Role of Bio-economy in Development of Sustainable Smart Cities

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Singapore-ETH Centre / ETH Zurich

Singapore-ETH Centre: An ETH Hub in South-East Asia

Future Cities Laboratory | Future Resilient Systems




- ETH Zurich's only major institute outside Switzerland
- Established in 2010 as part of NRF's CREATE campus
- Platform for two research programmes:

  Future Cities Laboratory &

  Future Resilient Systems
- 200 researchers

Singapore-ETH Centre

- Established 2010 under CREATE Initiative
- SIN providing “urbanization lab”
- SIN 1st Class Research Ecosystem
  - NUS & NTU among World Top 15
  - ~10 International Uni’s @ CREATE
- SEC Platform
  - FCL Future Cities Laboratory
  - FRS Future Resilient Systems
  - (FHT Future Health Technology)

Domains of expertise

Cities

Critical Infrastructure Systems

Digital Health

Sustainable future cities:
Through science, by design, in place

Research scenarios:

1. **High-Density Mixed-Use Cities**
2. **Responsive Cities**
3. **Archipelago Cities**

FCL Programme Structure

Disciplines	Inter-Disciplinary Scenarios	Network
	CIVAL	
Architecture, Planning & Design	**High-Density Mixed-Use Cities**	Government: URA, HDB, LTA
Mobility & Transport Planning	The *Grand Projet*	Universities: NUS, NTU, SUTD
Psychology & Social Sciences	Ecosystem Services Multi-Scale Energy Systems Dense and Green	Universities: UI, Chulalongkorn, ITB
Arts & Humanities	**Responsive Cities**	Universities: MIT, Harvard, LSE
Energy Systems	BigData-Informed Urban Design	Industry: Schindler, Siemens, Shell
Landscape & Ecosystems	Cyber Civil Infrastructure Engaging Mobility Cognition, Perception and Behaviour	Industry: Sika, Holcim, Veolia
Engineering & Materials Science	**Archipelago Cities**	Development Banks: ADB, WB
Information Technology	SIJORI and Extended Urbanisation	NGOs: Rockefeller, Mercy Corps
Computer Science	Urban-Rural Systems Alternative Construction Materials Tourism and Cultural Heritage	NGOs: KPC, Habitat for Humanity

The new urban world

The earth reaches a momentous milestone: by next year, for the first time in history, more than half its population will be living in cities. Those 3.3 billion people are expected to grow to 5 billion by 2030 – this unique map of the world shows where those people live now

At the beginning of the 20th century, the world's urban population was only 220 million, mainly in the west

By 2030, the towns and cities of the developing world will make up 80% of urban humanity

Key

- Predominantly urban 75% or over
- Predominantly urban 50–74%
- Predominantly rural 25–49% urban
- Predominantly rural 0–24% urban
- Cities over 10 million people (greater urban area)

