Long lasting, durable, in physical and human terms, but also flexible



Resilient to sudden shocks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‘Technology is merely an improved means to an unimproved end’ Henry David Thoreau (1817-1862)

All of these things are just more challenging in megacities…..