Sustainable cities

Natural and engineered solutions

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*by 2050 75% will live in cities
*Climate change is costing the world more than $1.2 trillion annually

* CLIMATE CHANGE VULNERABILITY MONITOR (2015) - DARA GROUP AND CLIMATE VULNERABLE FORUM
Green + blue interconnected natural systems perform vital functions

- Providing healthy, liveable environments
- Climate proofing our cities
- Providing buffers from extreme weather
- Purifying water, soil and air

Green infrastructure includes city parks, open spaces, streets, urban squares & plazas, urban woodland, scrub & hedgerows, natural areas, pocket parks, green walls & roofs, private gardens, agricultural land, allotments + waterways, rivers, lakes, canals, urban wetland, rain gardens, ponds & other water bodies
Why sustainable/green buildings
As distinct from greenhouses

Modern greenhouses – Hong Kong
80% of US commercial buildings rated uncomfortable

Carbon emissions over the past 50 years
First air conditioned building

Larkin building

In Buffalo, N.Y. Designed by Frank Lloyd Wright
Heating

100 W
10 l/s
20 °C 10 °C

100 W
10 l/s
20 °C 10 °C
Queens’ Building de Montfort University

Green building of the year 1995
Managing Air for Green Inner Cities

Grand Challenge 2: Future Cities: engineering approaches that restore the balance between engineered and natural systems
Cities with no air pollution and no heat-island?

5 year programme, started December, 2015
30 PRDA person years

Air quality and temperature are measurable and universal, providing clear metrics and proxies for urban ‘quality’; they are economically and socially important: health costs £10-20B p.a.

EPSRC - projects should also have a networking role and be inclusive of researchers in the community outside of the original consortium.
A completely new tool for urban planners and regulatory authorities based on a unified system MAGIC

- for long term planning, operational management, emergency response
- new generation computational modelling, adaptive observation technologies, integrated cost benefit model

- System that harmonises the built and natural environment, providing estimates
  - for health, social & carbon costs, impacts of climate change

- Integrated user and research community with the capacity to continue after the end of the grant: MAGIC Circle
Time and spatial resolution

Large domain, local detail

Emergency response

Daily lives

Planning

minutes - days

hours - months

years - decades
System components

Management and decision support system

Economics - Cost-benefit model
  - Integral models
  - ATHAM - Fluidity
  - Reduced order models

Physics

Technical data

Wind tunnel and salt bath experiments

Socio-economic data
Key technical elements

ATHAM-Fluidity
Imperial-Cambridge

Wind tunnel
Surrey
Key technical elements

Natural ventilation experiments

Salt-bath experiments
Cambridge
Key technical elements

Rapid models

- High fidelity ROM with orders of magnitude reductions in run times
- Integral and empirical models
- Used for
  - design, control and scanning studies
  - operational management
  - emergency response
Key technical elements

Cost benefit model

- Provides link between planning and costs
- Uses cost model and incorporates social costs, costs of carbon
- Critical to the management and decision support system
- Macroeconomic component
- Enables optimisation of sensor type and location, and numerical resolution
Case studies; e.g. Imperial West

Imperial White City Campus

Phased development
2015 - 2025

12 hectares
10,000 people
50+ companies

A40(M) crosses site, W-E, elevated urban freeway and intersection
Railway, N-S

Objectives
Pleasant, healthy environment; low carbon footprint
Safe/healthy routes between campuses
MAGIC Circle

We welcome interested groups to join our MAGIC Circle

• Receive information via our newsletter
• Access to information on the website

www.magic-air.uk