How can cities grow whilst reducing emissions and vulnerability?

Comparative Genetics of Cities, 21st May 2010

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Transformation of urban systems will require:

- Much improved understanding of the mechanisms of interaction in urban function, via:
  - Land use
  - Transport
  - Resource flows (energy, water, nutrients)
  - Building form and function
  - Urban climate
  - Information networks

- Recognition of the time scales of change and the legacy of past decisions (planning, infrastructure, buildings)

- Development of collective understanding of urban function and collaborative platforms for exploration of transition strategies

- Motivation and leadership
Land use and spatial interaction module

• Employment
• Multi-modal transport
• Developed land cover
• Population
• Land use planning constraints and attractors

Urban Integrated Assessment Facility
Land use and spatial interaction module
- Employment
- Multi-modal transport
- Developed land cover
- Population
- Land use planning constraints and attractors

City-scale climate scenarios
- Temperature
- Precipitation
- Sea level rise
- Storm surge

Urban Integrated Assessment Facility

Demographic scenarios

MDM-E3 Multi-sector city-scale economics module
- Dynamic resource interactions between sectors
- Specialist energy sector module

Greenhouse gas emissions assessment module
- Multi-sectoral emissions accounting tool
- Detailed sub-modules for transport (personal and freight)
- Analyse of city-scale energy policies

Climate impacts assessment and adaptation planning
- Analyse risks of flooding, drought, urban heat and health impacts
- Test adaptation options

Interface for testing of policy options

Working with key London stakeholders

Tyndall Centre for Climate Change Research
Land use and transport

Planning policy:
Attractors, constraints etc

Transport network and
generalised cost of travel

Spatial allocation of population
and employment

High resolution downscaling
of development

The real world
Transport infrastructure investment

Reduction in travel times from Heathrow to all other census wards within the GLA boundary by rail after the construction of CrossRail.
Emissions from personal transport

Analysed options for emissions reduction:

• **Option 1:** Implementation of the London Mayor’s Climate Change Action Plan: ~12% reduction by 2025 (relative to base line)
• **Option 2:** Additional savings from potential technological advances: ~23% reduction by 2025
• **Option 3:** Technological advances and increased demand for zero carbon modes of transport incentivised by carbon trading: ~25% reduction by 2025
• **Option 4:** Substantial modal shift to walking and cycling, supported by appropriate changes to London’s transport infrastructure: BUT can achieve >80% reduction by 2050!!!
Water scarcity

Expected annual number of drought orders

- UKCP09: Medium uncertainty bounds
- Demand change only
- Demand plus UKCP09 Medium

Year

2010  2020  2030  2040  2050  2060  2070  2080  2090  2100
Trade-offs in water management

Demand v supply

Graph showing the relationship between additional water supply and average demand reduction for different years and scenarios.
Trade-offs in water management

- Demand vs. supply
- Storage vs. new resources
Trade-offs in water management

Demand v supply

Energy consumption

Storage v new resources
Sub-urbanisation 2100
Baseline 2100
Eastern axis 2100
Centralisation 2100
Sub-urbanisation 2100

£29m

Expected annual damages (£k)
- 0
- <0.25
- 0.25-0.5
- 0.5-1
- 1-5
- 5-10
- >10

£47m
£33m
£89m
£43m
Flood risk in the tidal Thames

Graph showing expected annual damages (£m) over the years from 2000 to 2100, under different scenarios:
- Eastern axis; No adaptation
- Centralisation, No adaptation
- Suburbanisation, No adaptation
- Baseline, No adaptation
Flood risk in the tidal Thames

Graph showing expected annual damages (£m) from 2000 to 2100 for different scenarios:
- Eastern axis; No adaptation
- Centralisation, No adaptation
- Suburbanisation, No adaptation
- Baseline, No adaptation
- Eastern axis; Raise flood defences by 1m
- Eastern axis; Resilient buildings from 2030
- Eastern axis; Raised buildings after 2030
Adaptation to reduce risk

Unconstrained development
Adaptation to reduce risk

Floodplain planning

Unconstrained development
By virtue of their population density, cities are a focused opportunity to reduce vulnerability and emissions.

Engineers and planners are aware of the challenge but often lack necessary tools.

Innovative approaches to adaptation and mitigation can be developed by evidence-based integrated assessment of urban systems.

So... can cities grow whilst reducing emissions and vulnerability to climate impacts?

- Local government action insufficient, but important: centres of innovations and local level is where many issues best addressed.
- Today’s decisions will alter our vulnerability and emissions for years to come: we must be wary of ‘lock-in’.
- No magic bullet - a portfolio of measures is required.
- Socio-economic vs. climate change.
- Demand reduction vs. supply increase.
- Tradeoffs between mitigation, adaptation, living density etc.
- Substantial infrastructure change may be required and this takes time.
- Spatial planning plays a central role in mediating vulnerability and emissions.
Research Team
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“We have come to recognise how integrated modelling of the type delivered by the Tyndall Centre Cities programme can help to bring different stakeholders together to develop common understanding of processes and consequences of long term change.

That collective understanding is essential if we are to manage change rather than become its victims.”

Alex Nickson,
Strategy manager: climate change adaptation and water,
Greater London Authority