Climate change and buildings and the IPCC Fourth Assessment Report

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IPCC

IPCC (Intergovernmental Panel on Climate Change)

Established in 1988
by WMO (World Meteorological Organization)
UNEP (United Nations Environment Programme)

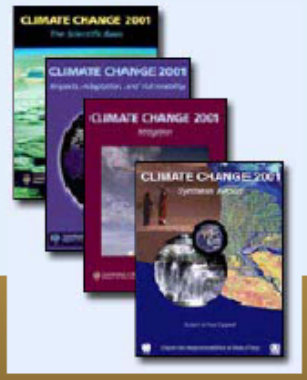
Endorsed by the United Nations General Assembly

Established to "***assess*** scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation."

IPCC Fourth Assessment Report - Climate Change 2007

to be published

IPCC Third Assessment Report - Climate Change 2001



Climate Change 2001: The Scientific Basis
SPM | TS | Full report

Climate Change 2001: Impacts, Adaptation and Vulnerability
SPM | TS | Full report

Climate Change 2001: Mitigation
SPM | TS | Full report

Climate Change 2001: Synthesis Report
SPM

UNFCCC

- IPCC provides advice on climate change to **UN Framework Convention on Climate Change (UNFCCC)**
- UNFCCC is a treaty, including the Kyoto Protocol, to stabilise GHGs to prevent "dangerous" human interference with the climate system.
- Annual meetings of politicians, Conferences of the Parties, COP, to the UNFCCC,

IPCC

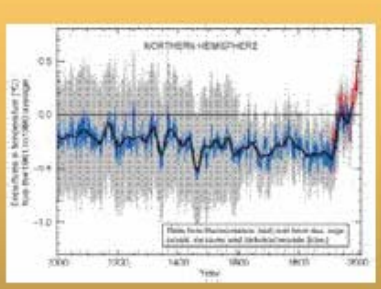
Role is to assess:

- technical and socio-economic information on *risk* of *human-induced* climate change,
- its potential impacts
- options for adaptation and mitigation.

IPCC is not to research or monitor climate data.

Assessment on peer reviewed and published literature.

IPCC criticism



The so-called Hockey-stick graph as shown in the 2001 IPCC report. This chart shows the data from Mann *et al.* 1999. The colored lines are the reconstructed temperatures, and the gray shaded region represents estimated error bars.

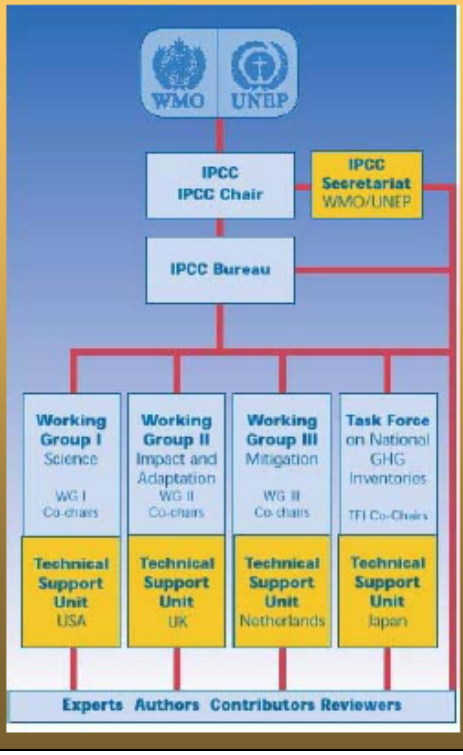
IPCC Structure

IPCC Panel

Representatives appointed by governments and organisations.

Meets about once a year, controls the organization's structure and procedures.

It elects the IPCC Chair, Bureau members and approves IPCC reports.



