Emerging Risks

Dr Keith Smith Research and Development Manager

13th July 2017

Contents

LLOYD'S

Our new definition: Emerging Risk

Defining the boundaries

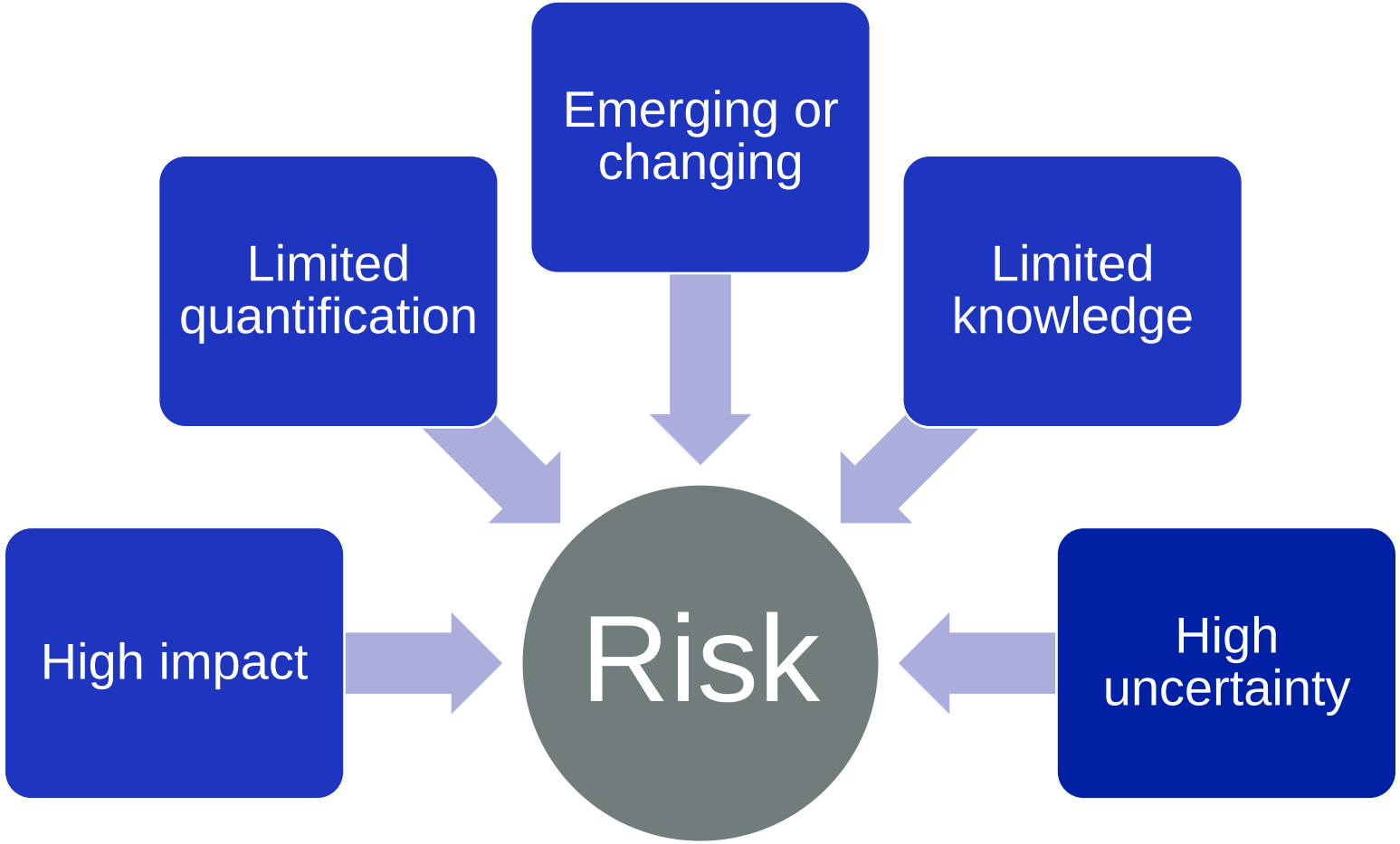
A risk which is yet to be fully understood that may have significant consequences for the insurance industry.

Lloyd's: January 2017

Note: This definition builds on the standard ISO definition of a risk: "the effect of uncertainty on objectives".

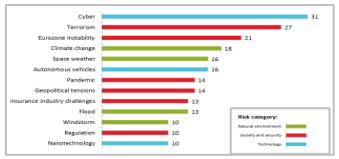
Emerging risk features

What makes them worth considering



Emerging risks management

A journey of knowledge growth

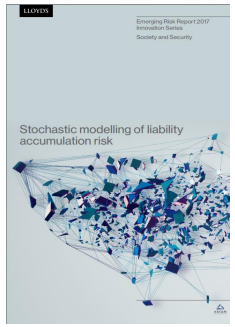


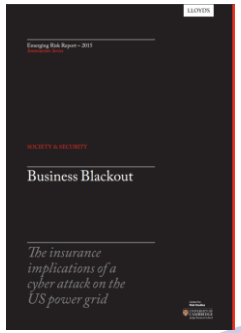
Identification

Horizon scanning

Evaluation

Judgment of significance





Awareness

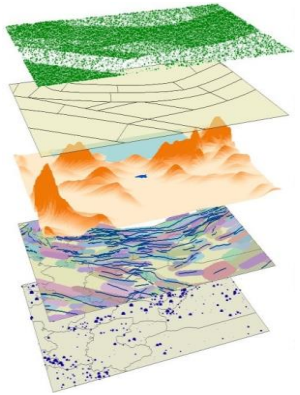
Thought leadership

Assessment

Decision-making resources (scenarios)

Quantification

For product innovation & exposure management



Four megatrends

Climate change

Urbanisation

Digital revolution

Globalisation

Four megatrends

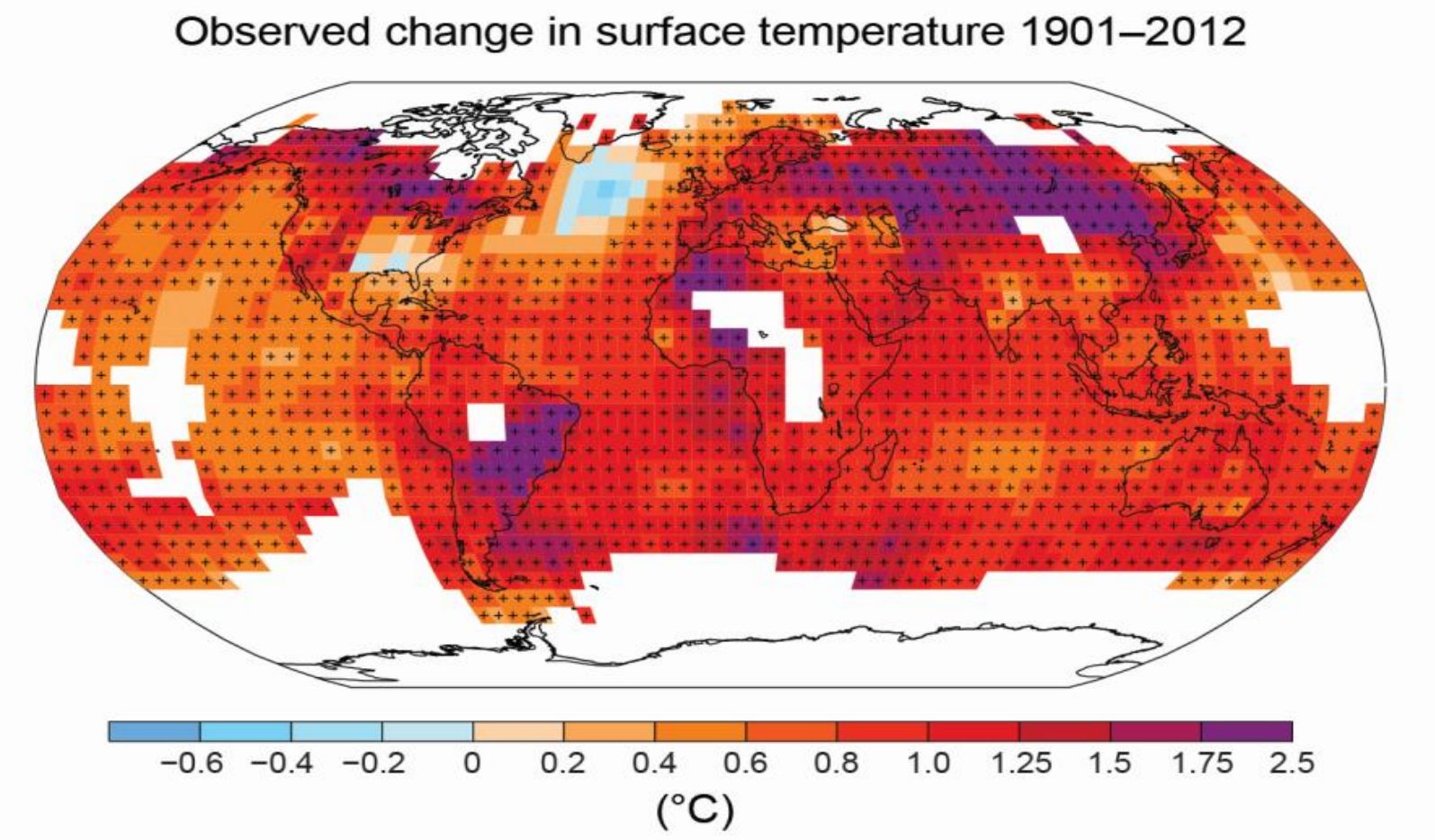
Climate change

Climate change

A risk multiplier rather than a peril

- The IPCC assesses that the current trajectory is for an additional 2.6 – 4.8°C of global warming by the end of the century

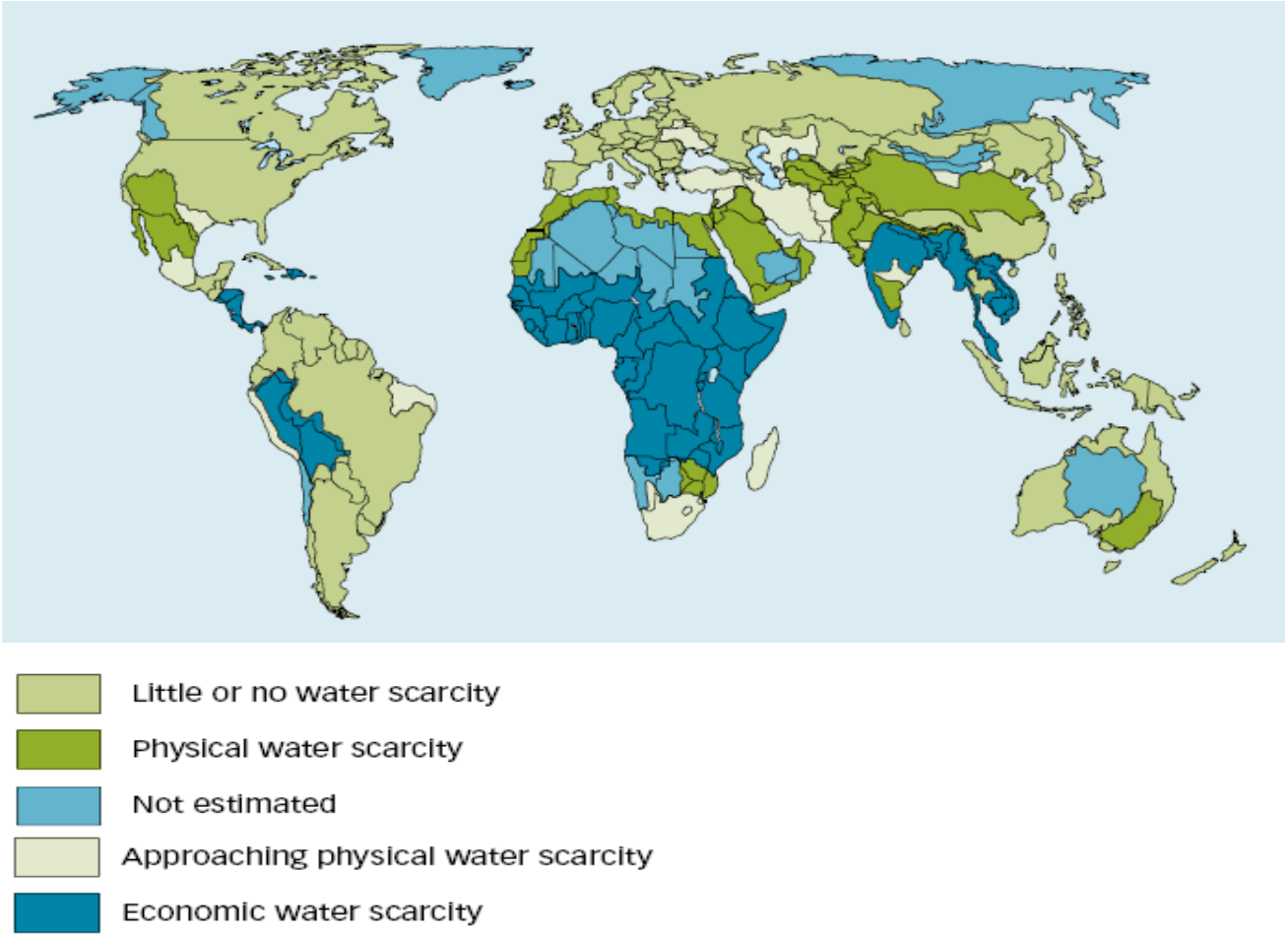
- This figure will **not** be uniform – there will be global variation



