CRC
FOR LOW CARBON LIVING

LOW CARBON LIVING CRC

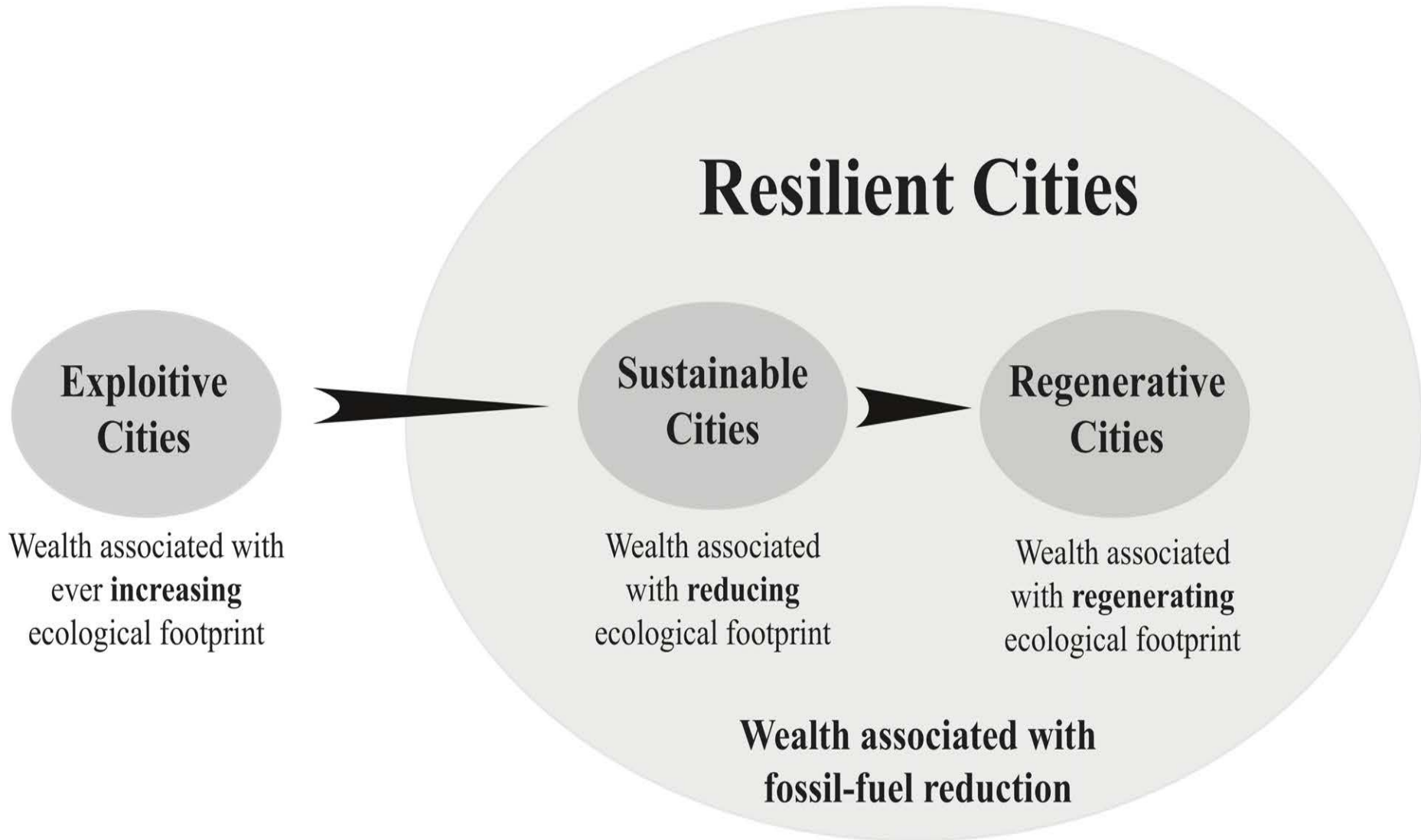*Innovations for a Sustainable Built Environment*

Future Challenges: Sustainable, Resilient and Low Carbon Cities

Scientia Professor Deo Prasad AO
CEO: CRCLCL

Some of the Challenges

- Urban Microclimates
- Transport
- Air Quality
- Energy futures
- Waste
- High Performance Buildings
- Urban landscapes, design and planning
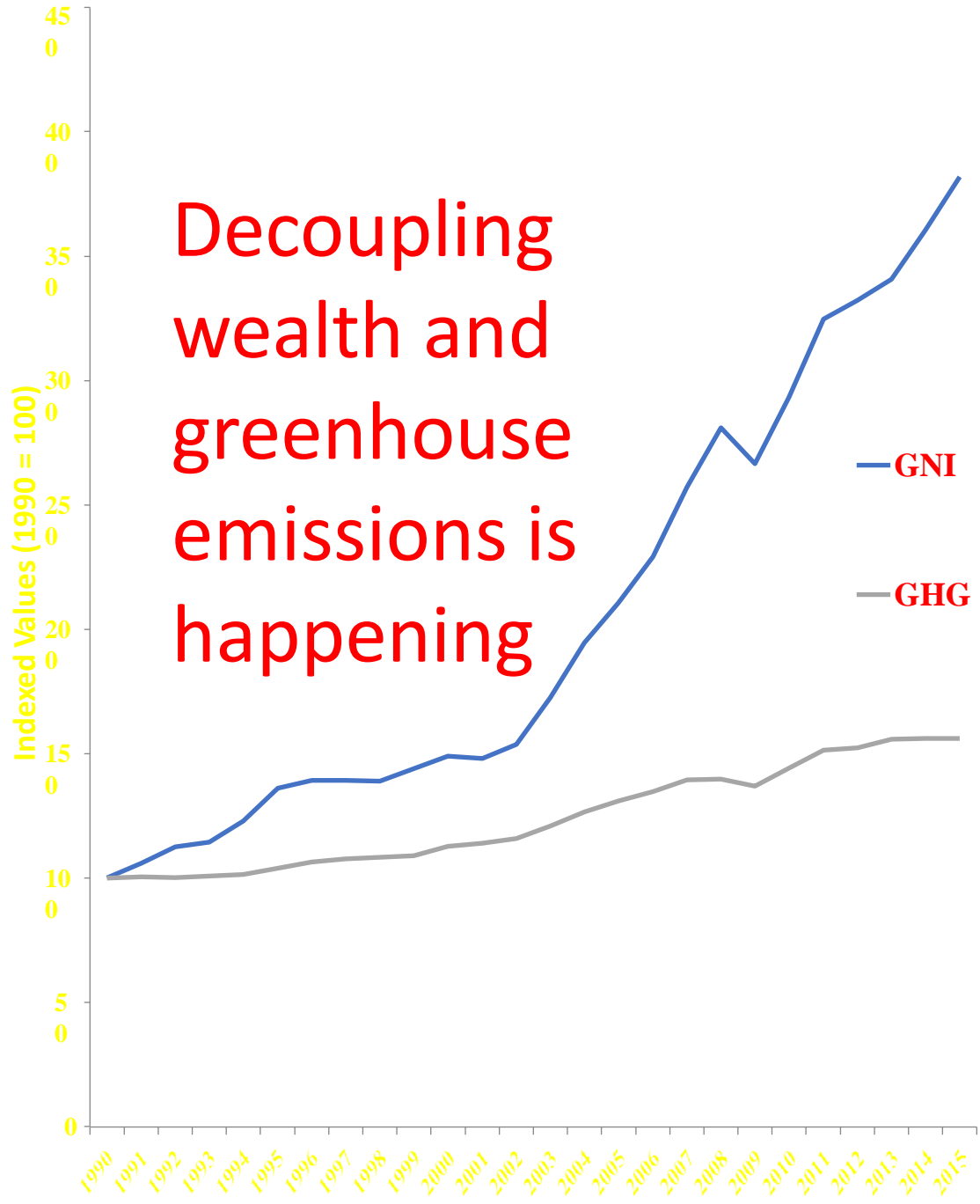- Comfort and Well being