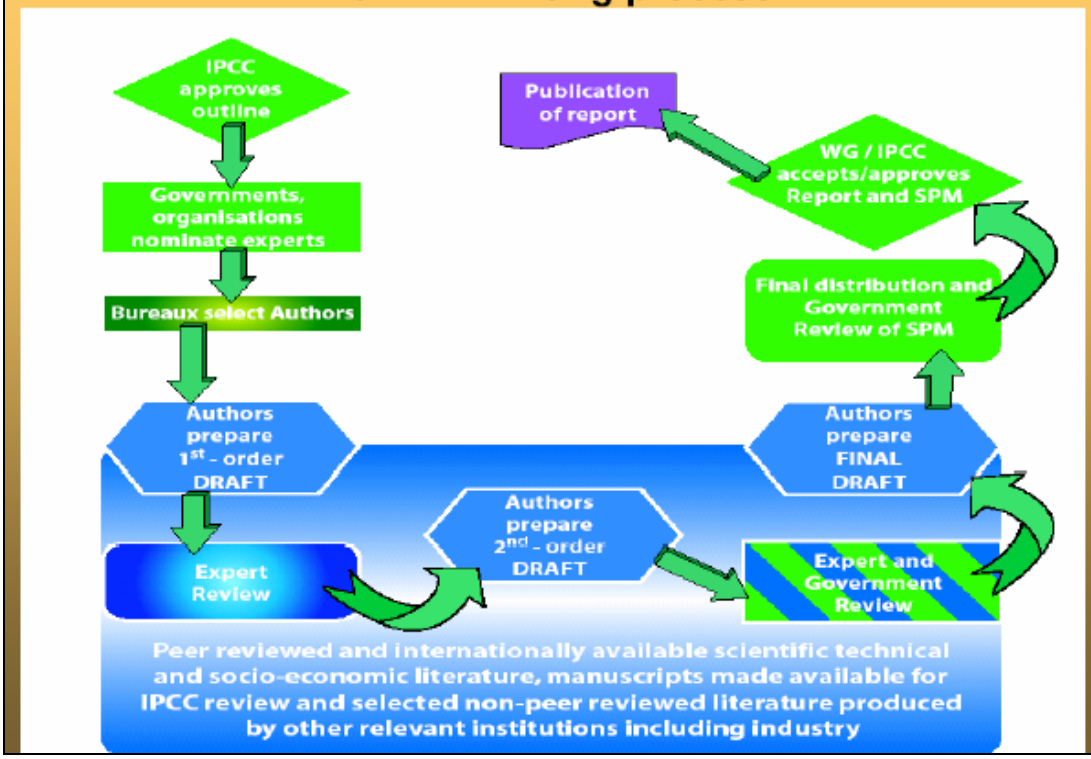
An important IPCC Output

- Special Report on Emissions Scenarios (SRES) in 2000
- Future emissions data (for climate change models).
- Emissions depend on projections of:
  - world population,
  - technological and economic development
  - governance.
- No scenario has future policies that explicitly address climate change.

The Fourth Assessment Report (AR4)

- 2002 Panel elected Dr. Pachauri (India) as Chair of the IPCC.
- To be published in the latter part of 2007 although it is now available on the web.
- It has cross-cutting themes including uncertainty and risk to avoid the hockey stick controversy.