Not enough water

Climate change and security

- People typically live where water is; if it moves, they move
- Access to water will be seen as a strategic weapon
- "Building a dam could be seen as an act of aggression"
- Key risks:
  - Nile
  - Tigris/Euphrates
  - Indus
  - Mekong

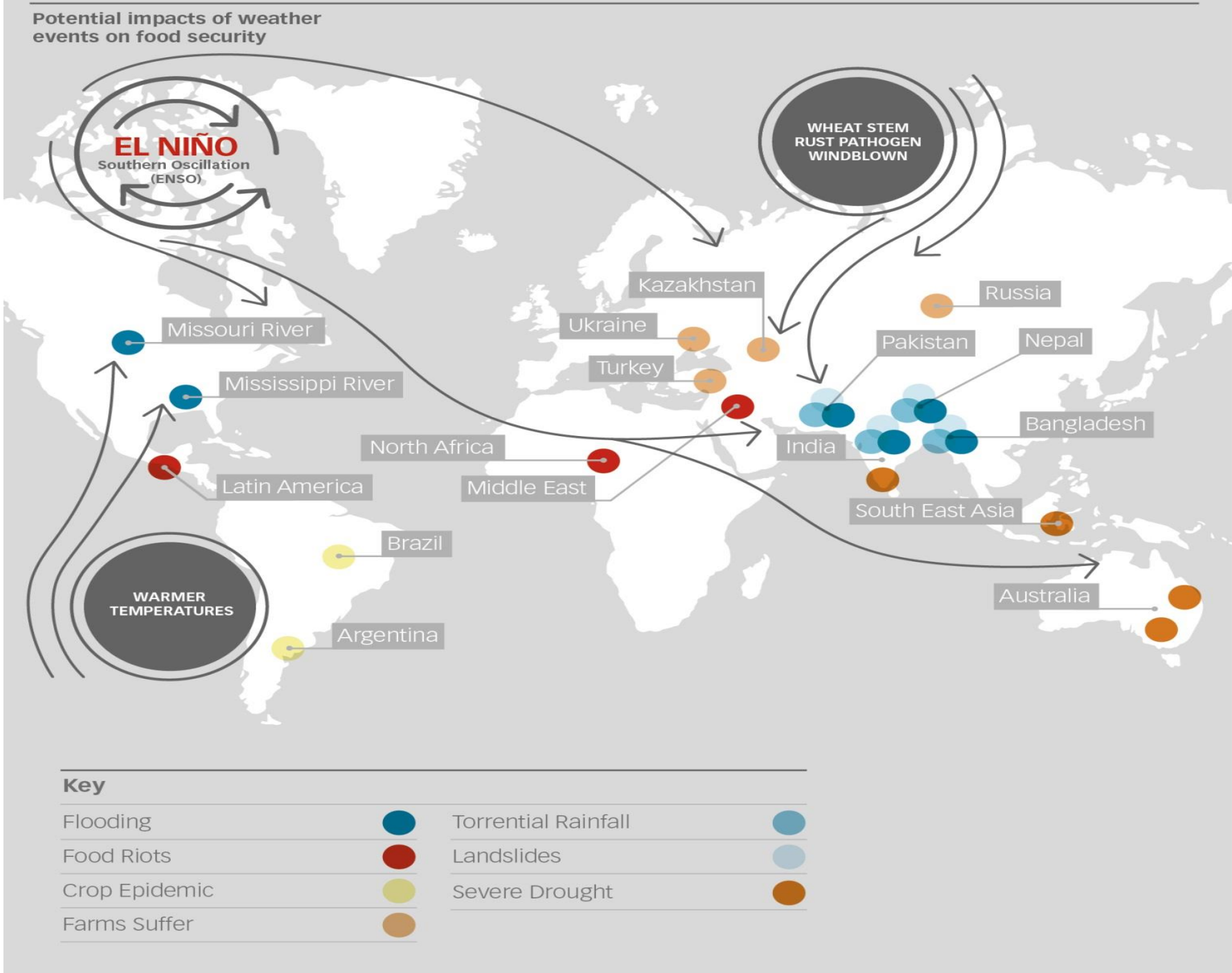


Food Security

The world's population is expected to reach 9bn by 2050

Climate change is expected to increase the risk of extreme weather events

Modern societies depend on global connected food systems

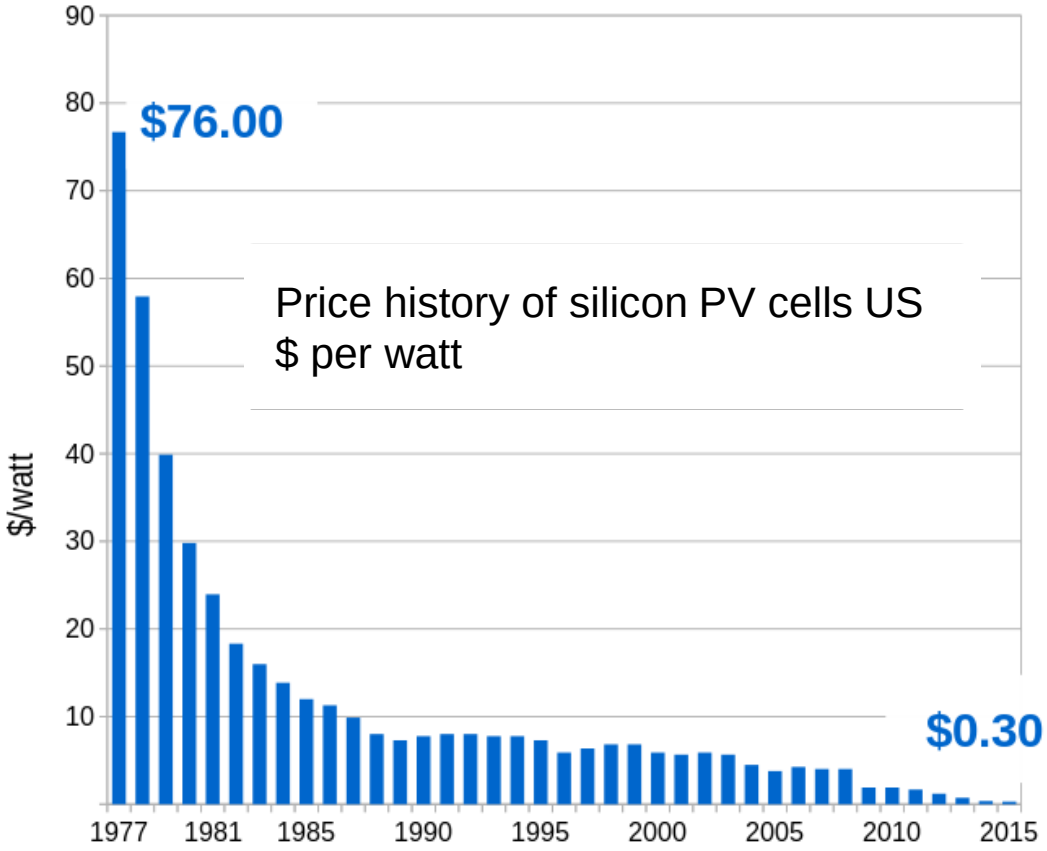


Let's think ahead

The transition to a low carbon economy

PARIS2015
CONFÉRENCE DES NATIONS UNIES SUR LES CHANGEMENTS CLIMATIQUES
COP21·CMP11

Remaining carbon budget 1,000GtCO^2



Source: Bloomberg https://www.bloomberg.com/news/articles/2016-04-06/wind-and-solar-are-crushing-fossil-fuels
Renaud Gignac and H Damon Matthews 2015 http://iopscience.iop.org/article/10.1088/1748-9326/10/7/075004
Carbon tracker 2014 https://www.carbontracker.org/wp-content/uploads/2014/09/Unburnable-Carbon-Full-rev2-1.pdf
Bloomberg https://commons.wikimedia.org/wiki/File:Price_history_of_silicon_PV_cells_since_1977.svg

Stranded assets

The transition to a low carbon economy: overview for the insurance industry

- Rise in potential from:
  - Technology and regulation
  - Extreme events
  - Confluence of new risks may make some assets more prone to stranding
- Significant and accelerating
  - Rarely understood or considered
  - Significant benefits associated with managing these risks.

Environmental challenges
(e.g. climate, water, biodiversity)

Falling clean technology costs
(e.g. solar and onshore wind)

Litigation & changing statutory interpretations
(e.g. directives, state-aid, carbon liability, fiduciary duty)

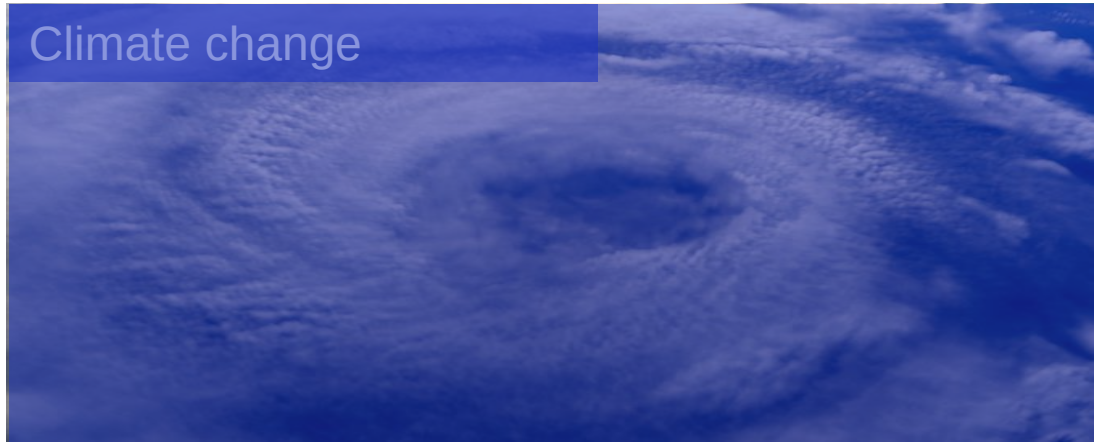
New government regulations
(e.g. carbon pricing, air pollution regulation)

Changing resource landscapes
(e.g. shale, fertilisers)