Urban growth, 2005–2010

3,307,950,000

The world's urban population – from a total of 6,615.9 million

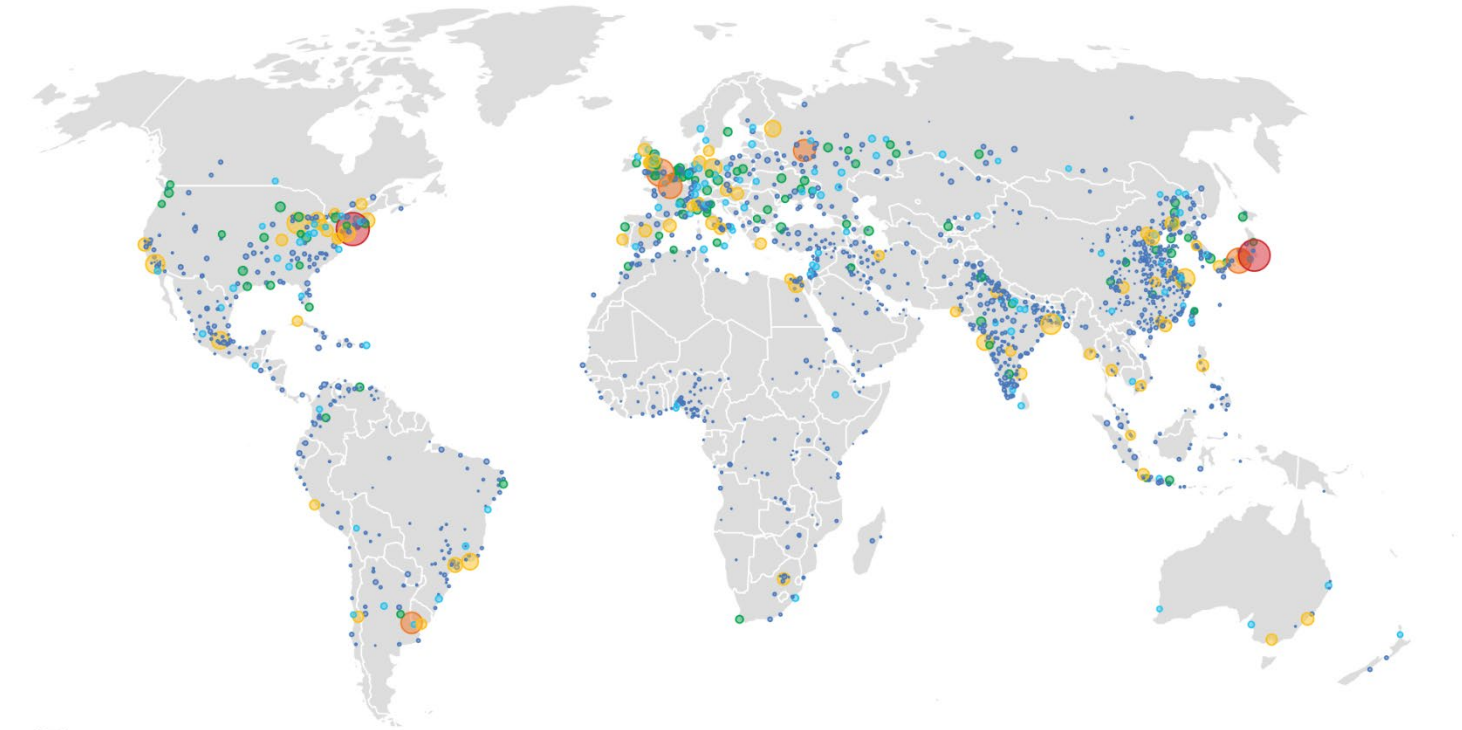
SOURCE: UNFPA GRAPHIC: PAUL SCRUTON

Urbanisation, 1950

Search cities

GLOBAL CITY POPULATIONS*

70.4%	17.7%	2.0%	2.6%	5.1%	1.3%	0.9%
Rural -	Other urban Fewer than 300,000	Smallest cities 300,000 to 500,000	Small cities 500,000 to 1m	Medium cities 1m to 5m	Large cities 5m to 10m	Megacities 10m or more



1950 1960 1970 1980 1990 2000 2010 2020 2030

Source: UN

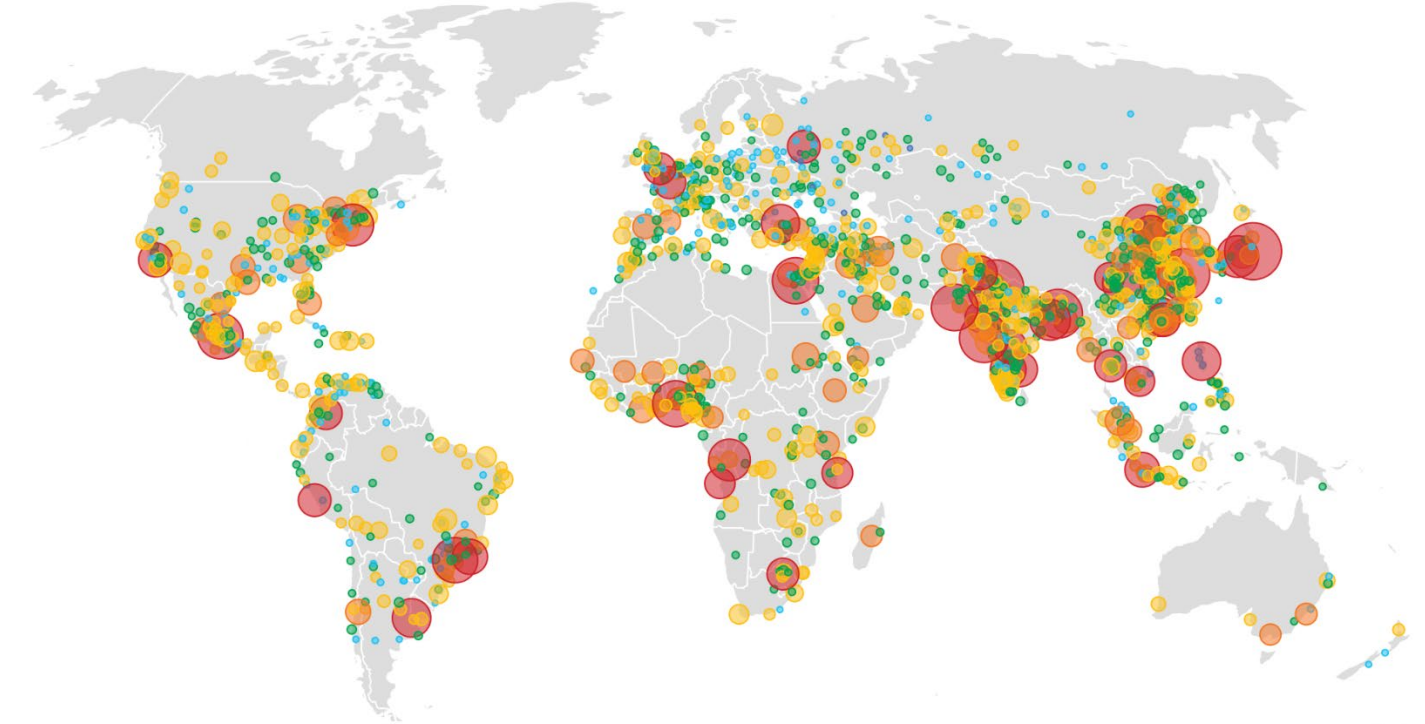
*Dataset comprises urban agglomerations with 300,000 inhabitants or more in 2014.
Data are for countries existing in 2014, mapped on modern borders. Projections from 2014.

Urbanisation, 2030

Search cities

GLOBAL CITY POPULATIONS*

40.0%	23.0%	3.8%	6.1%	13.4%	5.2%	8.6%
Rural -	Other urban Fewer than 300,000	Smallest cities 300,000 to 500,000	Small cities 500,000 to 1m	Medium cities 1m to 5m	Large cities 5m to 10m	Megacities 10m or more