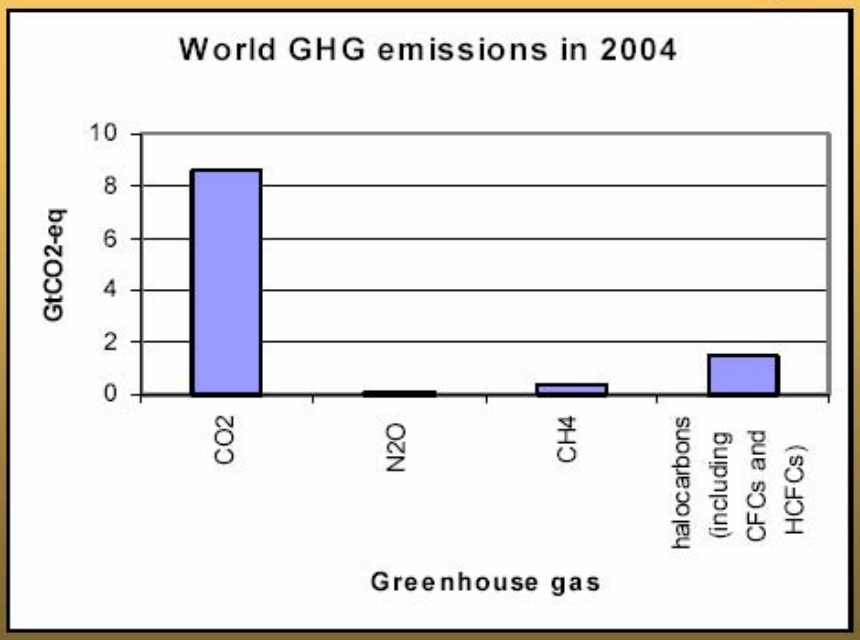
The IPCC writing process



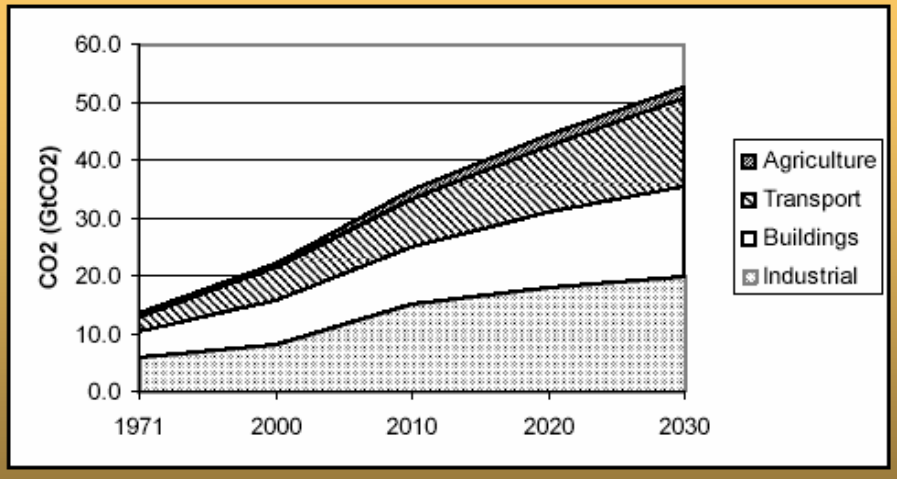
AR4, Working Group III

- **Authors of Chapter 6, Mitigation options for residential/commercial buildings**
- 2 Cordinating Lead Authors:
  - Mark Levine (USA), Diana Ürge-Vorsatz (Hungary)
- 9 Lead Authors
- 7 Contributing Authors
- 2 Reviewing Experts

Emissions from buildings



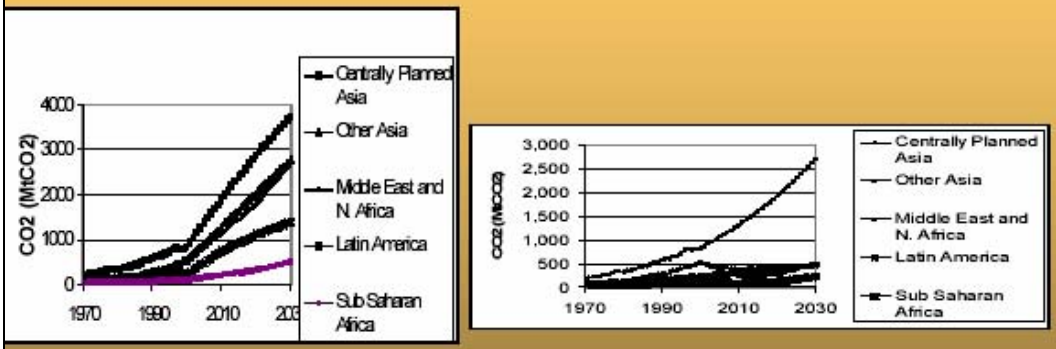
Trends in emissions



Global Energy-Related CO2 Emissions by End-Use Sector, Historical to 2000 and Projected by the SRES A1 Scenario to 2030.