Evolving social norms
(e.g. divestment) and consumer preferences

Four megatrends

Urbanisation



Urbanisation

World cities population: 1990

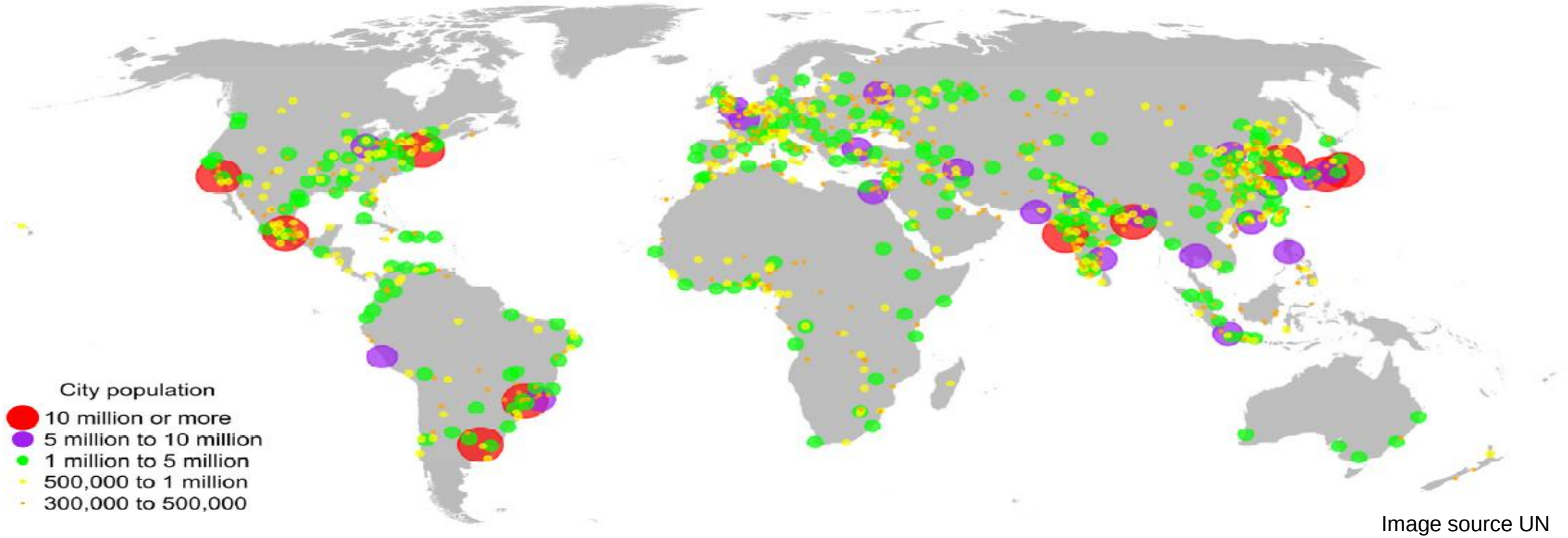


Image source UN

Urbanisation

World cities population: 2014

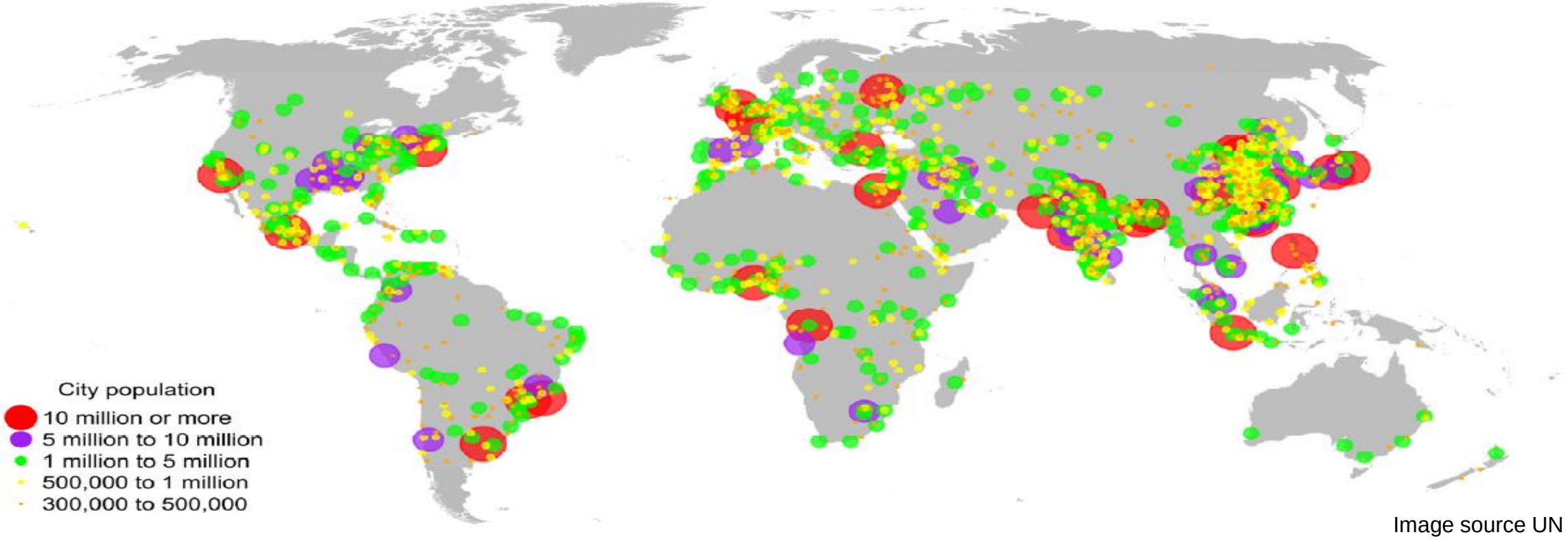


Image source UN

Urbanisation

World cities population: 2030

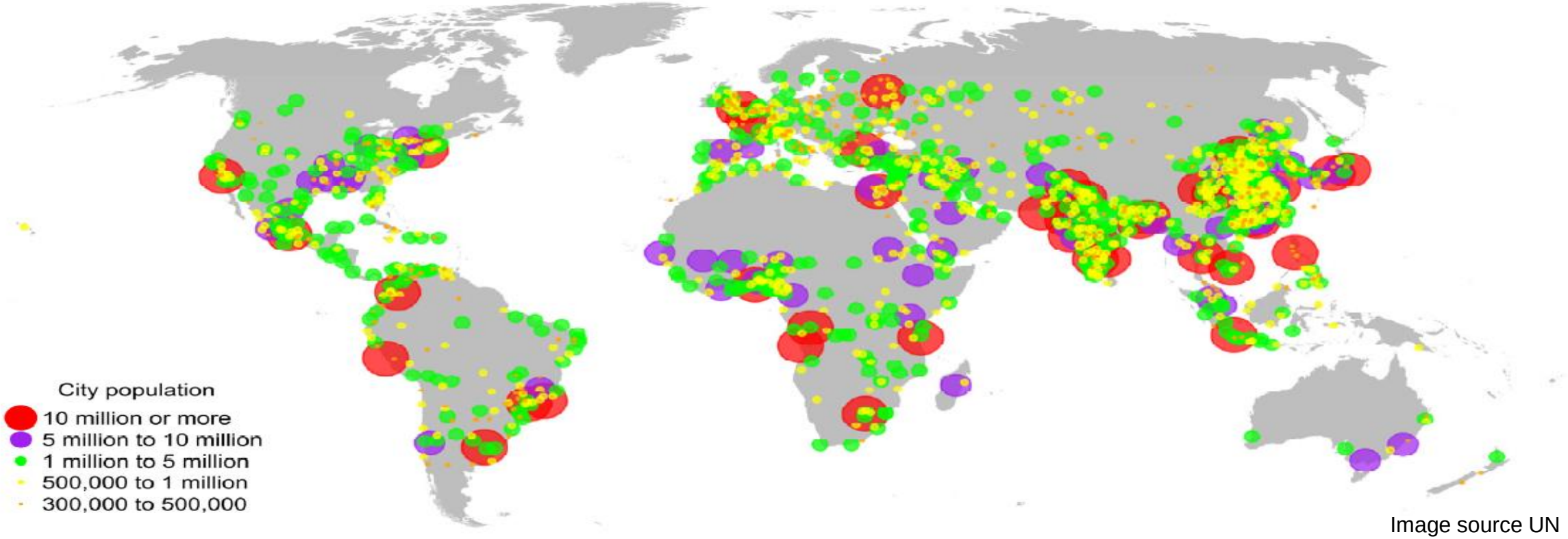
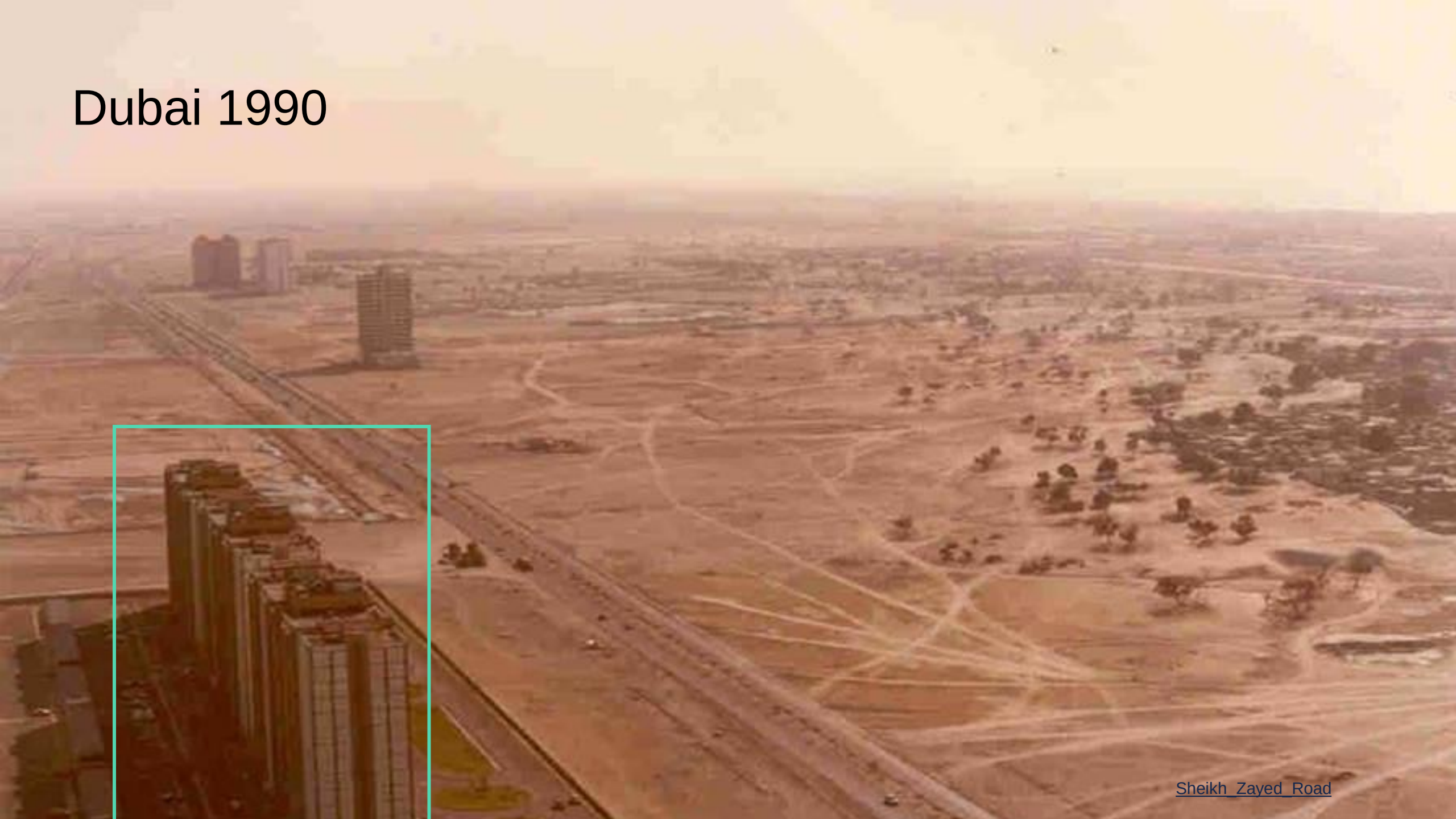