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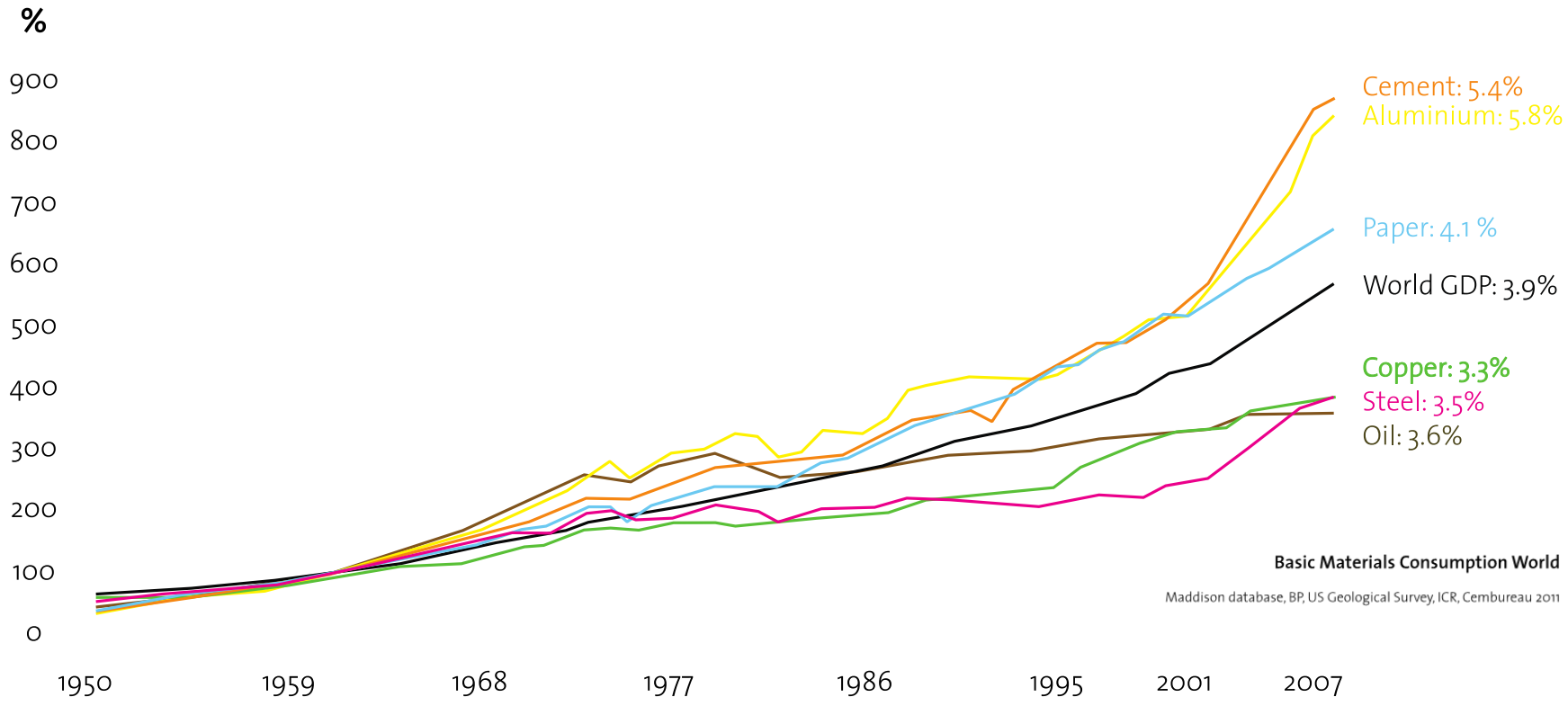