Based on Price, L., S. De la Rue du Can, S. Sinton, E,. Worrell, N. Zhou, J. Sathaye, and M. Levine, 2006. Sectoral Trends in Global Energy Use and Greenhouse Gas Emissions. Lawrence Berkeley Na¬tional Laboratory, Berkeley, CA. LBNL-56144

Trends in emissions



Emissions by End-Use Buildings Sector, 5 higher growth regions. Historical to 2000 and Projected by the SRES A1(left) B2 (right) Scenario to 2030.

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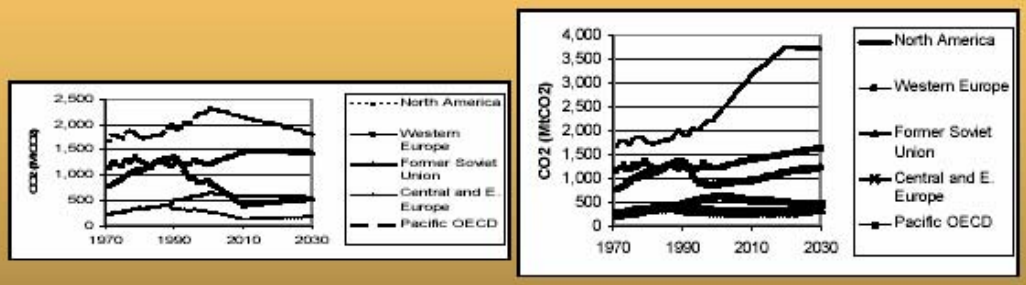
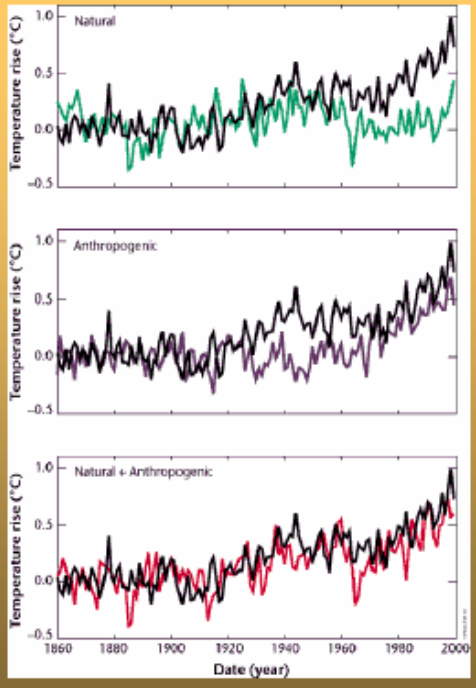
Trends in emissions



Emissions by End-Use Buildings Sector, 5 lower growth regions. Historical to 2000 and Projected by the SRES A1(left) and B2 (right) Scenario to 2030.



Source: Hadley Centre, The Met.Office

World view

6.6 billion population

Photovoltaic panels, batteries, LEDs can replace kerosene lamps. "Tunnelling" through inefficient tungsten lamps.