Image source UN

Dubai 1990



Sheikh_Zayed_Road

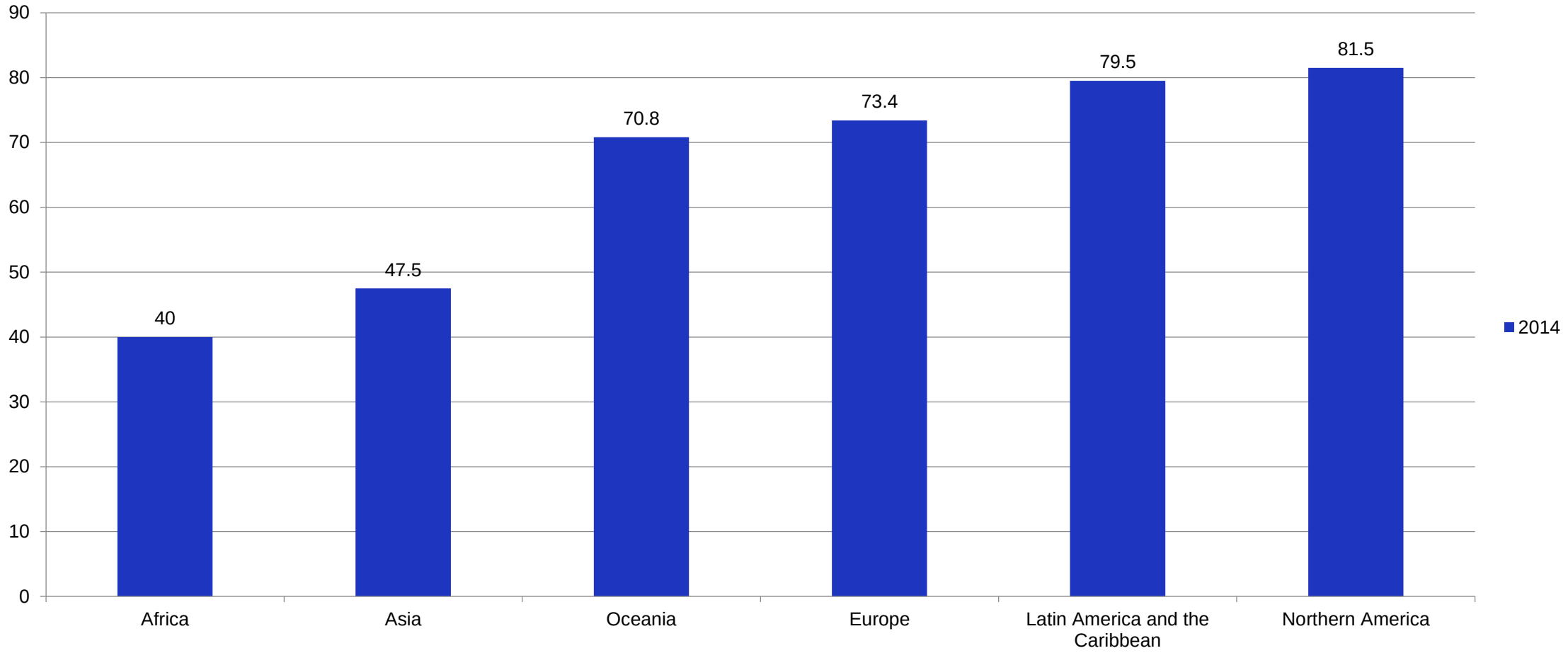
Dubai 2004

Dubai 2015

Tim Rockmann

Urban population

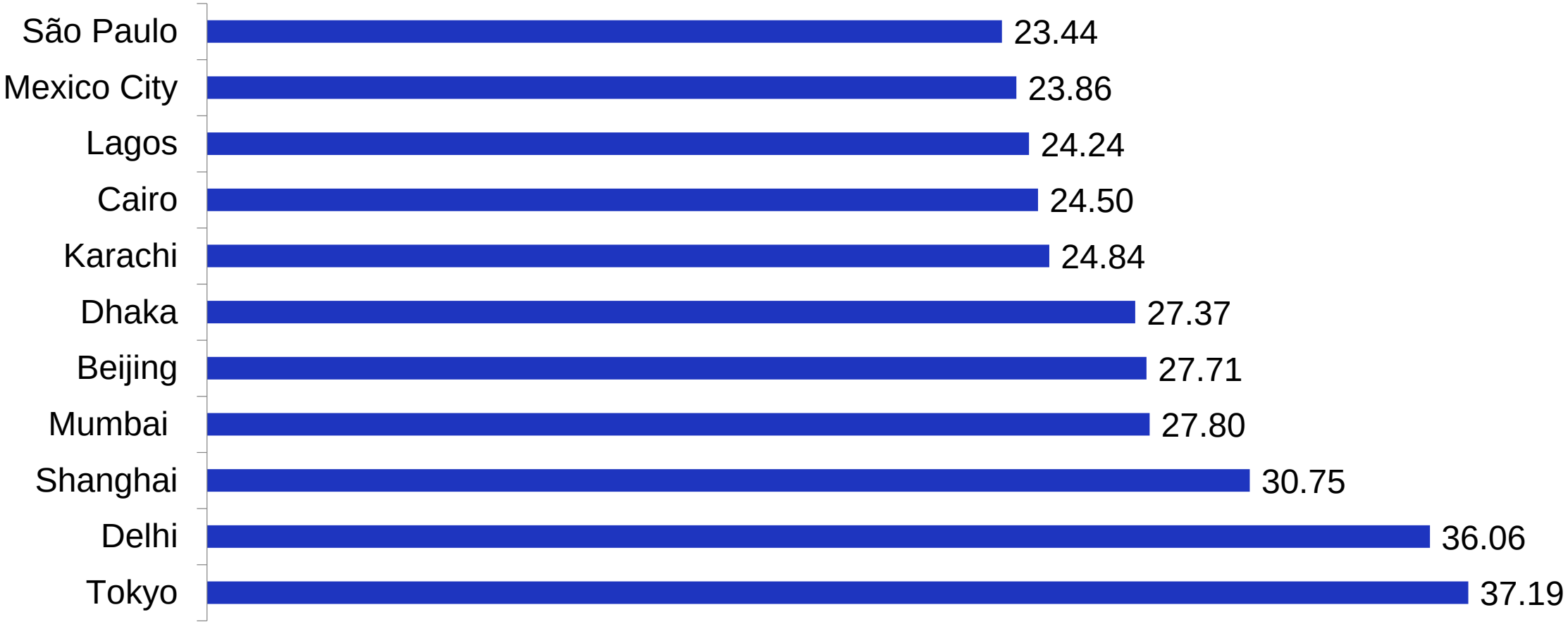
% of total population in 2014



Source: United Nations Department of Economic and Social Affairs/Population Division.
World Urbanization Prospects: The 2014 Revision https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Report.pdf

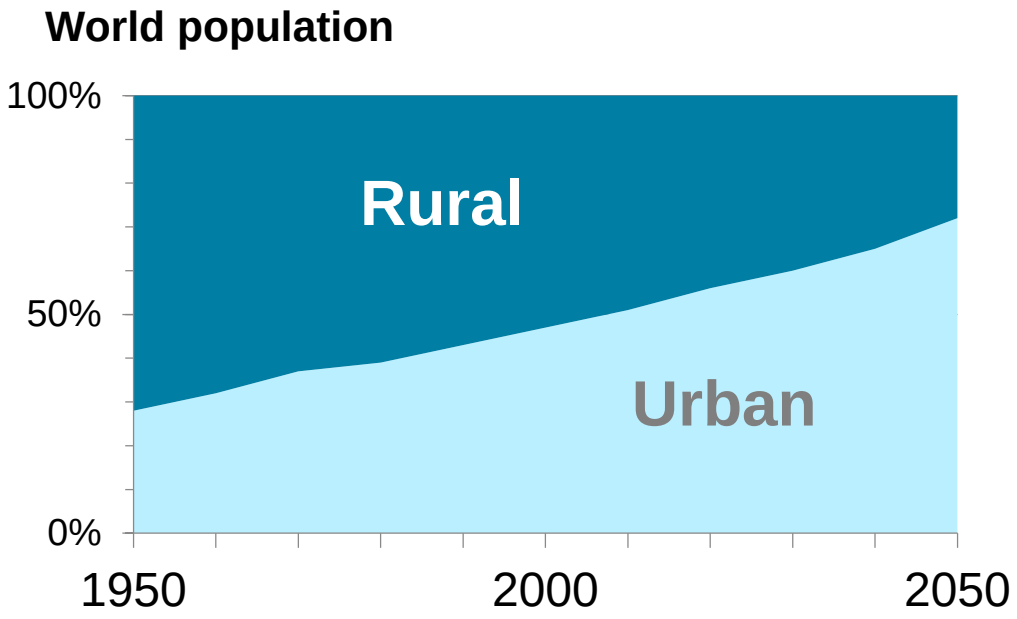
World's biggest cities in 2030

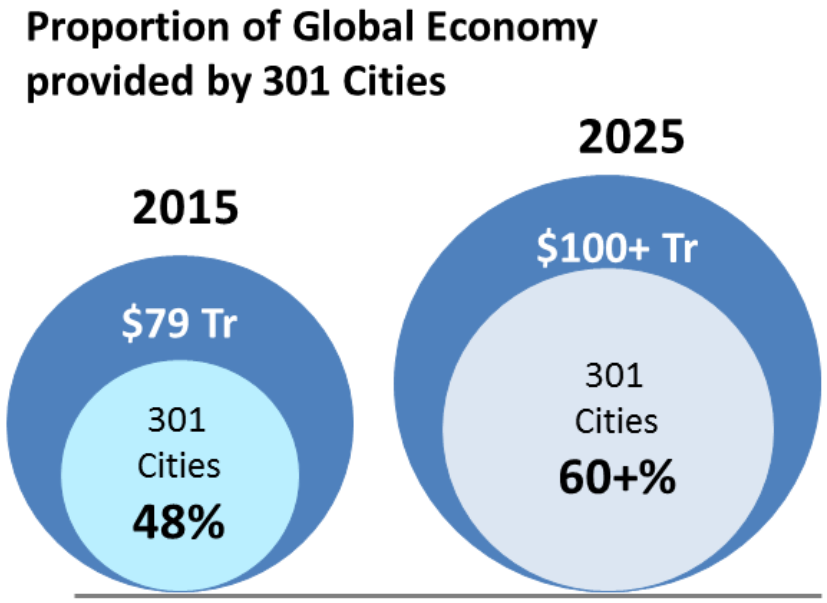
Latin America



Source: United Nations Department of Economic and Social Affairs/Population Division.
World Urbanization Prospects: The 2014 Revision
https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Report.pdf

Urbanisation of the economy





For example…

London economic region has increased its share of UK output from **15%** in 1960s to **45%** today