The urban transition…

Turning point in **world history**....
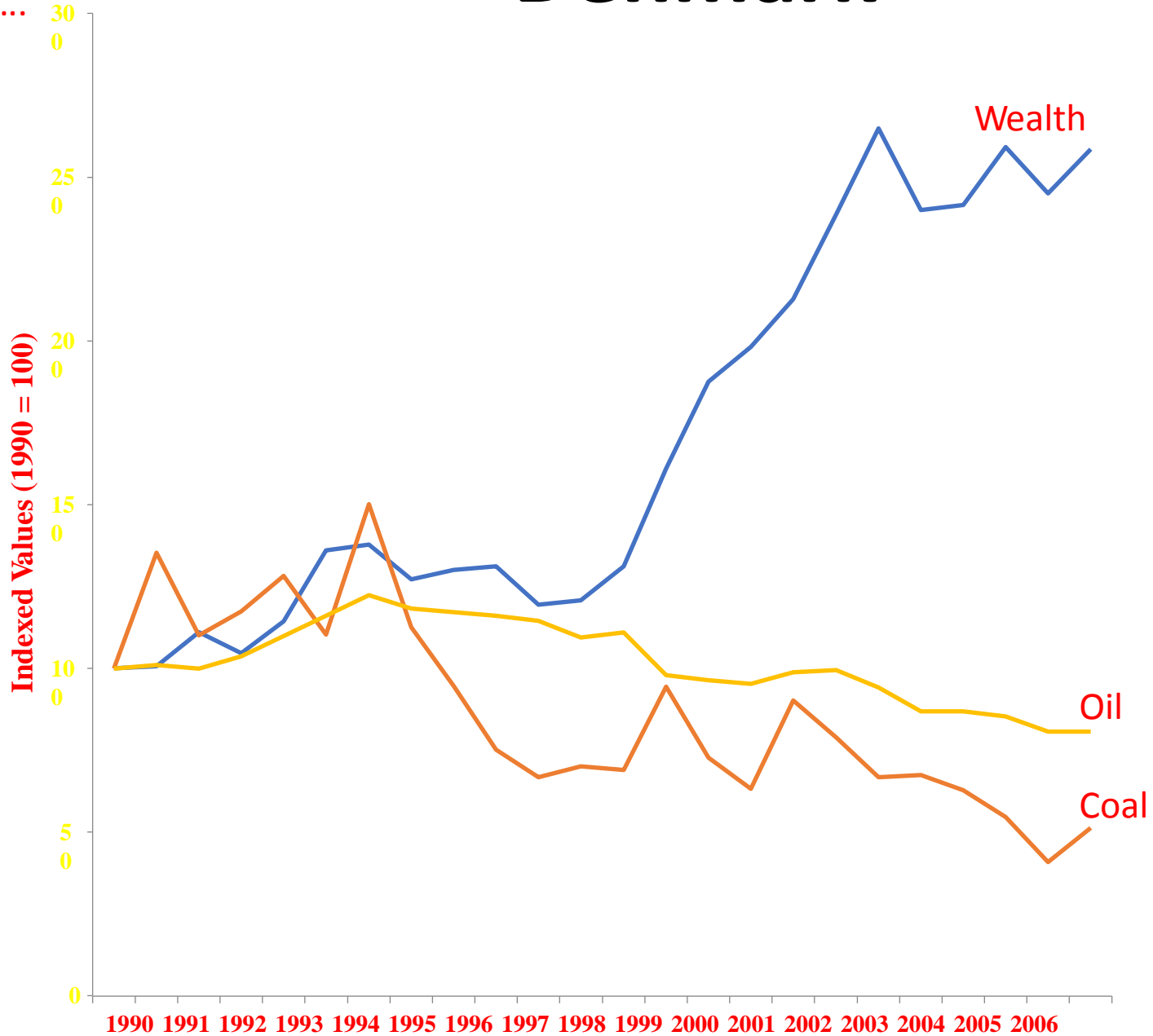
GHG going DOWN,

Wealth going UP

Decoupling wealth and greenhouse emissions is happening

Indexed Values (1990 = 100)

GNI

GHG

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

Denmark

Indexed Values (1990 = 100)

Wealth

Oil

Coal

300
250
200
150
100
50
0

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

Cycling has now outstripped car use in Copenhagen and not harmed the economy

Vehicle and Bicycle Entries into Copenhagen City Per Day 1970-2015

AUSTRALIA

Indexed Values (1990 = 100)

GNI
Coal
Consumption
Oil
Consumption

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
2007 2008 2009 2010 2011 2012 2013
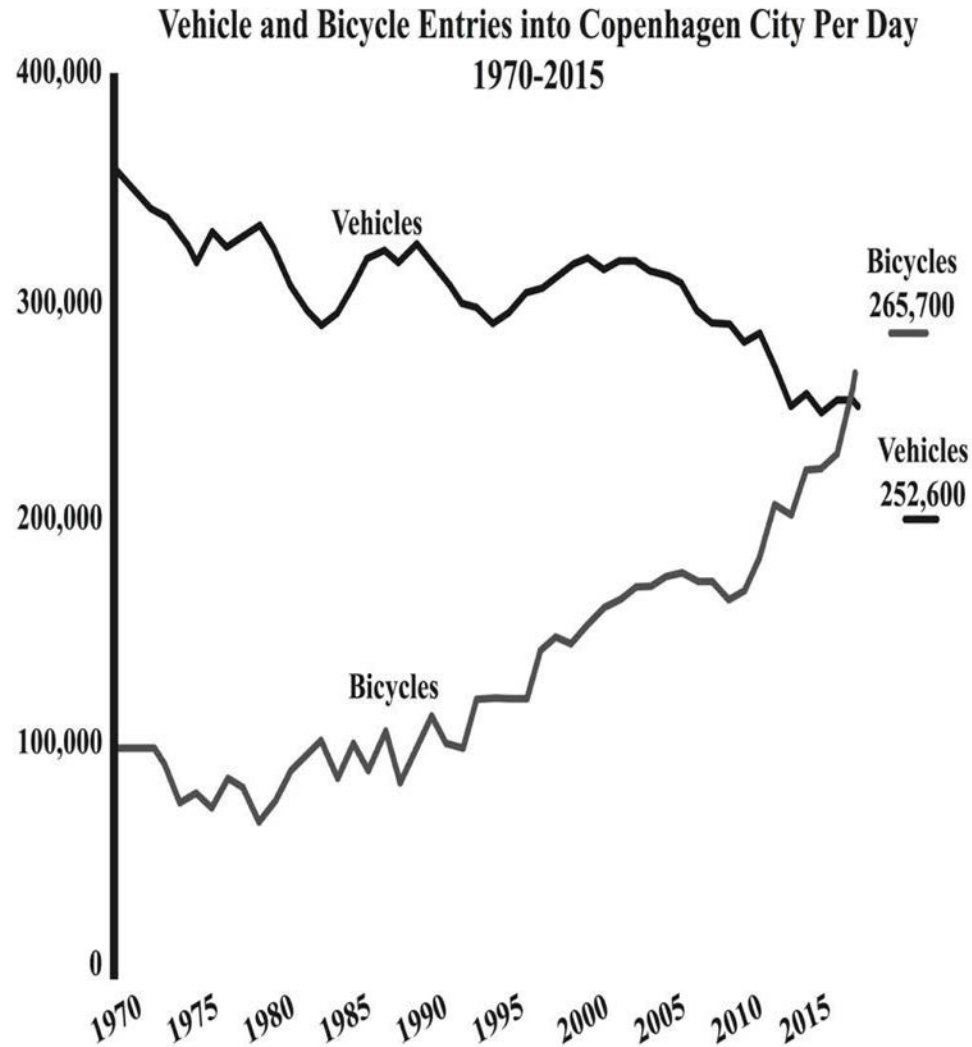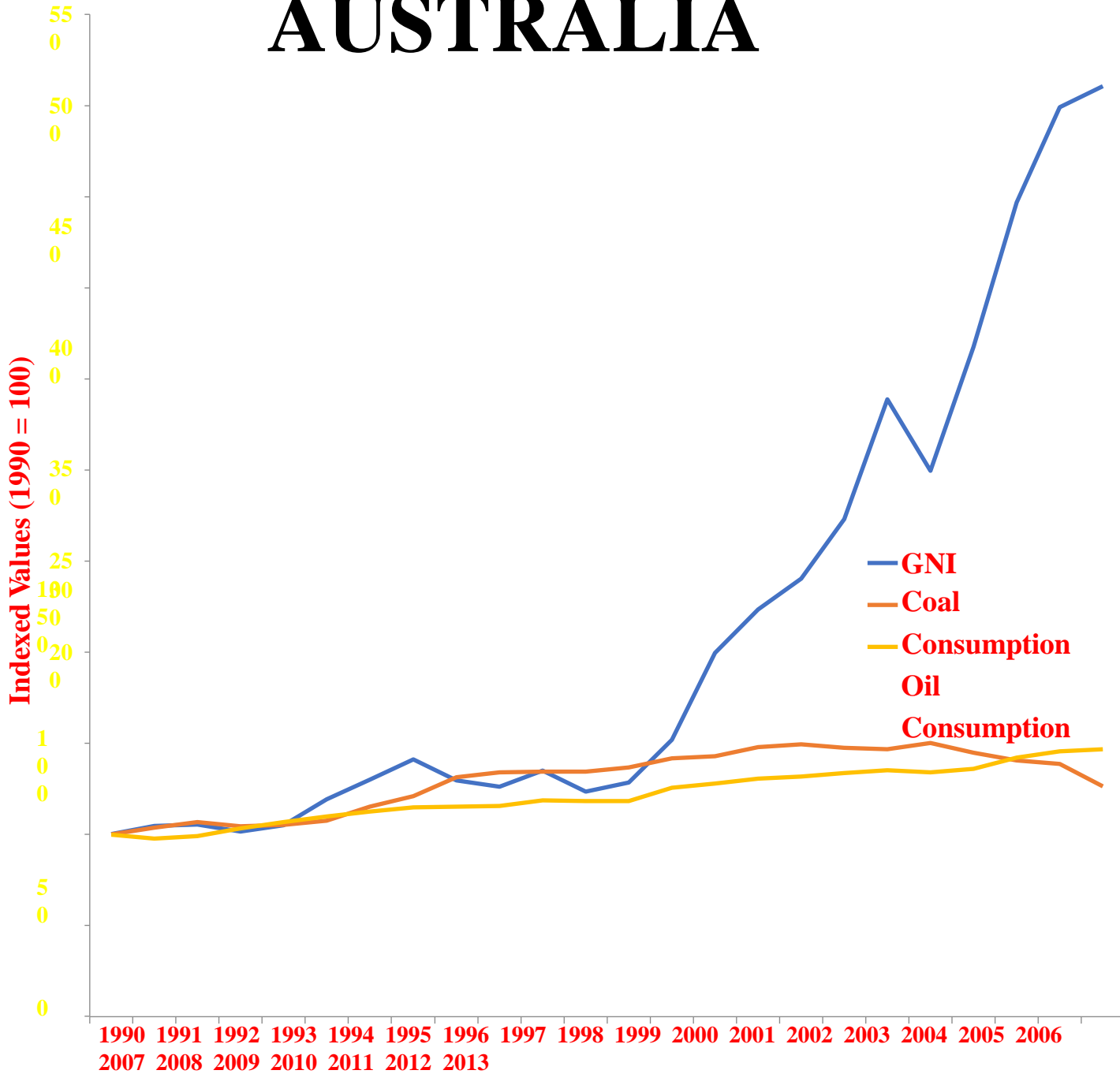
City Problems: Cities are the growth engines for their national economies