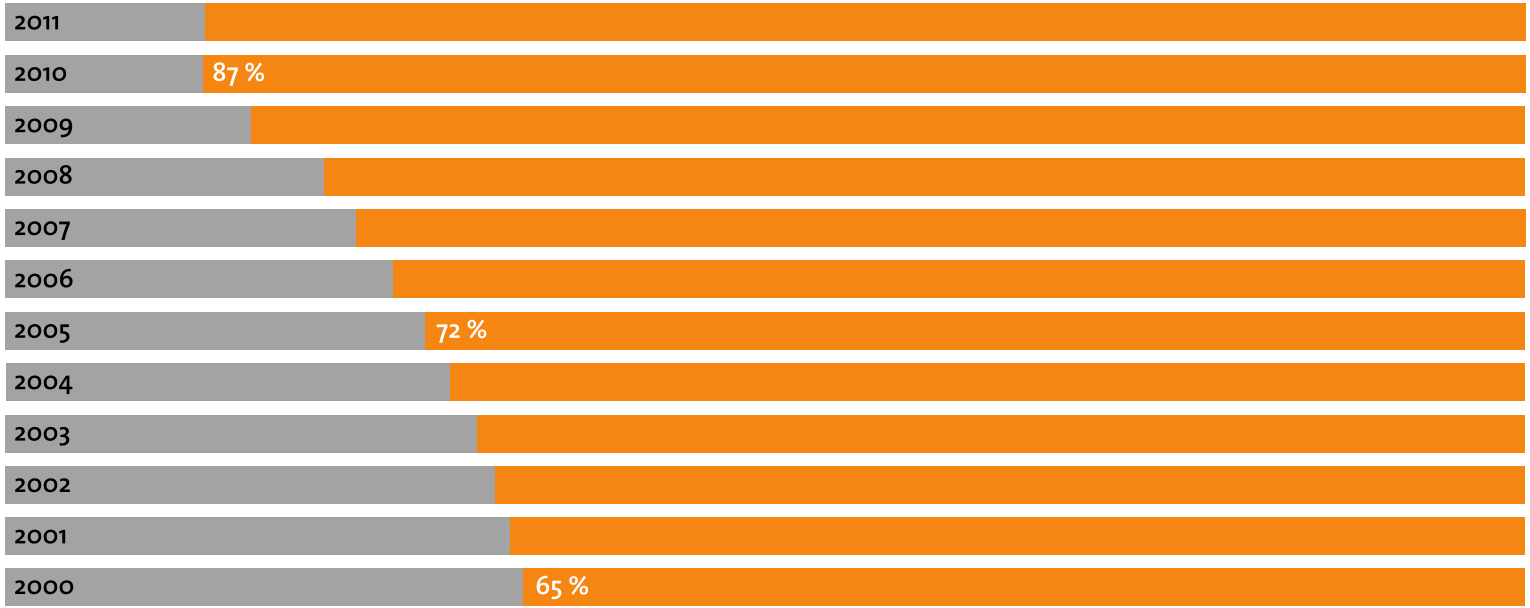
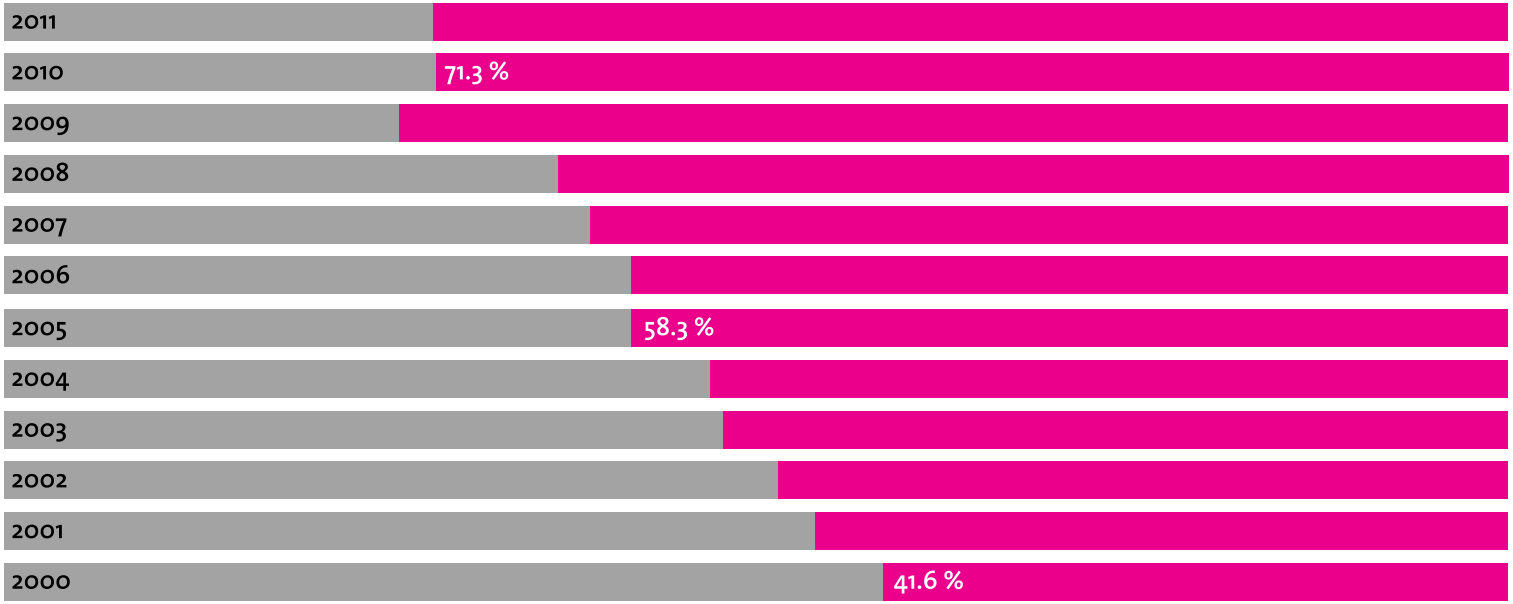