Lloyd's City Risk Index

Total GDP@Risk All Cities: $4.56trn

301 cities

50 cities analysed in greater depth

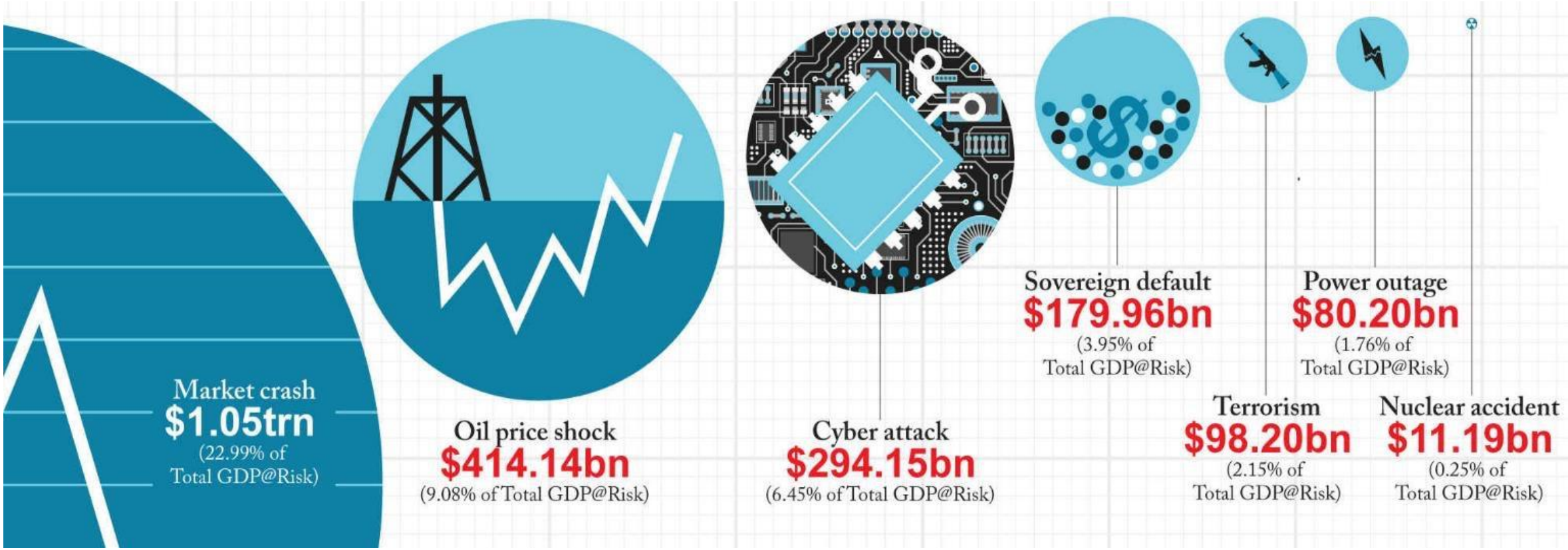
Downloadable city factsheets

Three threat types:

- Manmade
- Natural
- Emerging

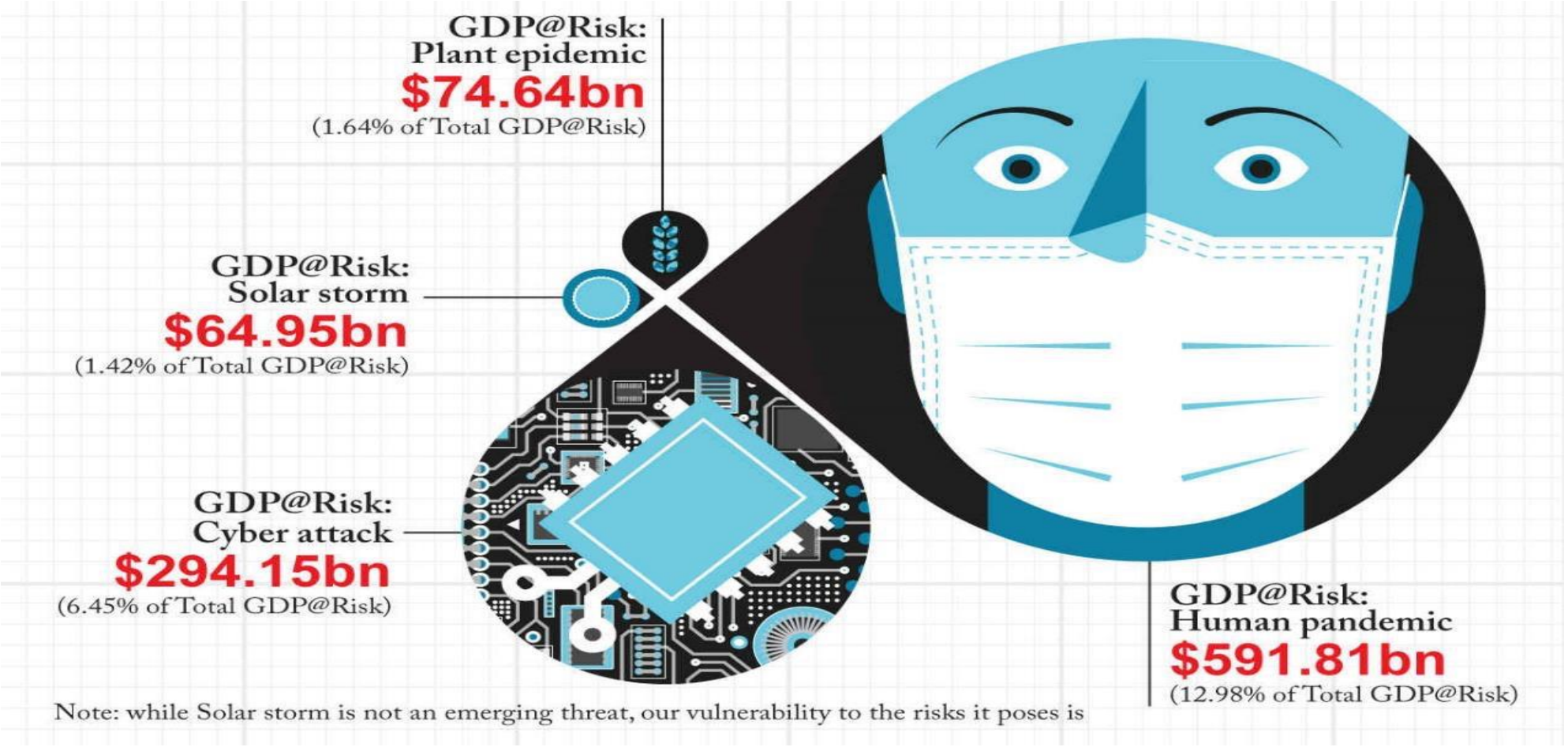
Manmade threats are becoming increasingly significant

Total GDP@Risk: $2.13trn



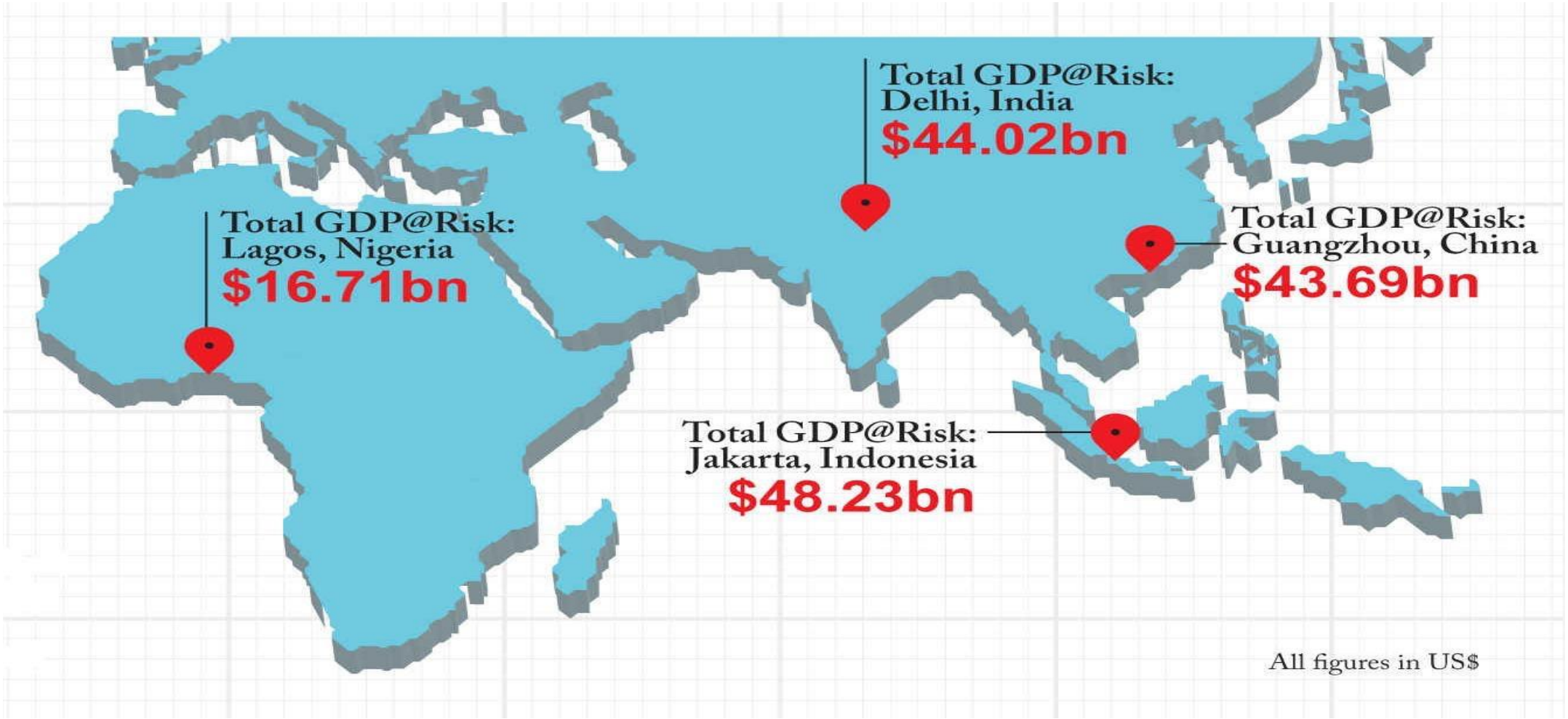
New or emerging threats are having a growing impact

Total GDP@Risk: $1.03trn



Emerging economies have the most to lose

Total GDP@Risk: $3.26trn

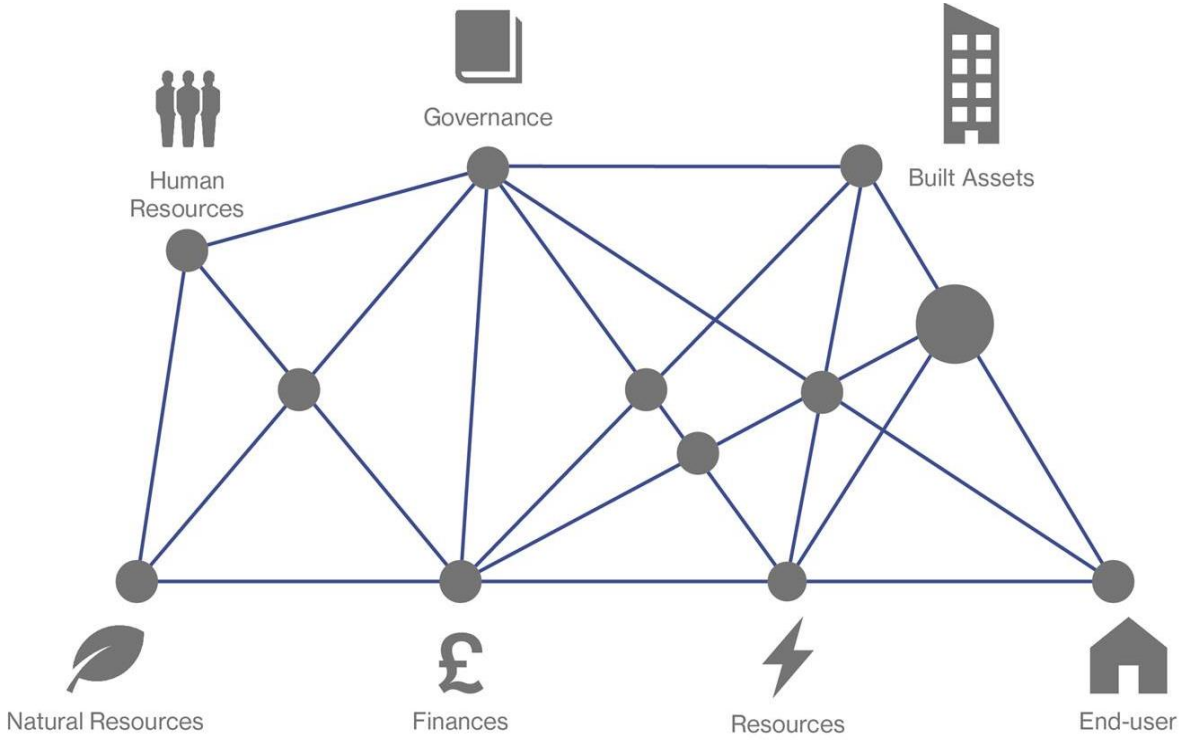


Underwriting human progress has never been more important for cities

Protecting growth and development by focusing on resilience

Cities are complex and the cost of disasters is growing:

- Rapid economic development and urbanisation are key reasons for natural catastrophe exposure growth
- Cities must mitigate risks to protect development
- City infrastructure supports complex interconnections



Source: Lloyd's 2017 https://www.lloyds.com/~/media/files/news%20and%20insight/risk%20insight/2017/arup/lloyds_arup%20future%20cities%202017.pdf

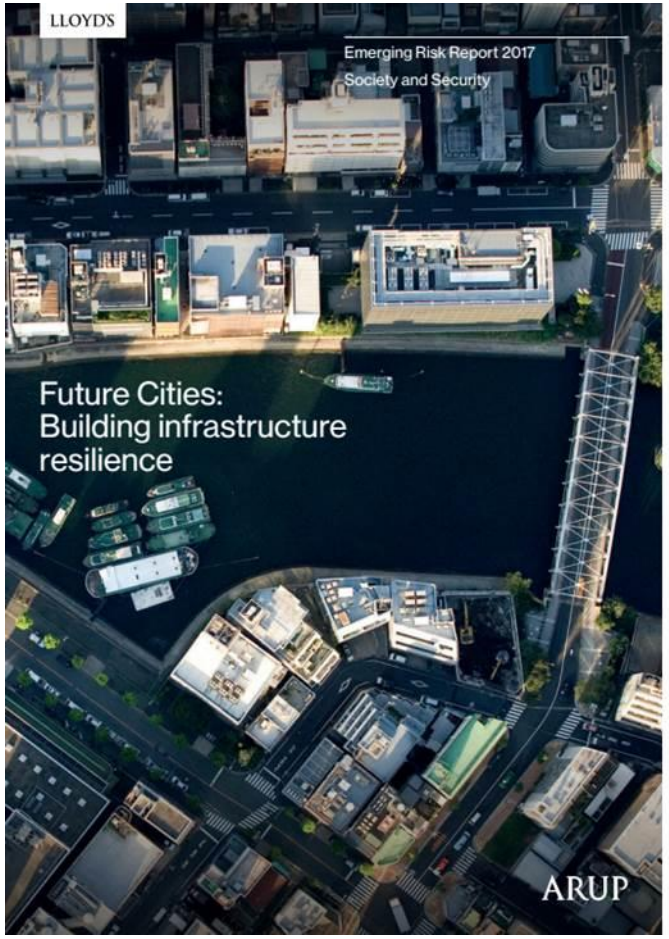
Future cities – building infrastructure resilience

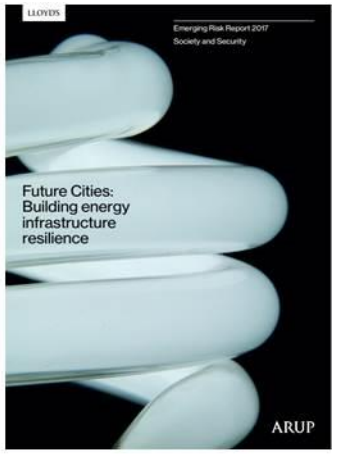
Category: Society and security; natural perils; manmade; global economy

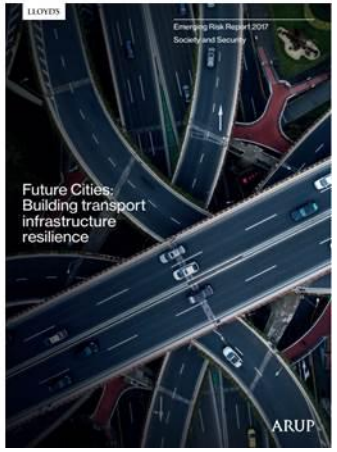
Key findings: Clear pathways and principles to guide action; Building resilience requires collaboration; Nine areas for collective action to build city resilience

Why?: Cities are complex; complex interactions; risks and changings; keen to assess opportunities for insurance

Partner: Arup; Lloyd's market; sector experts

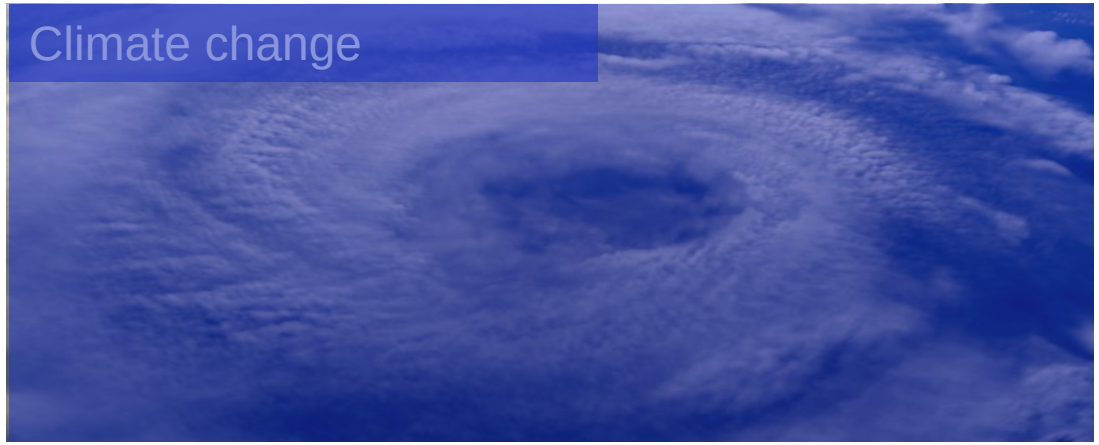






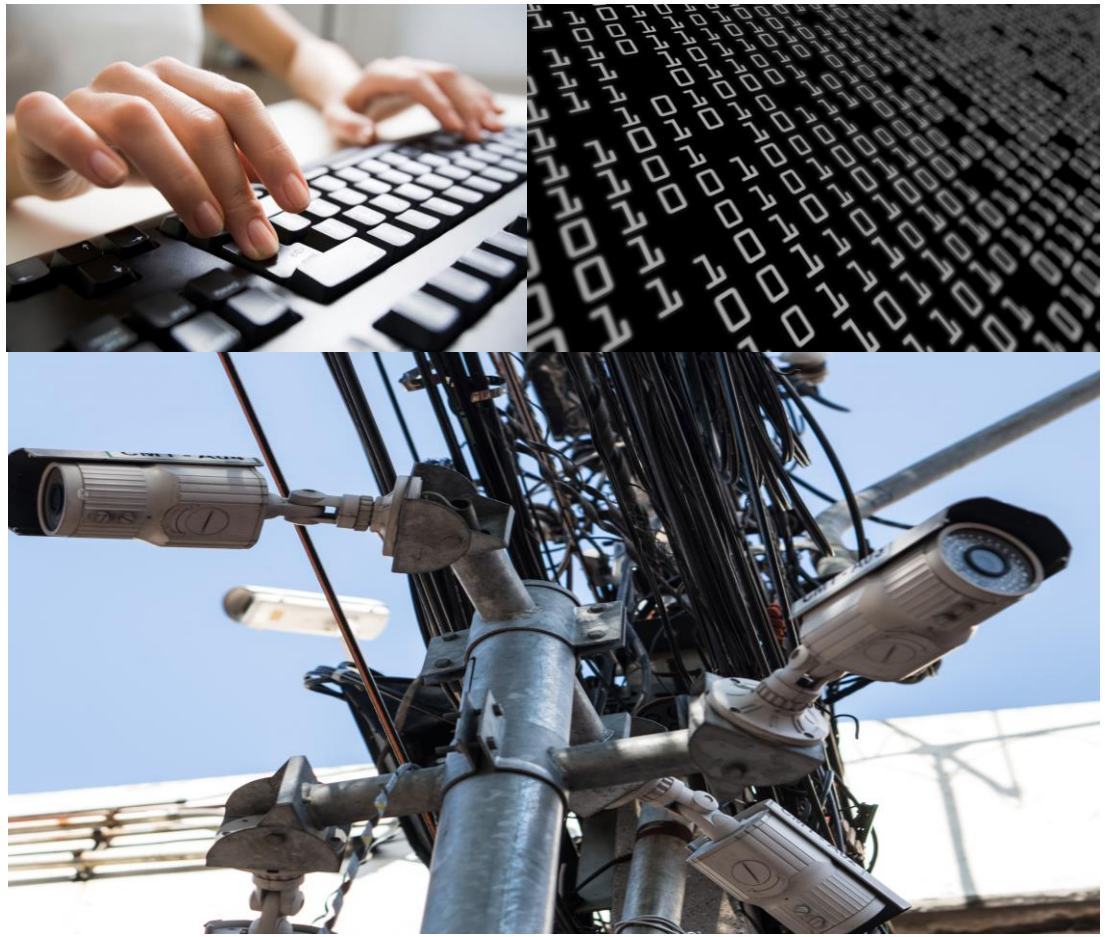
Four megatrends

Digital revolution



Digital revolution

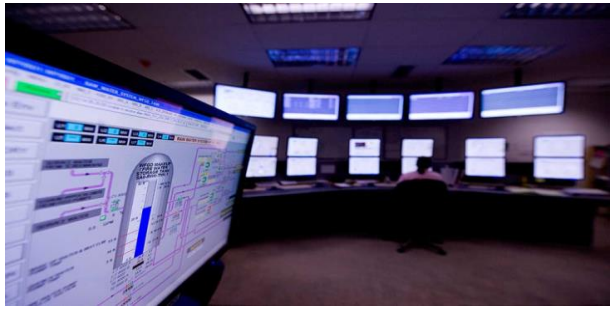
- Every aspect of our lives is becoming digital
  - Sharing economy
  - 'There's an app for that'
  - Internet of things
- The threat of cyber attack is growing and changing
  - Denial of Service
  - Virus and worms
  - Ransom ware
- Terrorism and ICT
  - Encryption wars
  - CCTV



Erebos cyber blackout scenario

Fictitous event, but plausible

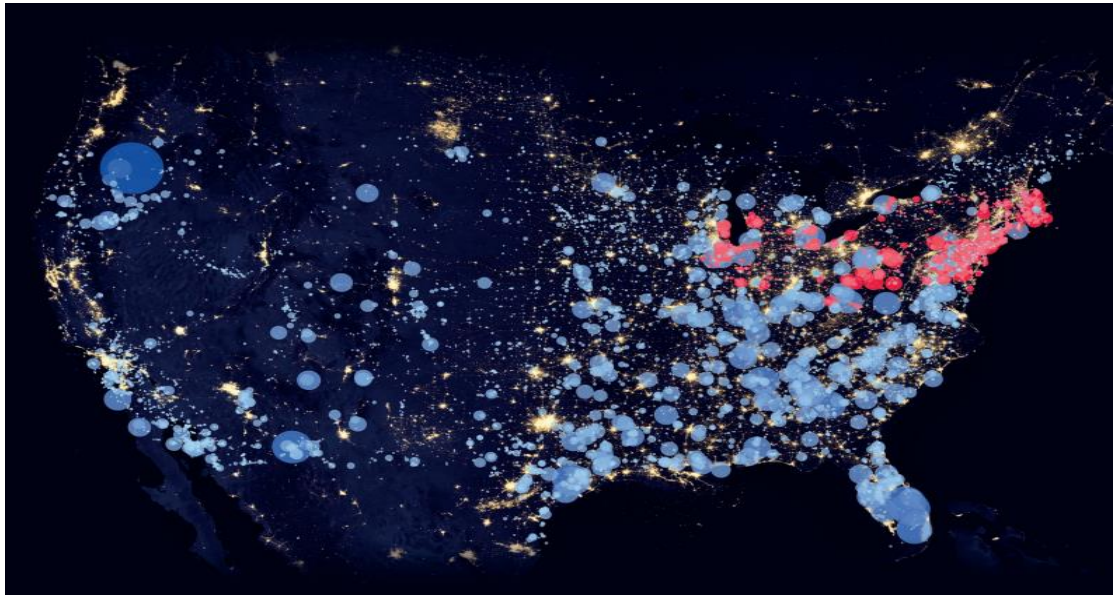
- On July 8 – during peak summer demand for electricity there is a coordinated simultaneous attack targeted at two regions of United States power grid (NPCC and RFC)
- Malware finds 50 generators that it can control and forces them to overload and burn out
  - in some cases causing additional fires and explosions
- Electricity blackout that plunges 15 US states and Washington DC into darkness
- 93 million people without power
- More than 17 TW-Hours of generation is lost – around 12% of supply