Megatrends imply significant challenges for city decision makers

Megatrends

Globalization & Urbanization
- Global players / trade volume increase
- 2030: 60% of population in cities
- High density living demands for new patterns in infrastructure

Demographic Change
- 65+ generation will nearly double by 2030 (from 7% to 12%)
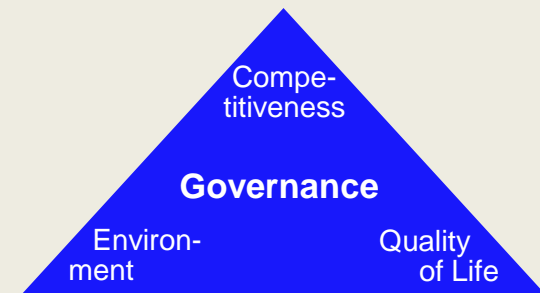- Need for adequate infrastructures as well as health- and elder care

Climate Change
- Cities responsible for ~80% GHG
- Need for resource efficiency and environmental care

Sustainable Urban Development

- Cities are competing globally to make their urban areas attractive to live and to invest in

Compe-titiveness

Governance

Environ-ment

Quality of Life

- Challenge to balance between competitiveness, environment and quality of life, and to finance infrastructure solutions
- Achieve committed CO_2 targets

➡ What is feasible in terms of proven technology, and for what cost and role?

GLOBAL PERSPECTIVE

(Global alliance for building and construction, COP22)

Table Building floor area growth to 2050 by region[3]

Energy use in buildings
represents more than
consumption and cont
greenhouse gases (GH

A growing population,
power in emerging eco   at energy demand in
buildings could increas   expected to double
by 2050, driving energ   nstruction.

Billion m2	2015	2030	2050
North America	38.1	47.1	56.9
Western Europe	29.8	34.3	36.9
Eurasia	9.8	13.1	14.9
China	57.2	79.3	84.6
India	15.8	32.1	57.6
Japan and Korea	9.8	10.9	11.1
Southeast Asia	15.6	23.8	32.3
Australia and New Zealand	2.1	2.7	3.4
Latin America and Caribbean	19.3	29.1	43.1
Middle East	8.0	12.7	18.3
Africa	18.0	30.4	56.0
World	**223.4**	**31.54**	**415.2**

LOW CARBON LIVING CRC
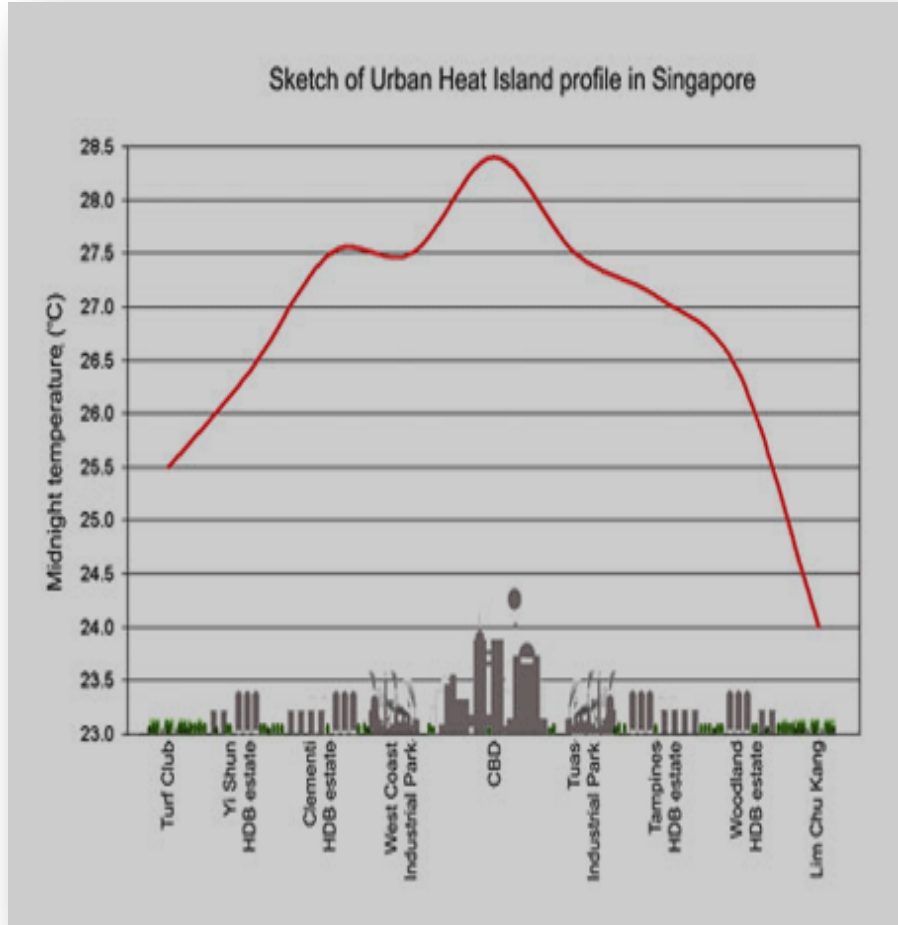
Urban ICT Technologies
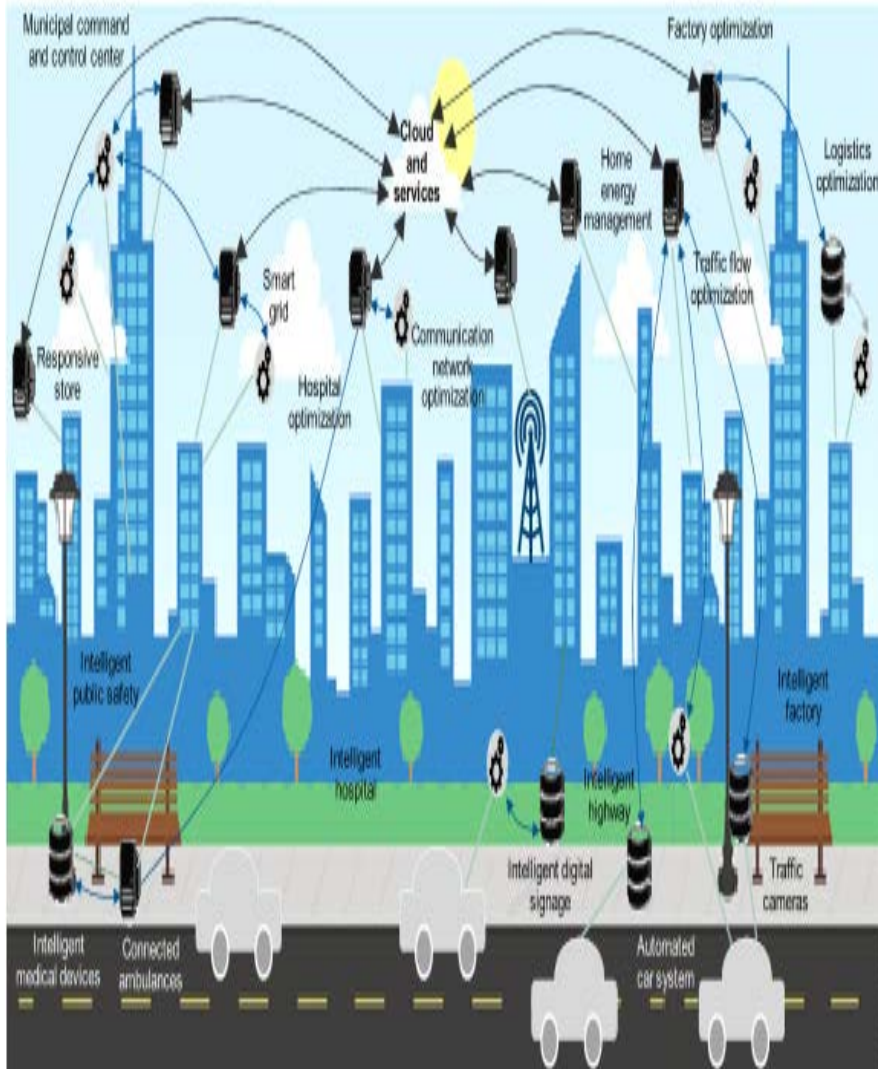
Ref : WHITE PAPER, Smart Cities and the Internet of Everything: The Foundation for Delivering Next-Generation Citizen Services, IDC, October 2013