%
900
800
700
600
500
400
300
200
100
0
1950
1959
1968
1977
1986
1995
2001
2007
Cement: 5.4%
Aluminium: 5.8%
Paper: 4.1 %
World GDP: 3.9%
Copper: 3.3%
Steel: 3.5%
Oil: 3.6%
Basic Materials Consumption World
Maddison database, BP, US Geological Survey, ICR, Cembureau 2011



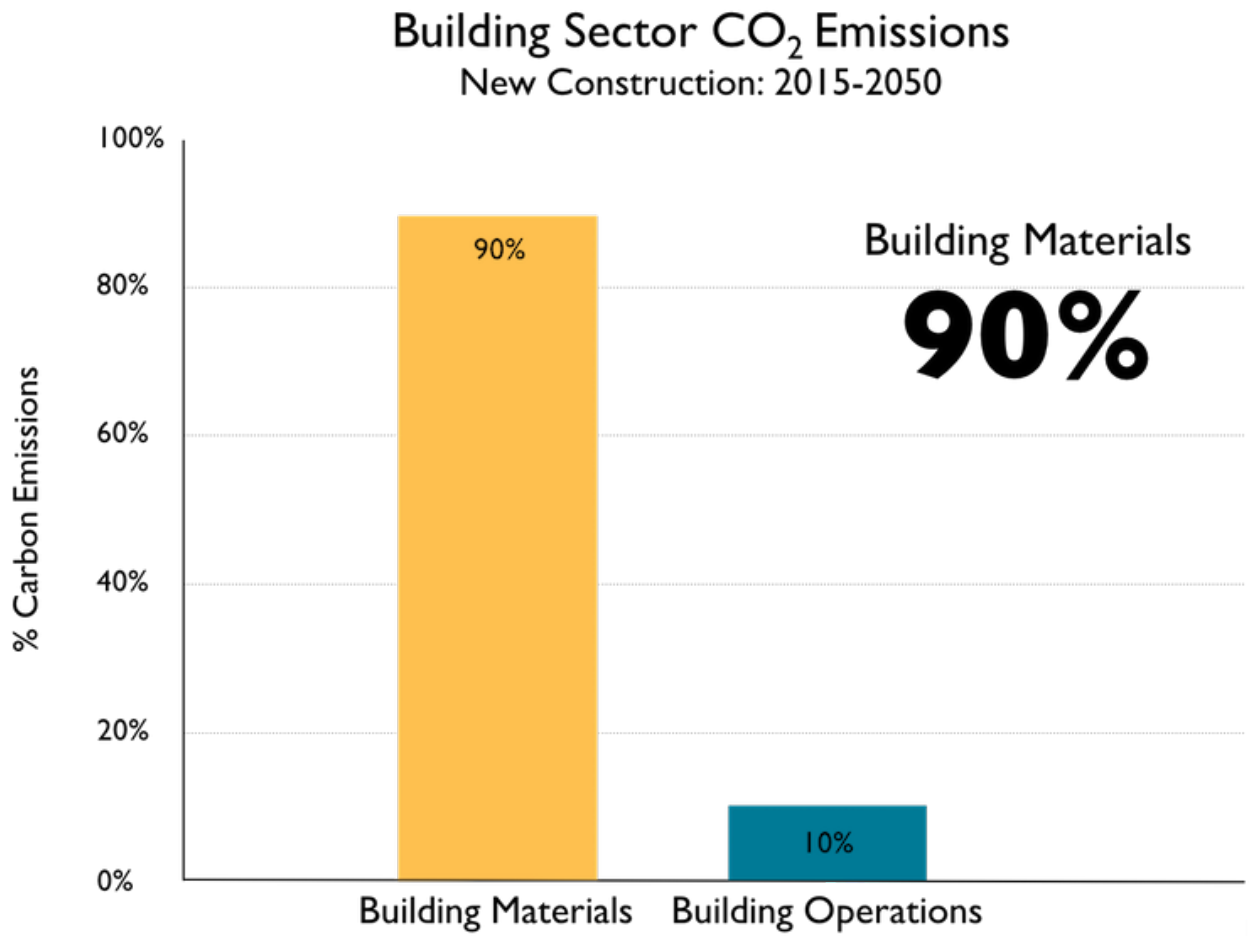
Reginal Share in World Cement Demand

Ernst & Young (2012)



Reginal Share in World Steel Demand

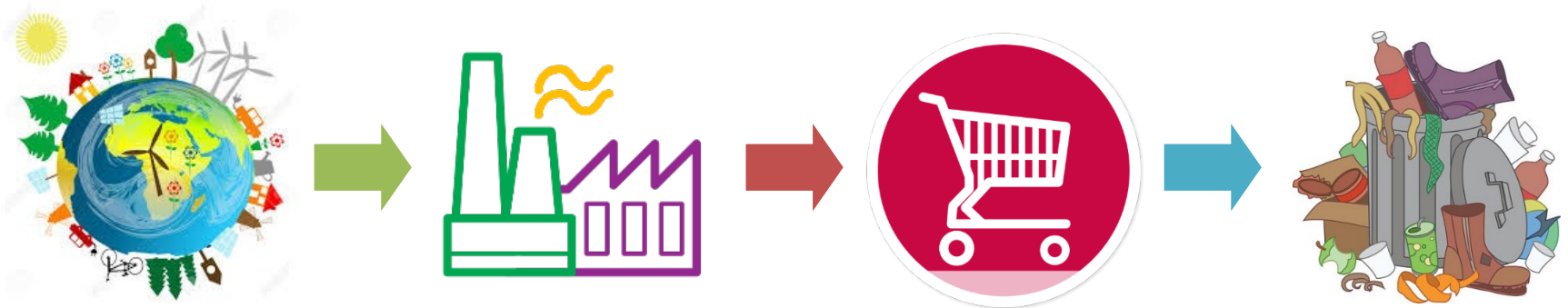
World Steel (2012)