Business blackout: Scenario creation

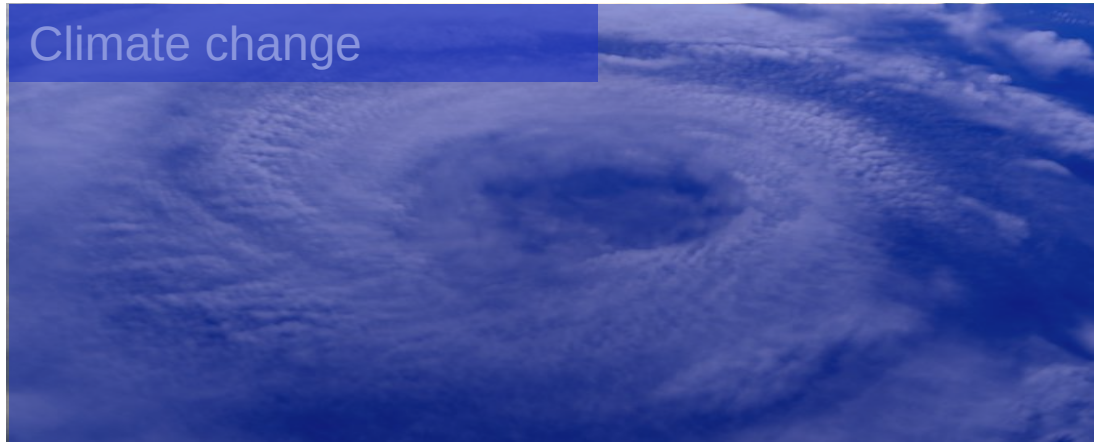
Year 1 | Year 2 | Year 3+

Research → Dormancy → Activation → Blackout → Aftermath



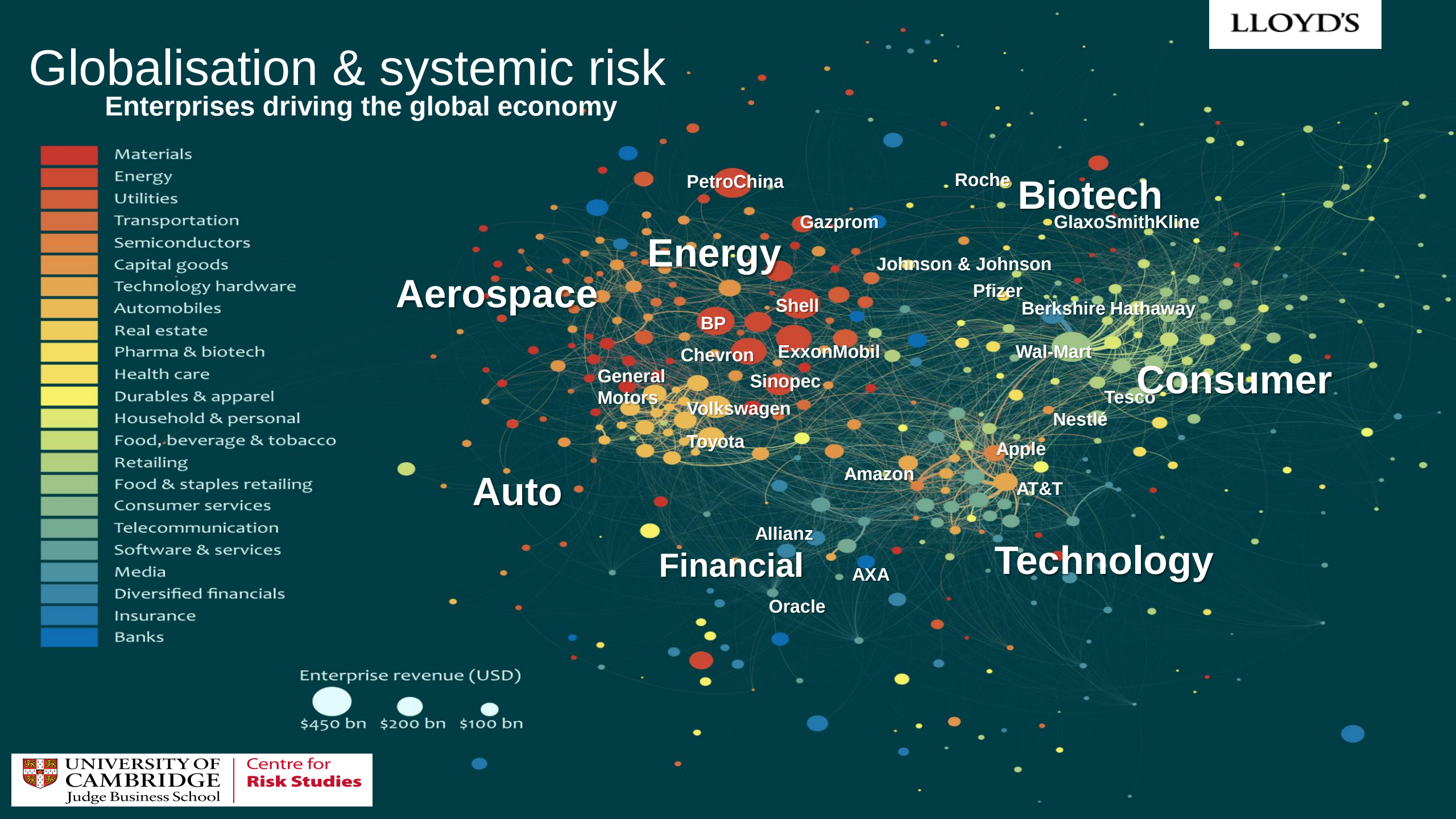
Four megatrends

Globalisation



Globalisation & systemic risk

Enterprises driving the global economy



LLOYD'S

UNIVERSITY OF CAMBRIDGE Judge Business School | Centre for Risk Studies

Four megatrends

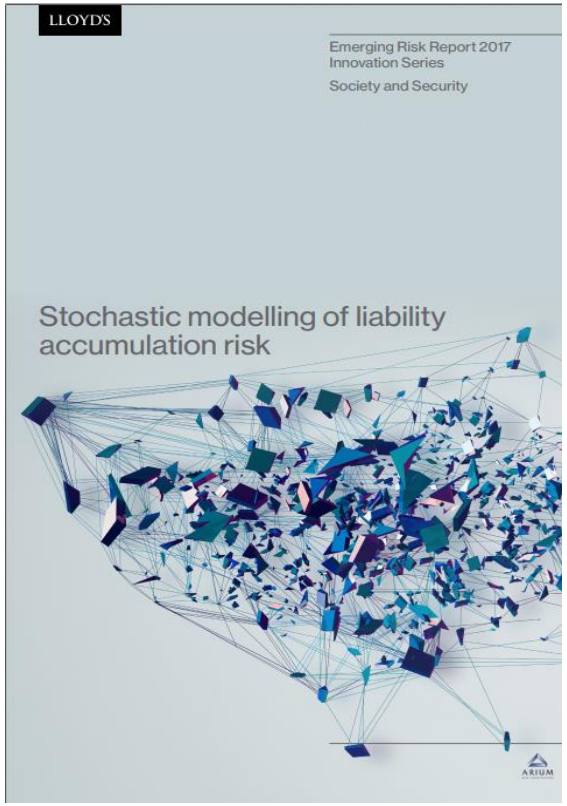
Understanding risk

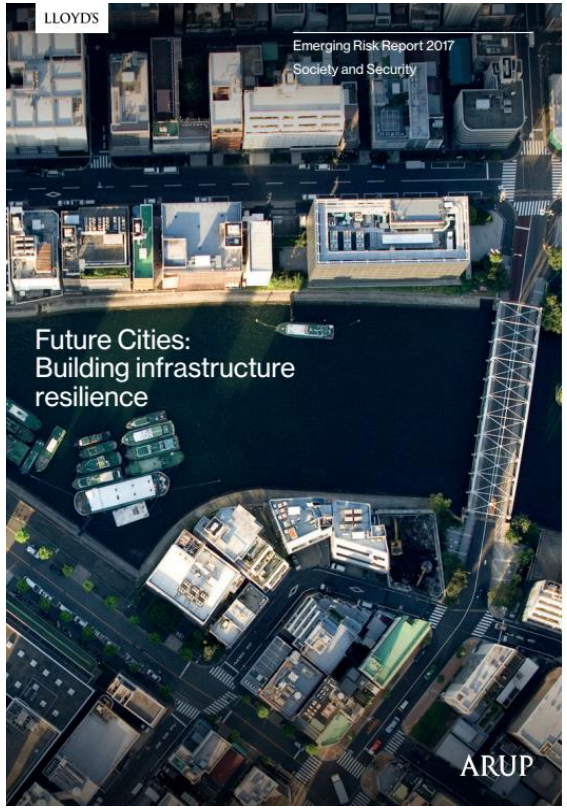
Research outputs

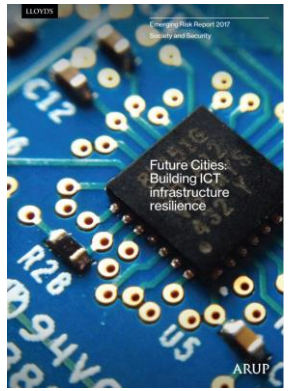

PANDEMIC
POTENTIAL INSURANCE IMPACTS
ELECTROMAGNETIC FIELDS
RECENT DEVELOPMENTS
DIGITAL RISKS
SPACE WEATHER:
IMPACT ON EARTH
RISKS
THE HERBERT HOOVER DIKE
BEHAVIOUR
BEAR, BULL OR LEMMING?
CLIMATE CHANGE LIABILITY
HRT
EAST LONDON
EXTREME RAINFALL
RISKS
NANOTECHNOLOGY
RECENT DEVELOPMENTS, RISKS
AND OPPORTUNITIES
OLYMPICS 2012
RISKS FACING LONDON
SYNTHETIC
BIOLOGY
GLOBAL WATER SCARCITY
SPACE WEATHER
MANAGING RISK IN
THE 21ST CENTURY
GLOBAL RECESSION:
THE MAGNIFYING
GLASS FOR POLITICAL
INSTABILITY
CLIMATE CHANGE
AND SECURITY:
GLOBALISATION AND
RISKS FOR BUSINESS
INSURANCE IN
DEVELOPING COUNTRIES:
EXPLORING OPPORTUNITIES
IN MICROINSURANCE
SUSTAINABLE
ENERGY SECURITY
CANCELLED
PROJECT DELIVERY
COST AND ORDERS
AILABILITY LOSS OF
OF CREDIT CUSTOMER
MAJOR ASSET PRICE VO
CURRENCY RISK
FLUCTUATION STRIK
GET PRICE VOLATILITY
GLOBAL BUSINESS
LEADER SURVEY:
FORECASTING RISK
THE VALUE OF LONG-RANGE FORECASTING
FOR THE INSURANCE INDUSTRY
MANAGING THE ESCALATING RISKS OF
NATURAL CATASTROPHES
IN THE UNITED STATES
ENERGY
DRILLING IN EXTREME ENVIRONMENTS:
SHALE GAS EXTRACTION:
A SPECIAL FOCUS ON HYDRAULIC FRACTURING
GEOMORPHOLOGY AND
CHANGING FLOOD RISK IN THE UK
ARCTIC OPENING:

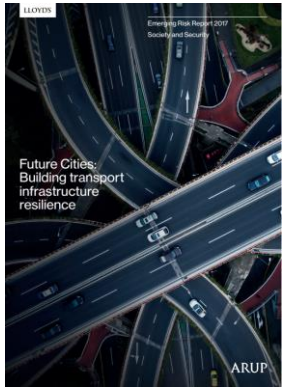
Published in 2017

More coming up!