'Proliferating technology equals exploding amounts of data. Security footage from video cameras, transponders collecting highway tolls, and sensors attached to bridges, parking spots, water pipes, street lights, and waste bins provide new data about city operations. According to IDC's 2013 Digital Universe Study, this digital data is expected to double every two years from now until 2020. How cities leverage and share this data will be a competitive differentiator. Big data and analytics will turn the vast amount of data into valuable and usable information and knowledge. Cities that have opened their data to the public have spurred the creation of new business; these businesses develop applications using city data and provide innovative citizen services while creating exciting new jobs'.
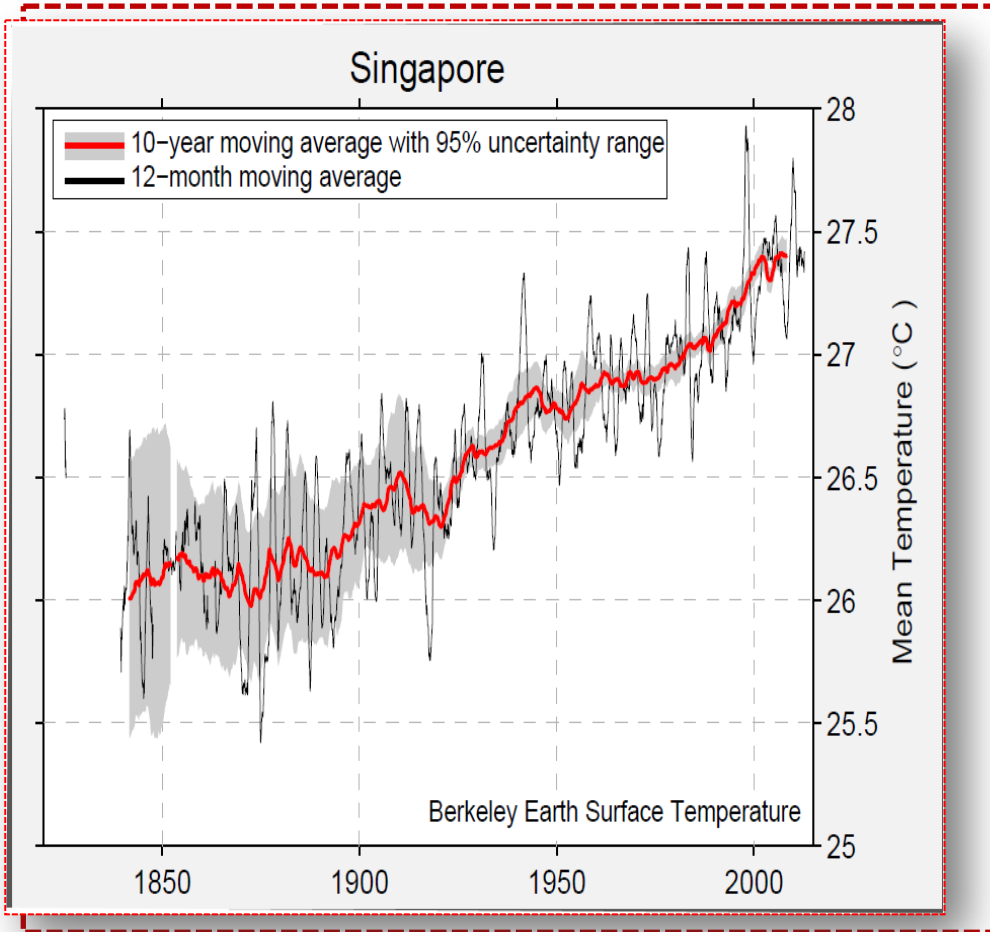
Atmospheric Research 51 1999 85–98 Long term changes in diurnal temperature range in Cyprus Colin Price, Silas Michaelides, Stylianos Pashiardis, Pinhas Alpert

Ambient Temperatures have increased

The frequency of heat waves has increased

Duration of Hot Spells has increased

The Intensity of Heat Island is increasing continuously.

Source : M. Santamouris Climatic Change and Urban Mitigation Techniques, Published
        D. Kolokotsa by Francis and Taylor, 2015

Sketch of Urban Heat Island profile in Singapore

Heat Island intensity ranges close to 5 K.
Heat Island is present in low, mid and high latitude locations.
It is observed during the day and the night period.
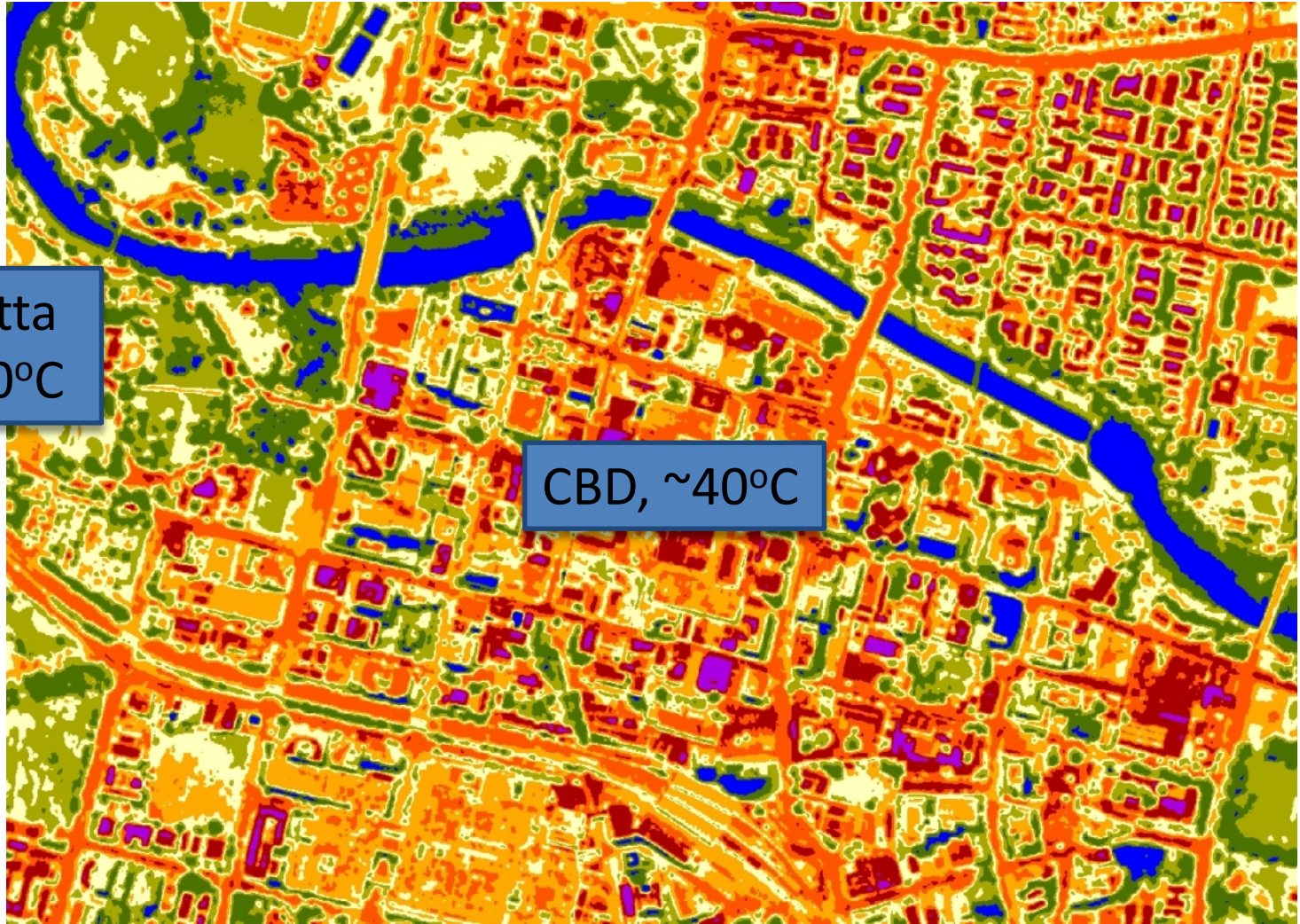Especially in the southern locations like Singapore, heat island is very important during the day period contributing to a high increase of discomfort hours, increase of the cooling load of buildings and a very high increase of the