Potential savings

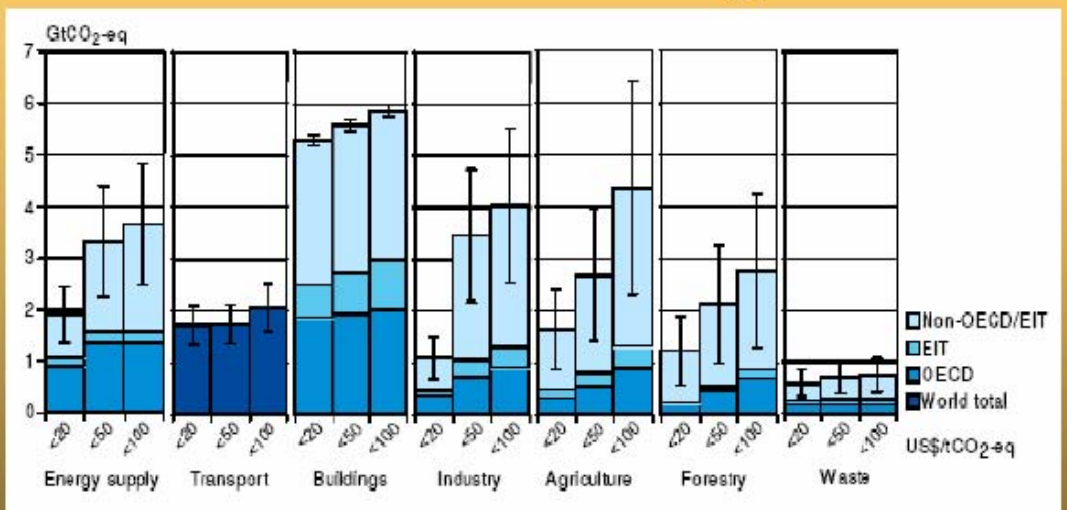


Figure SPM 6: Estimated mitigation potential at sectoral level in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments (see notes)

From IPCC AR4 SPM 2007

Potential GHG reducers

- lighting technologies, daylight use, good in most regions of the world,
- solar water heating systems,
- efficient appliances, (washing machines etc)
- building energy management systems.

Good savings from

- Cooler regions
  - Improved insulation
  - District heating
- Warmer regions
  - Efficient space conditioning
  - Efficient cooking stoves in developing countries.

Good design to reduce GHG emissions

- integrated design process (IDP)
- reduce peak thermal loads
- need for good commissioning, operation and maintenance.

Technical fixes

- Improvements to the thermal envelope of houses; use 10% of the heating of a house built to the local regulations. Passive houses.
- Condensing boilers and ground source heat pumps.
- thermal performance of windows has improved; they can reduce summer solar heat gain by up to 75%.

Technical fixes

- Summer heat gain reduction, minimising the glazing facing east or west, utilising thermal mass.
- Reflective roofs and trees for shade are reported as being successful in some USA cities.
- Use low energy ac (displacement, chilled ceilings)
- Natural ventilation with night ventilation; adaptive comfort.

Refurbishment

- One of biggest challenges; buildings last a long time and therefore vast majority is old inefficient stock.
- In the scenario projections to 2030 the largest portion of carbon savings will be from refurbishment.
- UK study showed that reducing air leakage and improved insulation reduced heating energy by about 35% and that a 50% reduction could be achieved using well-proven technologies.

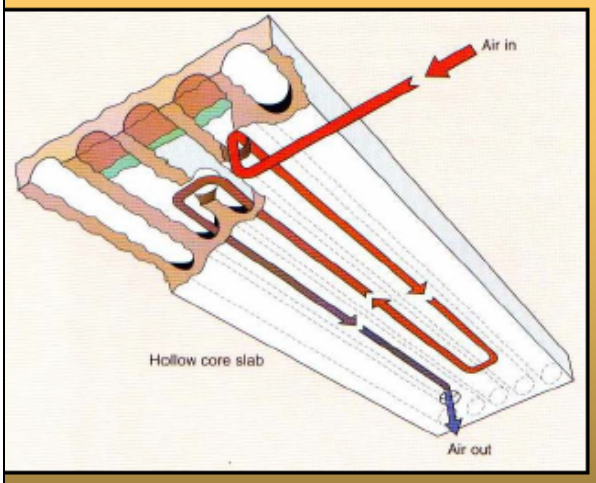
Policies

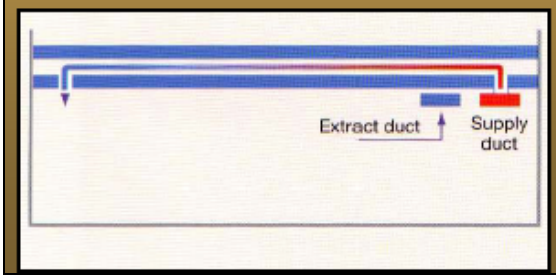
- AR4 Chapter 6 says for GHG mitigation:
- The technology is there,
- The costs are reasonable
- But there are many barriers, e.g.:
  - Fragmentation of building and design industry
  - First cost accounting
  - Tenant–landlord costs
  - Behaviour