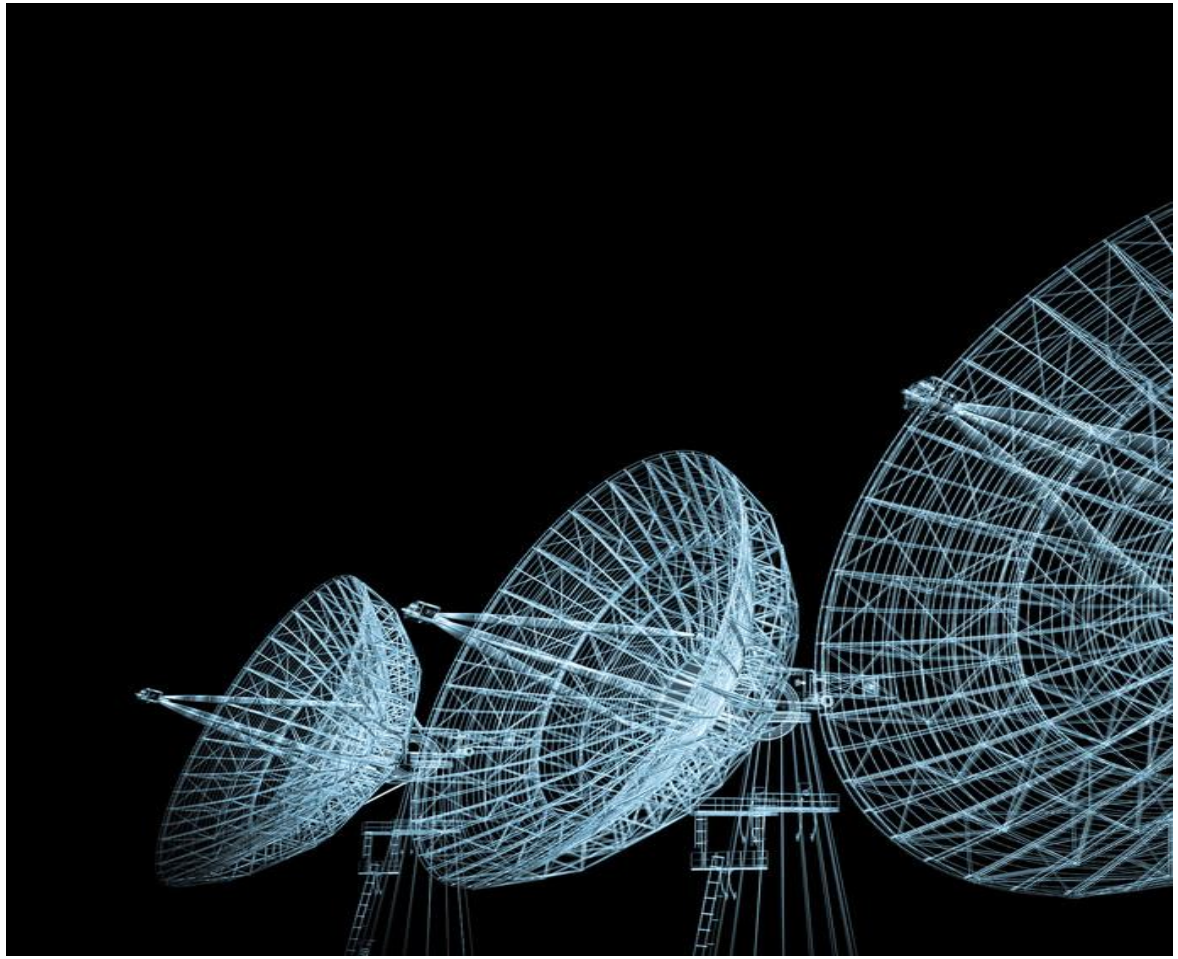


On the Horizon

Space

New actors in the space economy

- Brazil is developing technology to send domestically-made satellites into space with its own rockets by 2020.
- Elon Musk – Space X, reusable rockets
- Mining in space – Luxembourg. Harvesting resources from outer space!
- MBA grads – space economy
- Virgin Galactic and Blue Origin, space tourism



Source: Reuters 2017 http://uk.reuters.com/article/us-brazil-satellite-idUKKBN16T2BD
Sharing Earth Observations Resources 2016 https://directory.eoportal.org/web/eoportal/satellite-missions/p/perusat-1

The Internet of Things (IoT)

Lifestyle and Cyber threat changes

When simple 'Things' become connected, we create a new complex system. Complex systems exhibit a number of characteristics:

- **Emergence** of new unexpected behaviours
- **Sudden transitions**
- **Large events** occurring from small changes
- **Self Organisation** and a resistance to being organised
- **Evolution** towards new norms

Cisco estimate that by 2022, there will be over 50 Billion connected devices

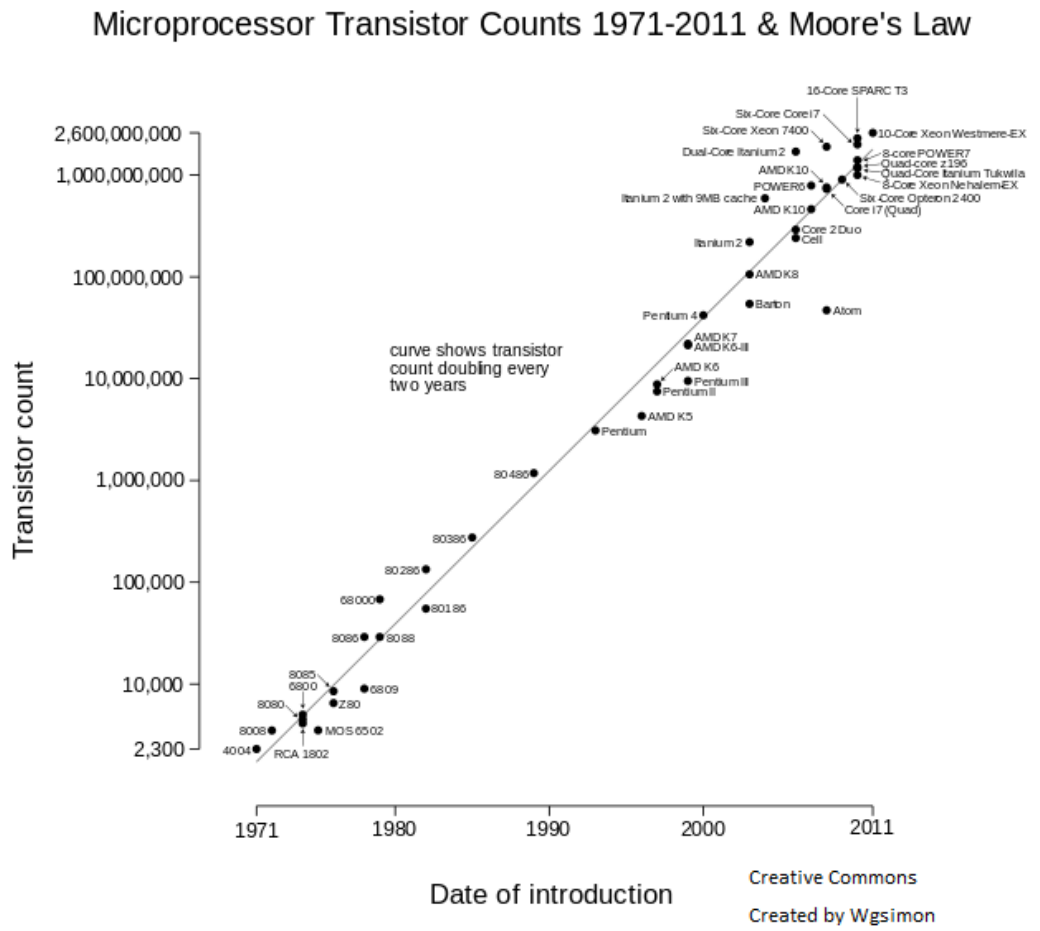
Limits to Classical Computing

The end of Moore's Law

Moore's law comes in many forms, but the most frequently quoted is that the number of transistors on a chip will double every 2 years. This is based on a view expressed by Gordon Moore who originally worked for Fairchild and later Intel.

Problem is, to double in such a way, the size of transistors needs to shrink exponentially. And when transistors get to be 5nm in size, quantum effects mean they will no longer work. Many feel we will reach this limit in 2025.

There are new transistor types on the horizon, but at the moment it looks like Moore's law has run its course.

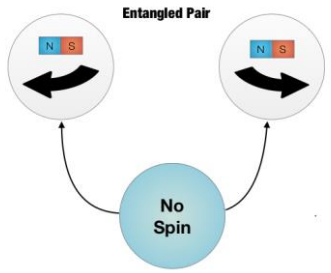


Quantum Computing and Quantum Devices

A new approach to computation

- Classical computing uses Binary state electronics Bits
  - Switch on, switch off. 1 and 0.
- Quantum computers will use Qubits
  - At any point in time, providing it has not been measured, a Qubits can be a 0 and a 1 at the same time
- So what?
  - Quantum computers may solve problems not solvable using Classical computers because they have a high degree of parallel computation
  - Quantum computers are good at cracking codes. So current encryption methods will become “crackable”

0 1 0



EPSRC predicts that within 5 Years we will see:

- Nanoscale biological temperature sensors
- Single molecule MRI
- Gravity sensors
- Single atom image sensors
- Electromagnetic detectors

LLOYD'S

Conclusion

Conclusion

- The focus of emerging risks management is to reduce uncertainty – not to predict the future
- By exploring and understanding uncertainty, risks can be explored to develop opportunities
- Key problem lies in challenging assumptions based on experience & behavioural bias
- Scenarios are useful tools
- A common theme in emerging risks is complexity driven by the pace of globalisation
- A lot more reports! http://Lloyds.com/emergingrisks
- And lots more to do ……

LLOYD'S

Thank you

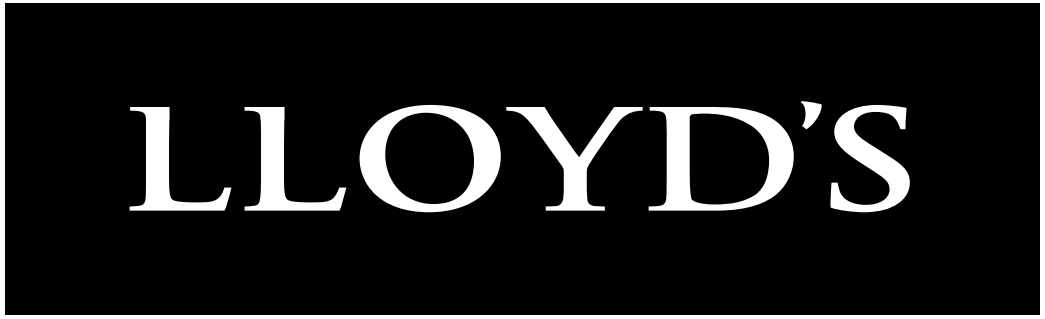
innovation@lloyds.com

LLOYD'S

Disclaimer

This information is not intended for distribution to, or use by, any person or entity in any jurisdiction or country where such distribution or use would be contrary to local law or regulation. It is the responsibility of any person publishing or communicating the contents of this document or communication, or any part thereof, to ensure compliance with all applicable legal and regulatory requirements.

The content of this presentation does not represent a prospectus or invitation in connection with any solicitation of capital. Nor does it constitute an offer to sell securities or insurance, a solicitation or an offer to buy securities or insurance, or a distribution of securities in the United States or to a U.S. person, or in any other jurisdiction where it is contrary to local law. Such persons should inform themselves about and observe any applicable legal requirement.


LLOYD'S