Source : : Dr Wong Nyuk Hien
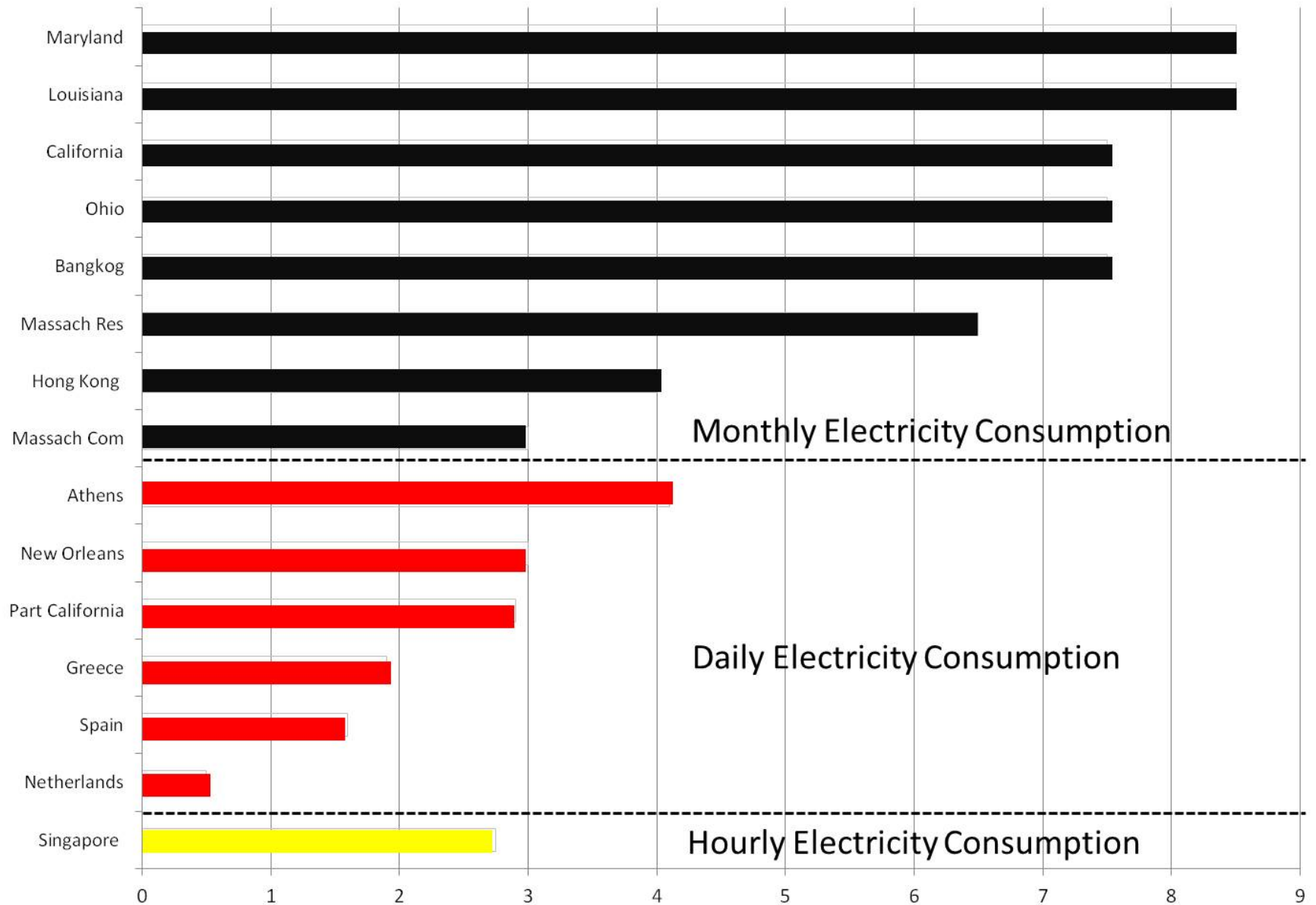
Increase of the Electricity Demand per Degree of Temperature Rise (%)

Evidence base for policy

Parramatta Park, ~30°C

CBD, ~40°C

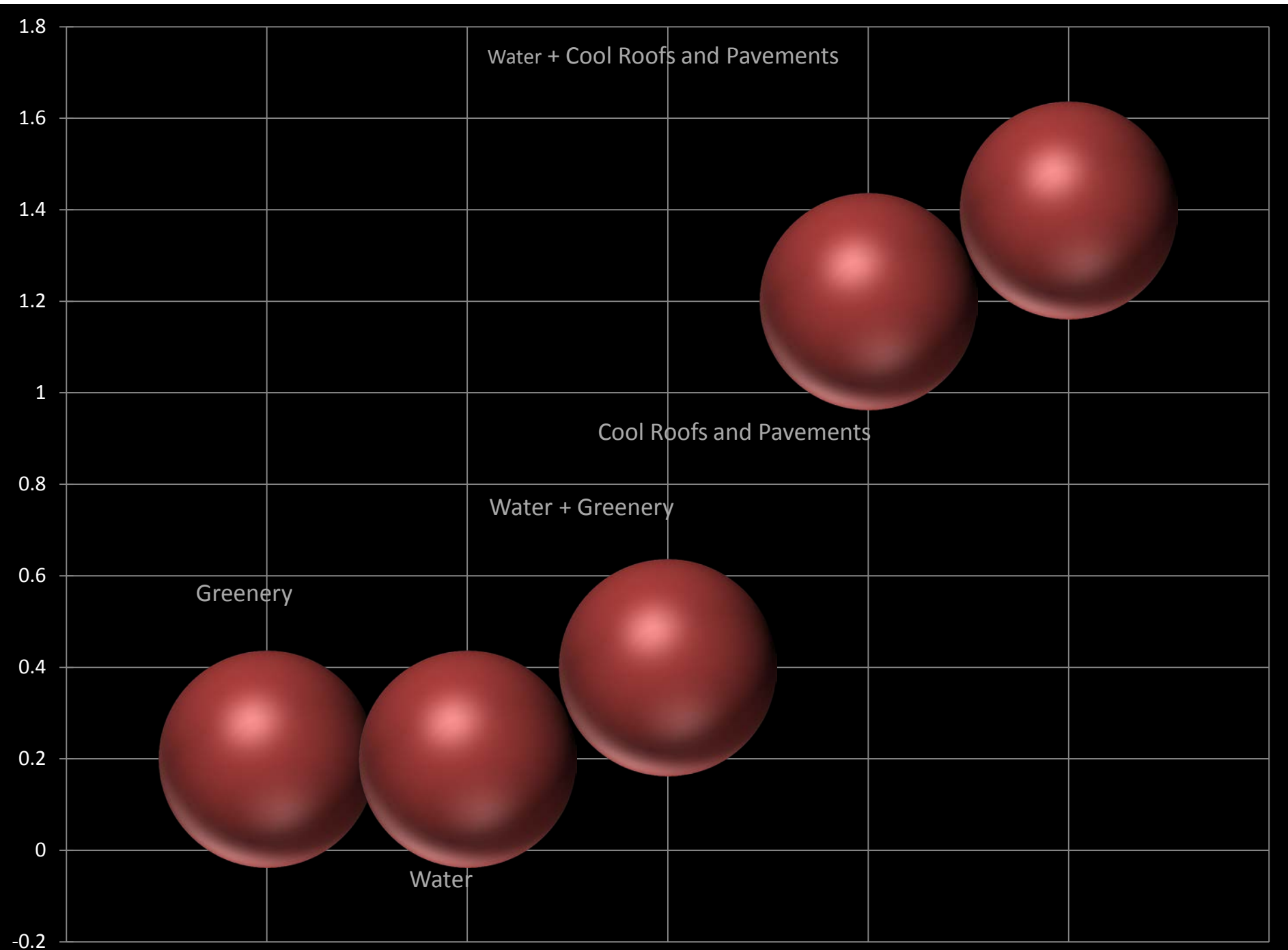Parramatta CBD – Day thermal   Source: Parramatta City Council http://www.remotesensing.com.au/urbanheat.html

Green Infrastructure

Golf courses

Green walls

Green infrastructure is used to improve the built environment and provide ecosystem services