McKinsey Global Institute 2011


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

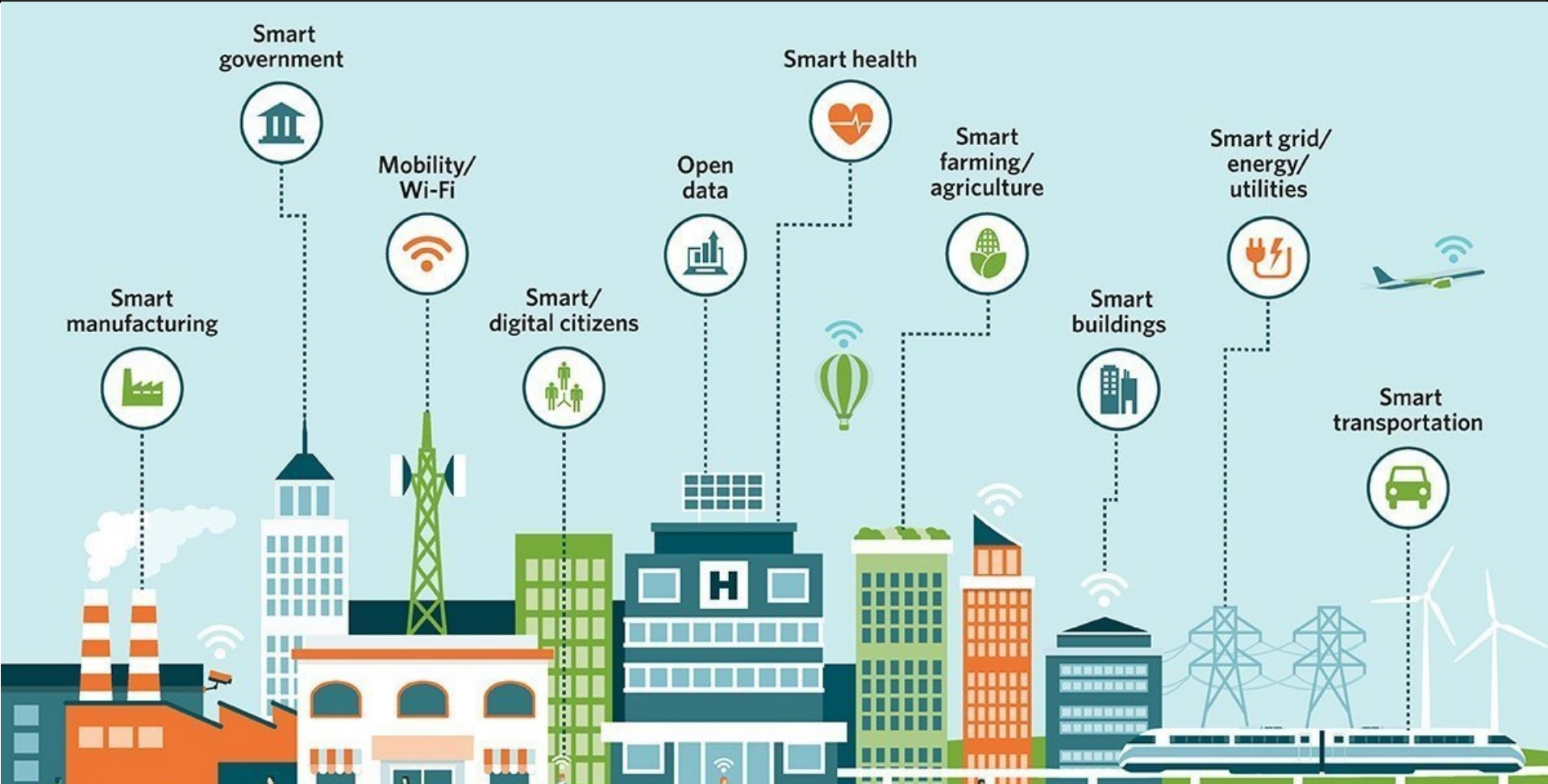
Linear economy



Limited Resources → Production → Consumption → Disposal

Circular economy

Smart Cities


Smart government
Smart health
Mobility/ Wi-Fi
Open data
Smart farming/ agriculture
Smart grid/ energy/ utilities
Smart manufacturing
Smart/ digital citizens
Smart buildings
Smart transportation
H

Smart City's mission is to optimize city functions and drive economic growth while improving quality of life for its citizens using smart technology and data analysis.

The top 10 Smart Cities

IMD Business School Smart City Index 2019

Internet of Thing

Information and Communications Technology

Machine Learning

Automation

Energy

Communication

Transport

Environment

Sustainable Cities

- Social development
- Economic development
- Environmental management
- Urban governance

Sustainable Smart Cities

How?