Example Policies

- Performance building codes (carbon based).
- Demand-side management, ESCOs promoted
- Energy Star Labeling, Leadership in Energy & Environmental Design (LEED) rating.
- Carbon trading, renewables obligation
- Financial incentives for the design process (Canada, Commercial Building Incentive; California,Savings By Design program)

ollow Core Slab Cooling Using Air





- Hollow core systems Termodeck
- Performance typically 30-50 W/m^2 cooling

TermoDeck Installation – Elizabeth Fry Building UEA, Norwich

Urban heat island effect not included in IPCC WGIII Chapter 6

New project in Manchester:

SCORCHIO

(Sustainable Cities: Options for Responding to Climate cHange Impacts and Outcomes)

Prof Geoff Levermore, Dr Claire Smith

MACE,

The University of Manchester

SCORCHIO Investigators

- Manchester University
- Sheffield University
- Newcastle University
- University of East Anglia
- Hadley Centre, MetO

Aim and objectives

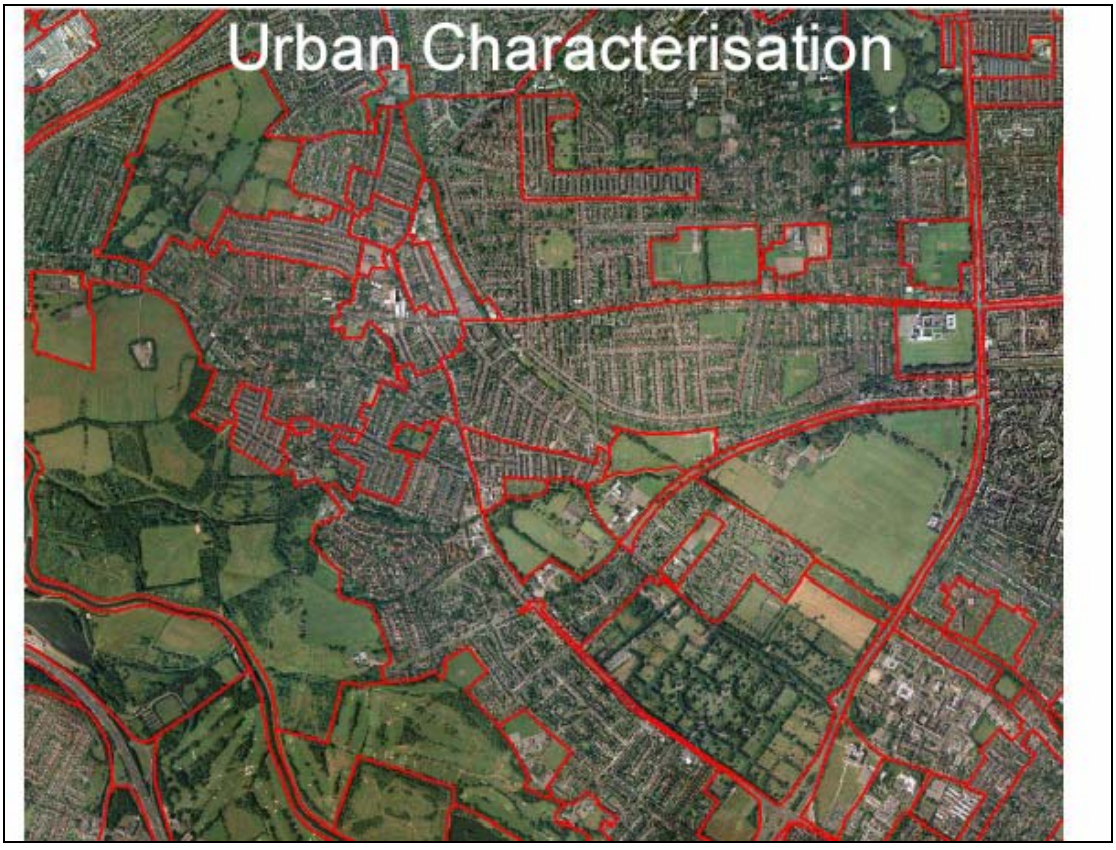
- Develop a statistical climate simulator for urban areas with climate change
- Model typical buildings and their surroundings for a new, readily usable heat and human comfort vulnerability index that accounts for the effects of building construction, form and layout.