Remnant Vegeation

WSUD

City street trees

Green roofs

Vegetated urban design

Parks and gardens

Source: The Growing Green Guide: A guide to green roofs, walls and facades
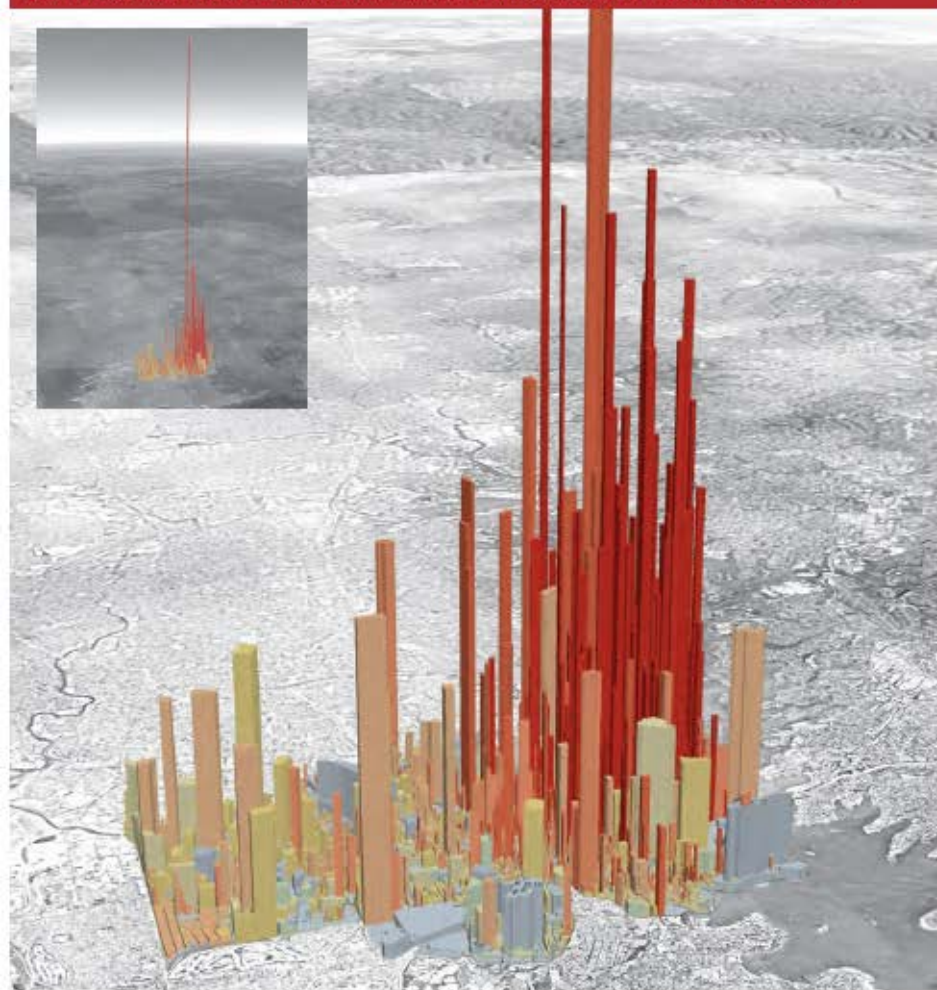http://www.growinggreenguide.org/

Low Carbon Cities – Businesss Case Based

WITHOUT THE DECENTRALISED ENERGY NETWORK

Figure 23 shows the city's emissions in 2030 under business as usual conditions. Each bar displays the amount of greenhouse gas emissions through vertical height and the intensity through colour, i.e. the greater the stack the higher the emissions, the darker the colour the greater the intensity per square metre of lot area.
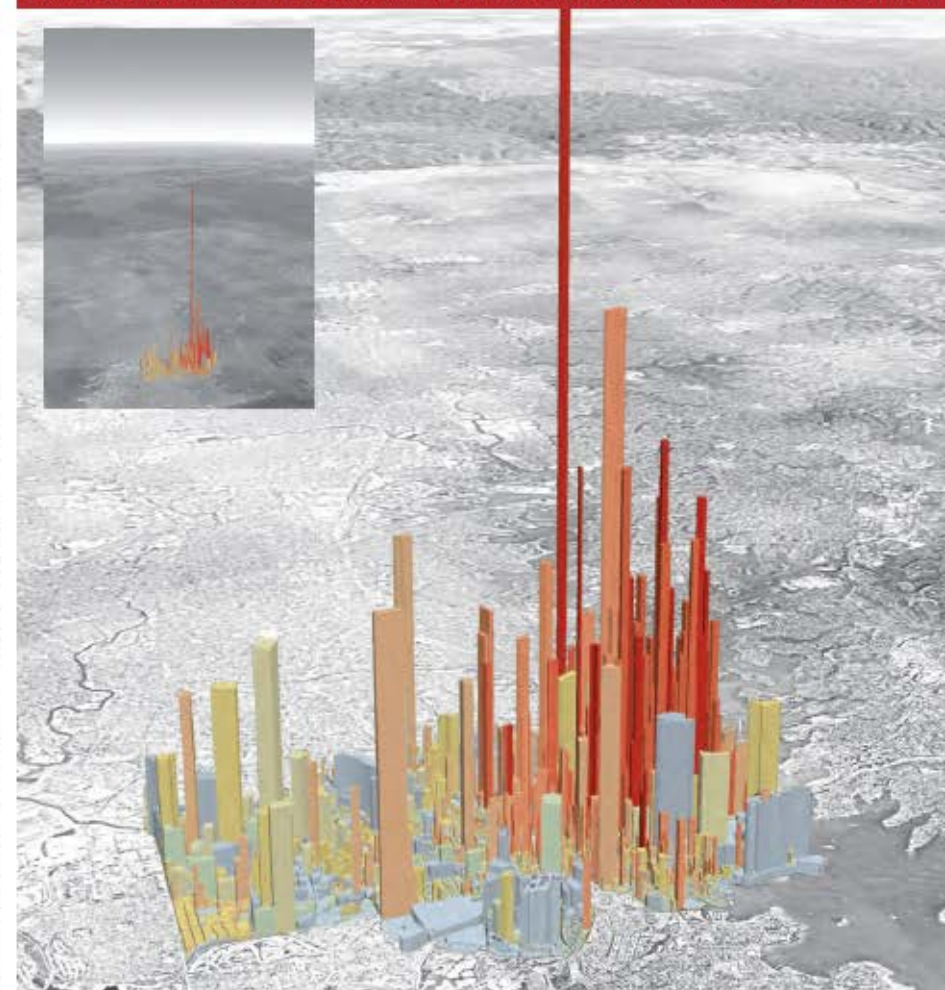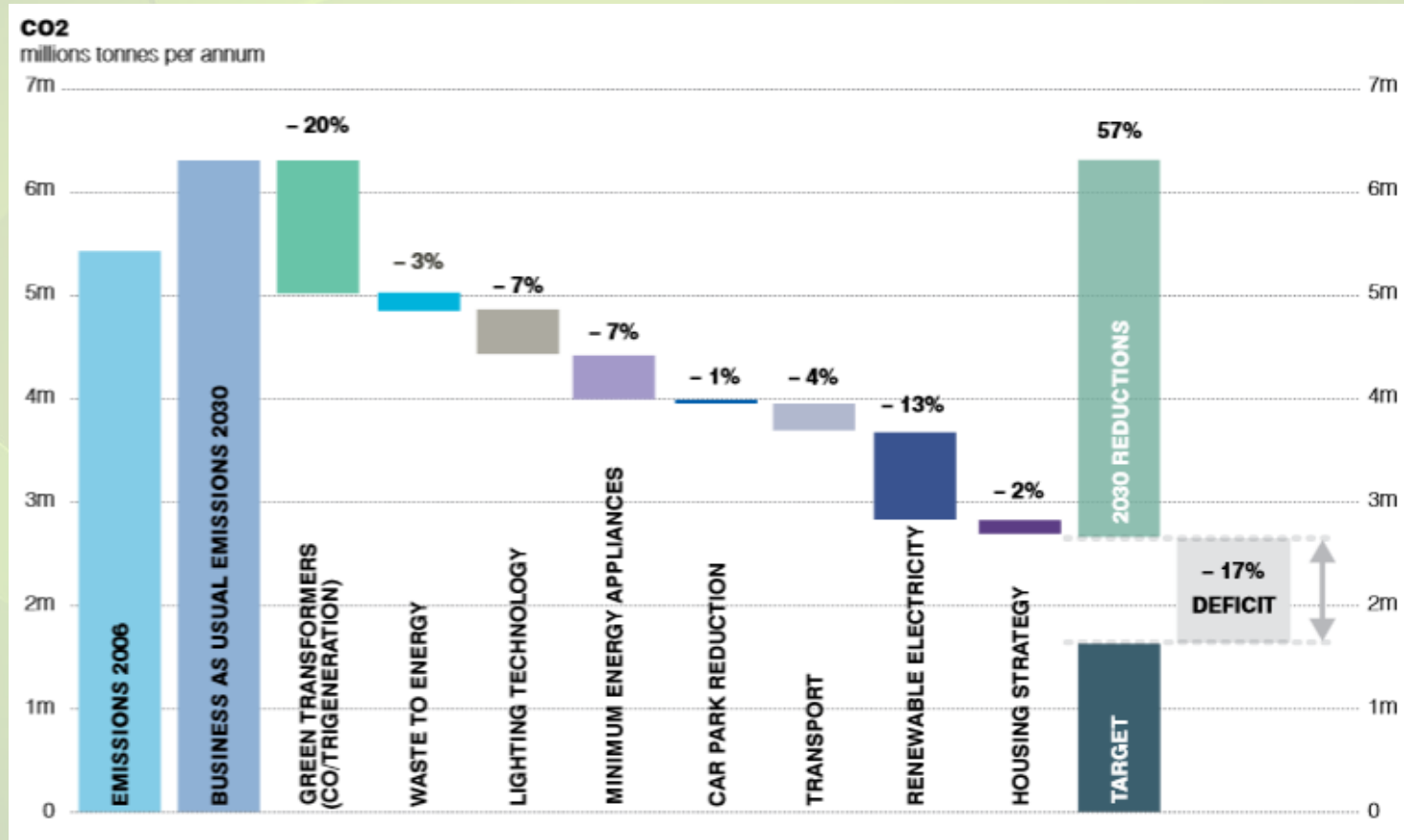
WITH THE DECENTRALISED ENERGY NETWORK