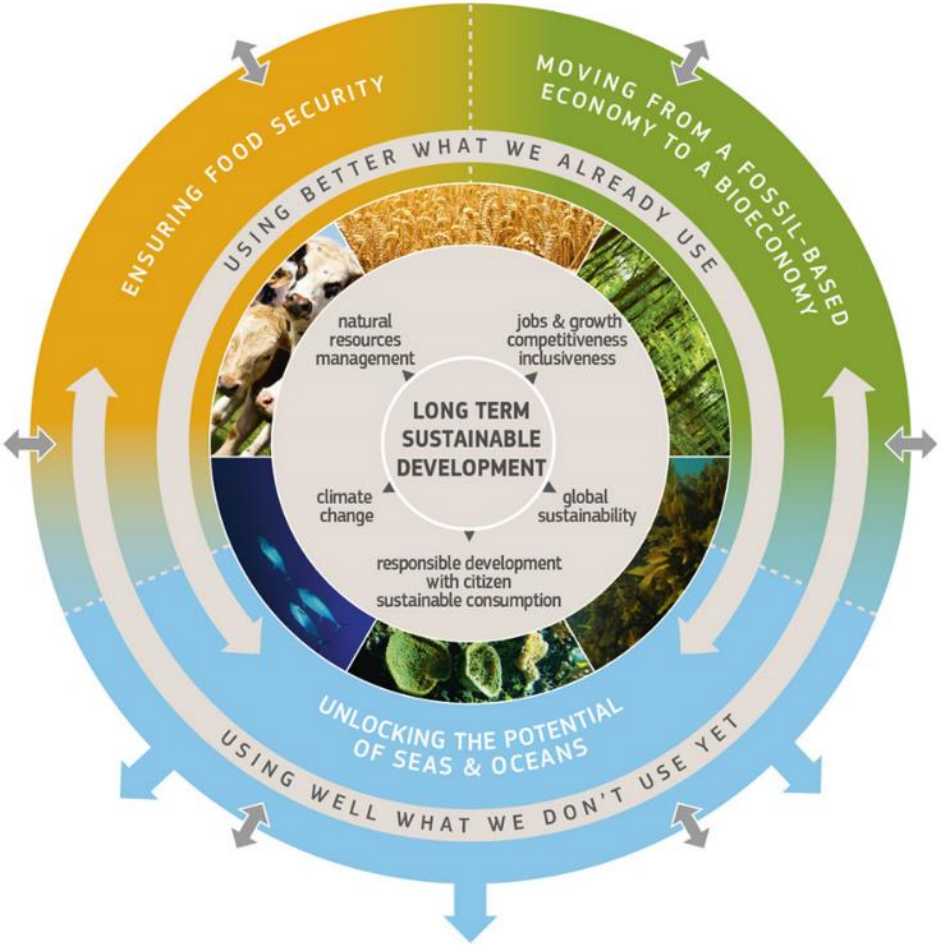
Circular Bioeconomy

Improved resource and eco-efficiency

Low Green House Gas footprint

Reducing the demand for fossil carbon

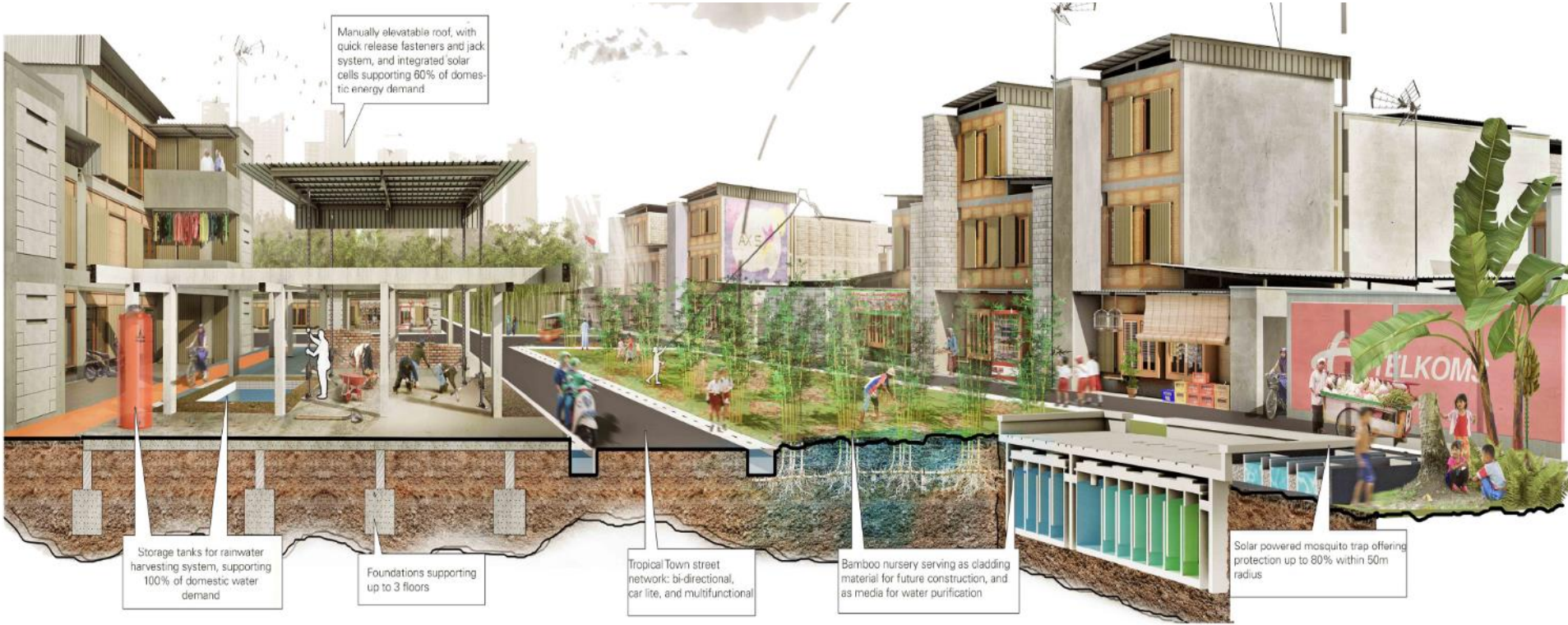
Repurposing of waste and side streams



Sharing ETH works in Asia

Tropical Towns in Indonesia

Building sustainable housing and township



Tropical Town in Batam, Indonesia



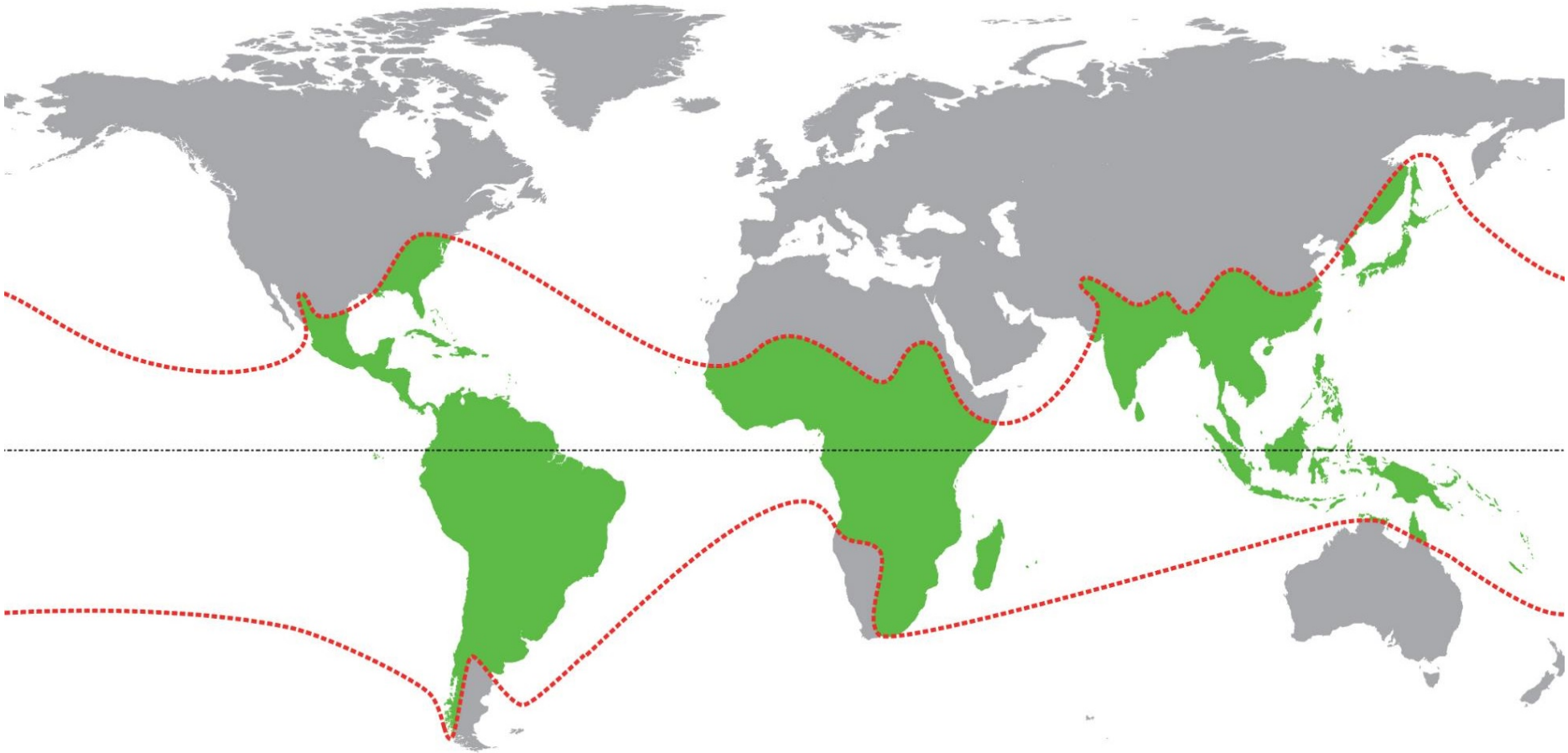


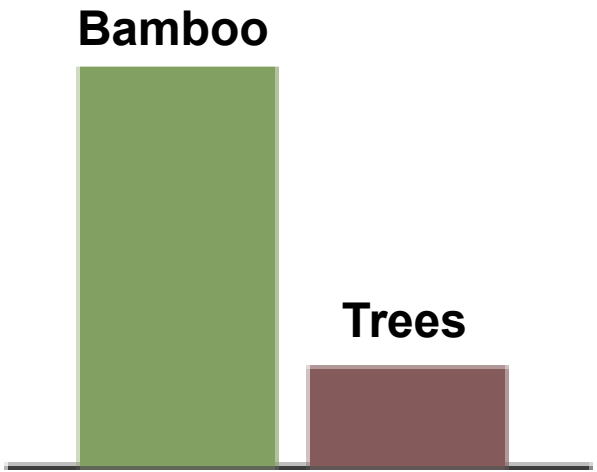

Karlsruher Institut für Technologie

MYCOTECH

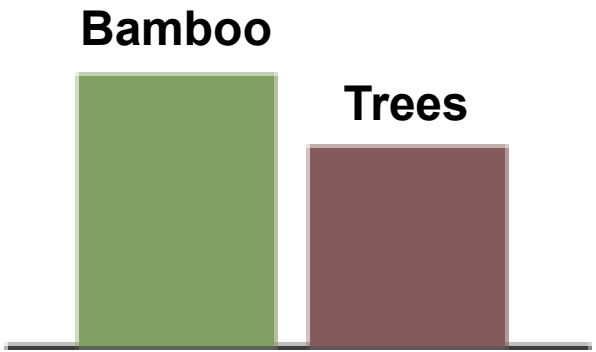
UNIVERSITAS INDONESIA
Veritas, Probitas, Iustitia

Local resources

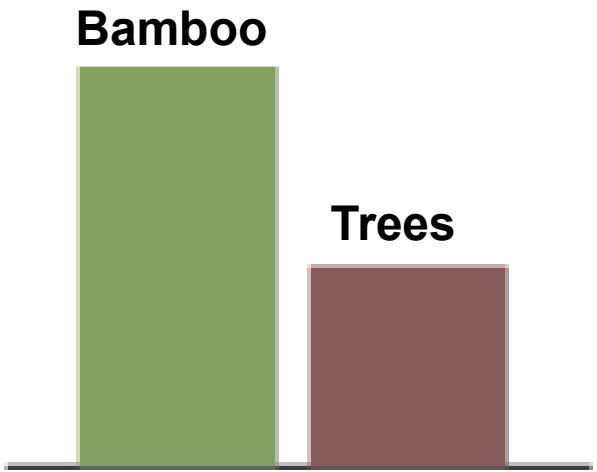




CO2 sequestration



Oxygen generation



Water retaining

BVL™ (Bamboo Veneer Lumber)

A high performance sustainable composite synthesized from bamboo fibres

RENEWABLE & SUSTAINABLE

- ✓ Highly renewable
- ✓ Eco-friendly material
- ✓ Carbon negative

STRONG

- ✓ Up to 3x stronger and dimensionally more stable than wood

DURABLE

- ✓ Highly resistant to decay and rot

Horticultural Waste utilization

Turning Waste into Bio-based Materials

Creating sustainable value chains using local resources by creating jobs and employing people

green sustainable alternative to steel, concrete and glass

Bamboo as :
- Clean source of charcoal
- For biomass for electricity