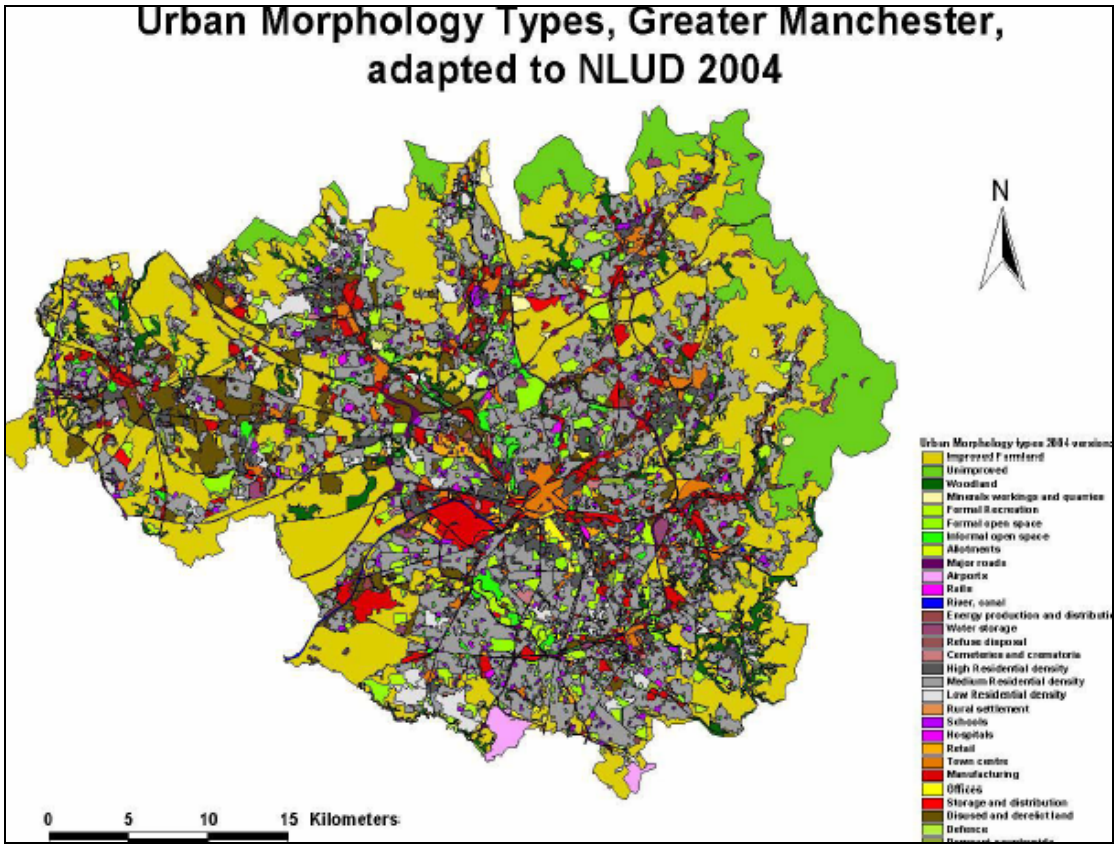
Aim and objectives

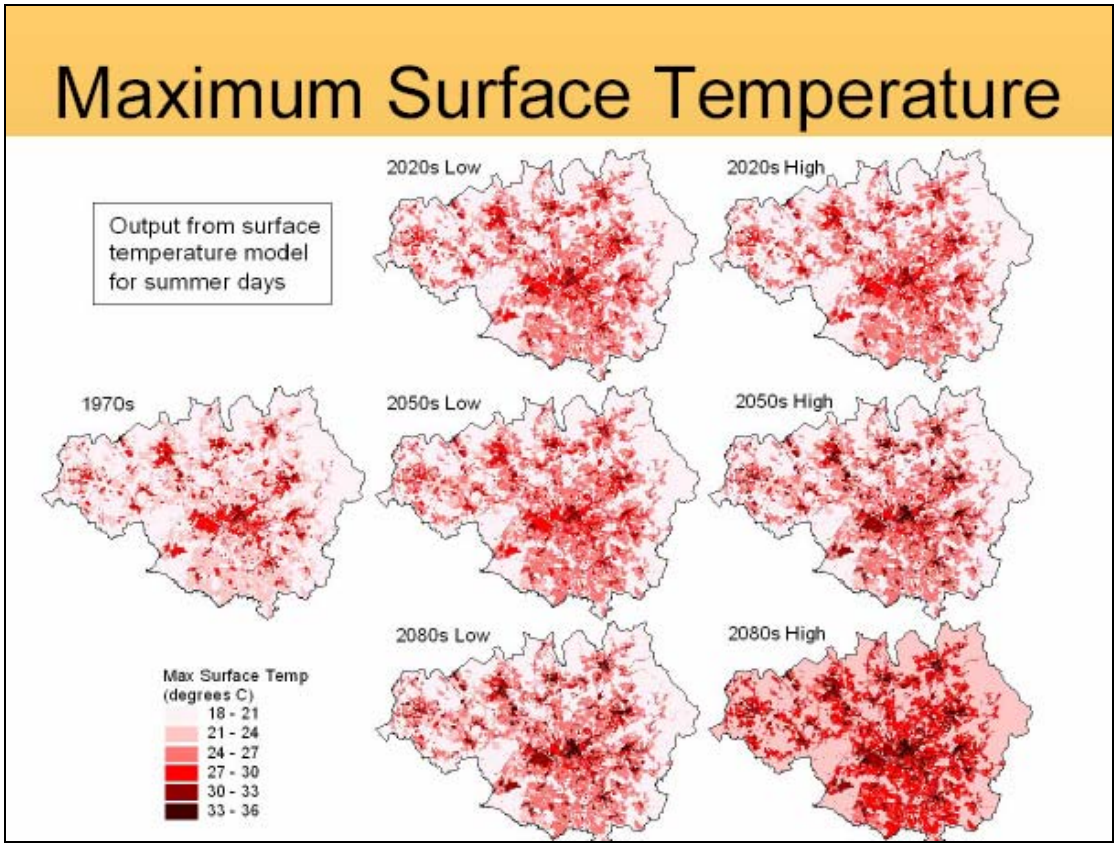
- To estimate heat emissions from buildings, to understand the implications of different building adaptation options.

Aim and objectives

- To develop GIS-based decision support tools for urban planning and design.
- To demonstrate with Manchester and Sheffield, cities in the UK.




Urban Morphology Types, Greater Manchester, adapted to NLUD 2004
N
0 5 10 15 Kilometers
Improved Farmland
Unimproved
Woodland
Mineral workings and quarries
Formal Recreation
Formal open space
Informal open space
Allotments
Major roads
Airports
Rails
River, canal
Water storage
Refuse disposal
Cemeteries and crematoria
High Residential density
Medium Residential density
Low Residential density
Rural settlement
Schools
Hospitals
Retail
Town centre
Manufacturing
Offices
Storage and distribution
Disused and derelict land
Defence


Maximum Surface Temperature
Output from surface temperature model for summer days
1970s
2020s Low
2020s High
2050s Low
2050s High
2080s Low
2080s High
Max Surface Temp (degrees C)
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36

Conclusions

- Buildings are responsible for about 33% of global GHG emissions
- Buildings show largest potential reduction in future emissions
- The technology exists
- It can be applied cost effectively
- Many barriers but policies need to be implemented
- Urban heat island needs to be considered