Figure 24 shows the reduction in greenhouse gas emissions in 2030 after the implementation of the decentralised energy network. This is based on a 7am–10pm configuration as described on page 22.

FIGURE 23: 2030 PROJECTED BUSINESS AS USUAL BUILDING GREENHOUSE GAS EMISSIONS

FIGURE 24: 2030 PROJECTED BUILDING GREENHOUSE GAS EMISSIONS WITH 360 MW$_e$ TRIGENERATION

Sydney

- Target set for a 70% reduction in GHG emissions by 2030 compared to 2006.

- http://www.metaefficient.com/architecture-and-building/skyscraper-gets-covered-in-7000-solar-panels.html
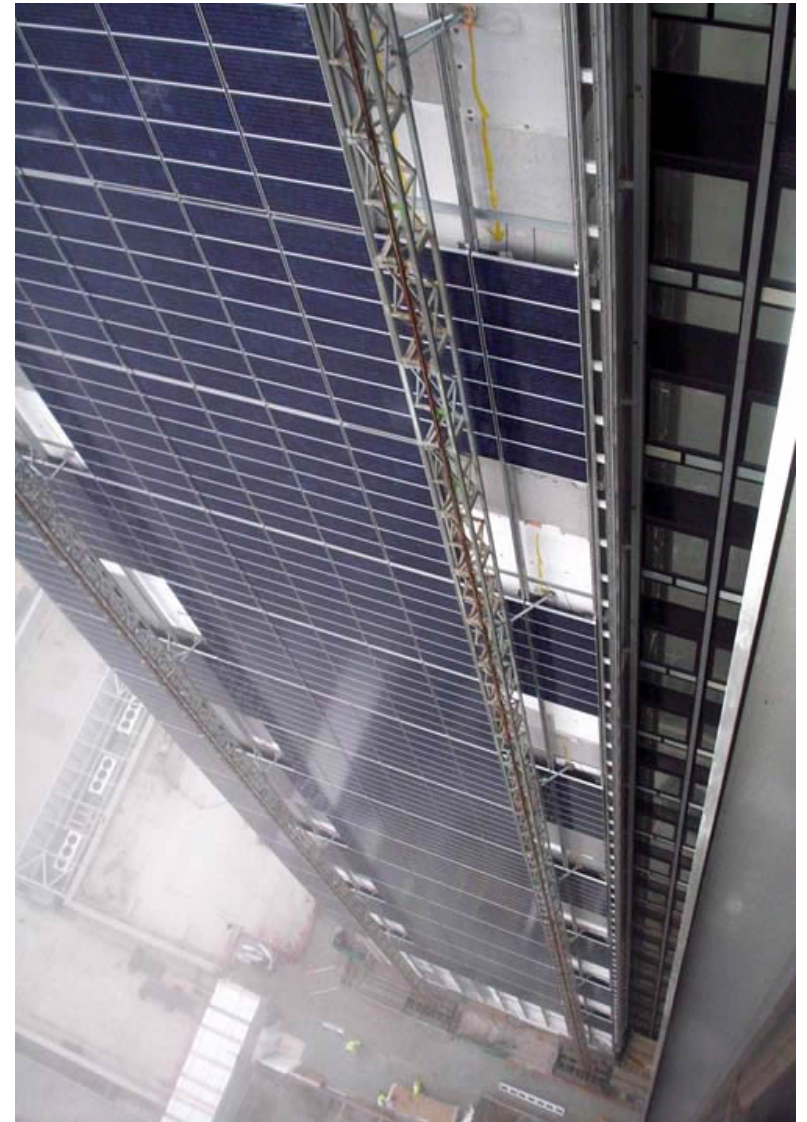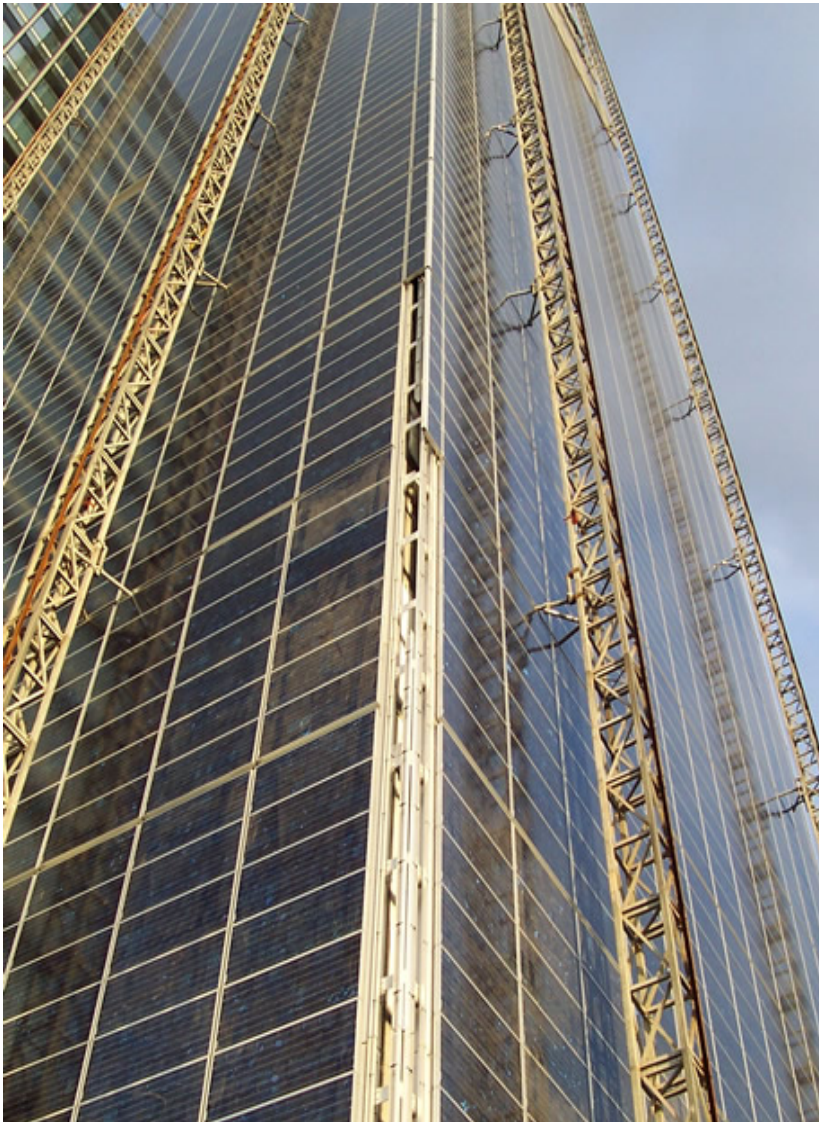
POLISHED STONE
$2400-$2800 m³

PHOTOVOLTAICS
$500-$1500 m²

STONE
$800+ m²

GLASS WALL
SYSTEMS
$560-$800 m²

STAINLESS STEEL
$280-$400 m²

What is Smart City?