a great alternative to cement, steel and even timber as a natural carbon sink to fight climate change

Engineered Bamboo and Mycelium for affordable,Modern and High-tech housing solutions

Bamboo forest and plantation can help to restore degraded land and Help to balance the ecosystem in the nature

Sharing with stakeholders


EXIT


19 땅 열용량
EARTH THERMAL MASS

WIDUZ

HIGH PERFORMANCE APPLICATIONS

Spinoff ETH zürich


EPFL
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE


Berkeley
UNIVERSITY OF CALIFORNIA


NATIONAL RESEARCH FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE

ETH zürich


KIT
Karlsruher Institut für Technologie


MIT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POLYTECHNIC
DISCOVER. TRANSFORM. ACHIEVE


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TECHNOLOGICAL
UNIVERSITY
SINGAPORE


NUS
National University
of Singapore


UNIVERSITAS
INDONESIA
Veritas, Probitas, Iustitia


SMU
SINGAPORE MANAGEMENT
UNIVERSITY


SINGAPORE UNIVERSITY OF
TECHNOLOGY AND DESIGN


NANJING FORESTRY UNIVERSITY
1902


THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA


NATIONAL
PARKS
LET'S MAKE
SINGAPORE
OUR GARDEN


CITY
DEVELOPMENTS
LIMITED


Building and Construction
Authority


Empa
Materials Science and Technology


CENTRE for
LiveableCities
SINGAPORE


WEB STRUCTURES


WACKER

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