A developed urban area that excels in:
- ✓ economy,
- ✓ mobility,
- ✓ environment,
- ✓ people,
- ✓ living,
- ✓ and governance

Through:
- ✓ strong human capital,
- ✓ social capital,
- ✓ and/or ICT (Information & Communication Technology) infrastructure

240 Persons travel
to work:
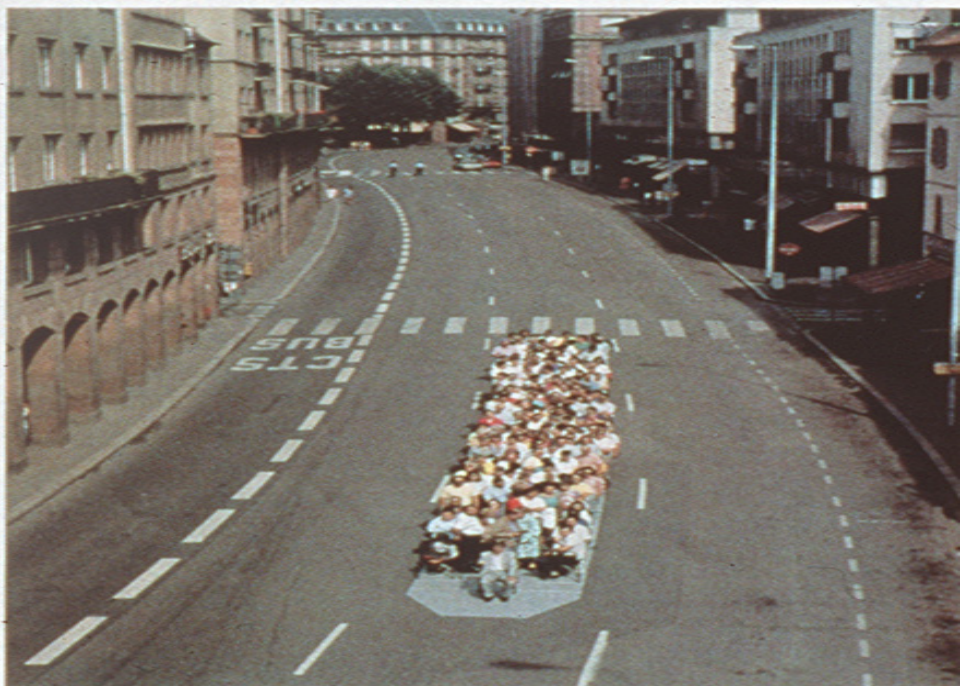
-- in   177 Cars

-- in   3 Busses

-- in   1 Tram

Key Performance Indicators (KPIs) for Sustainable Cities

Sustainable Development Goals for Cities - Make Cities and Human Settlements Affordable, Safe, Healthy, Resilient, Sustainable and Efficient

These Sustainable Development Goals are based on UN's Sustainable Development Goal 11 and associated targets as outlined in the Bangalore Outcome Document (UN 2015) and considered for a Chinese Context.

Safe and Affordable Cities 城市人口与居住地

The growth of urban populations requires access to adequate, safe and affordable housing. This is achieved through the improvement of living conditions in slums and informal settlements. (Refer to SDG11 Target 11.1)

Transportation and Accessibility 交通与便利性

It is essential to provide access to safe, affordable, energy-efficient and accessible transport systems for all people and goods, improving road safety and expanding public and non-motorized transport, with attention to the needs of those in vulnerable situations. (Refer to SDG11 Target 11.2)

Land Use Efficiency 土地使用

Sustainable urban development must address the relationships between land use and population growth, and promote land use efficiency covering economic, social and environmental benefits. The more equitable and efficient land use is achieved through participatory urban and regional planning and management. (Refer to SDG11 Target 11.3)

Cultural and Natural Heritage 文化和自然遗产

Recognizing the role of culture and strengthening cities' efforts to protect and promote cultural and natural heritage. (Refer to SDG11 Target 11.4)

City Disaster Resilience 风险管控和管理策略

Cities need to reduce the risks and become resilient to disasters. The reduction of social, health, economic, and ecological impacts of disasters, environmental change and disease outbreaks creates a safe and resilient environment, protecting people in vulnerable situations. (Refer to SDG11 Target 11.5)

Healthy Eco-Environment 生态环境

The reduction of the adverse impacts of city development is achieved through the preservation of biodiversity, the reduction and management of waste, and maintaining a high standard of air quality. (Refer to SDG11 Target 11.6)

Safe and Sustainable Public Spaces 公共空间

Providing, maintaining and encouraging access to safe, inclusive public space encourages a diverse, healthy and sustainable city. Multipurpose public spaces for a diversity of users provide services and opportunities for marginalized inhabitants to establish healthy social cohesion. (Refer to SDG11 Target 11.7)

Resource Efficiency 资源效率

Establishing a resource efficiency baseline provides the foundation for the development of sustainable cities. Energy efficient systems with the responsible use of renewable energy, water sensitive urban design (WSUD) with appropriate management and conservation, and food management and availability are all fundamental to sustainable city development. (Refer to GI-REC)

City Management and Policy 城市管理与政策

The preparation and implementation of a national urban and human settlements policy framework will facilitate economic growth, reduce poverty, improve the management of natural resources, and improve coordination within and between tiers of government. (Refer to SDG11 Target 11.a)

Increasing the number of cities implementing a wide-range community participation mechanism and integrated policies towards inclusion, resource efficiency, adaptation to climate change and resilience to disasters will form a cohesive national framework for future sustainable development. (Refer to SDG11 Target 11.b)

Supporting national, regional and local governments through financial and technical assistance in order to strengthen revenue streams, regulatory and institutional capacity. (Refer to SDG11 Target 11.c)

Key Performance Indicators (KPIs) for Sustainable Communities

Sustainable Development Goals for Communities - Make Liveable, Healthy, Proud, Safe, Productive, Inclusive, Self-reliant and Sustainable Communities

Sustainable Buildings 绿色建筑

Sustainable or *Green* Building design involves careful consideration of the total life-cycle impacts of a building (and the building supply chain). This holistic approach includes reducing embodied energy and material transport, using non-polluting and non-toxic construction materials, limiting construction and operational waste, reducing operational energy and water demand through passive solar, ventilation, green envelope and water-saving design, aiming for zero-carbon energy supply and the adaptive re-use of existing building stock.

Economic Productivity 经济效益

The generation of local employment opportunities and good transport networks to surrounding employment opportunities contribute to community sustainability. Local economic activity supports community and family cohesion by reducing commuting times and enabling community interaction. Inclusive local economic policy promotes youth employment and gender equity.

Inclusive Community Facilities and Service 社区设施与服务

Community Facilities and Service are essential factors to support the growth, security and diversity of a community for present and future generations. This involves a clear vision, formed by broad community participation, for any future infrastructure, services or facilities. Support for the elderly, young and women is established through strong standards of service and infrastructure that promote social equity, healthy and resilient communities.

Safety 安全

Safe and secure neighbourhoods are an essential component to achieving sustainable communities. A safe, attractive and enjoyable environment is achieved by reducing the community's vulnerability to crime and violence, providing emergence management and service, and solving food safety problems.

Liveable Community Landscapes 社区景观

Community landscaping provides ecosystems benefits, social connectivity and recreational opportunities. Accessible, safe, active recreation, walkability and social interaction enhance social cohesion and reduce the social and economic costs of non-communicable (lifestyle) diseases.

Proud and Educated Community 教育

Education is fundamental to the promotion of liveable, healthy and sustainable communities. This involves providing services and infrastructure to support early learning, the education of girls and caregiver training, and sustainability awareness.

SUC
Sustainable Urban Development and Liveable garden Community
可持續城市與社區中國項目

UNEP

佳粹環境
J C E P

LOW CARBON LIVING CRC

Community Facilities and Service
社区设施及服务

Aims

- A clear vision, formed by broad community participation, for any future infrastructure, services or facilities.

- Support for the elderly, young and women to promote social equity, healthy and resilient communities.

KPI examples:

- New facilities are accessible, visitable and adaptable for a person with a disability.

- Community interaction and participation.

- Community health management plan including regular physical checks and encouraging regular sport activities.

Public Space – International Best Practice
公共空间 - 国际最佳实践

Vancouver Waterfront, Canada

Visions and Pathways 2040

- A four year project to explore and articulate visions, scenarios and pathways for a low carbon cities in Australia.

- Using an integrated perspective on socio-technical systems innovation to find new low-carbon, resilient configurations for urban life and form.

- Involves extensive engagement with CRC stakeholders and other experts in workshops around Australia.
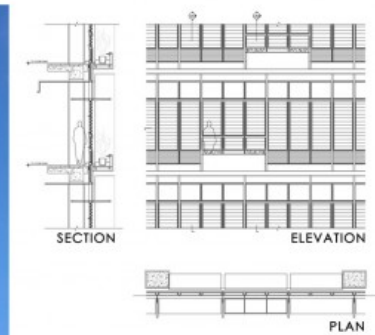
Project Partners: University of Melbourne, University of New South Wales, Swinburne University, Aurecon, AECOM, Hassell, Brookfield Multiplex, City of Melbourne, City of Sydney, Sydney Water, ICLEI

Biophilic Design: Khoo Teck Puat Hospital in Singapore

Source: https://www.ktph.com.sg/main/explore_ktph_pages/232/a_healing_environment

Community Engagement – Living Laboratories

The possible positive and negative disruptive changes from our Annual Conference participants

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"While cities are at the heart of today's global crisis, they are also the source of solutions for a sustainable/regenerative future."

- UN-HABITAT