



Climate Change The Educational Perspective

Barry Clarke



- The Demanding World
- Sustainable Development
- The Educational Perspective



The Demanding World

Current trends

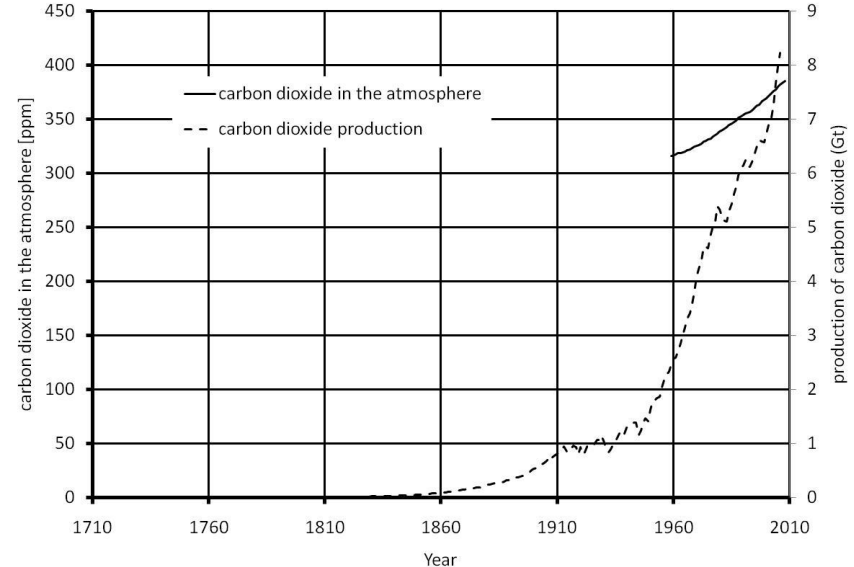
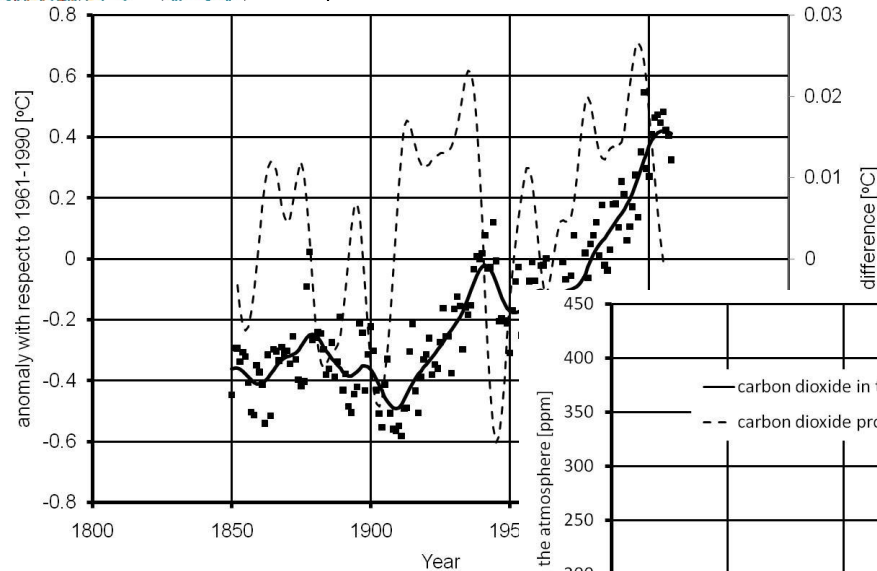
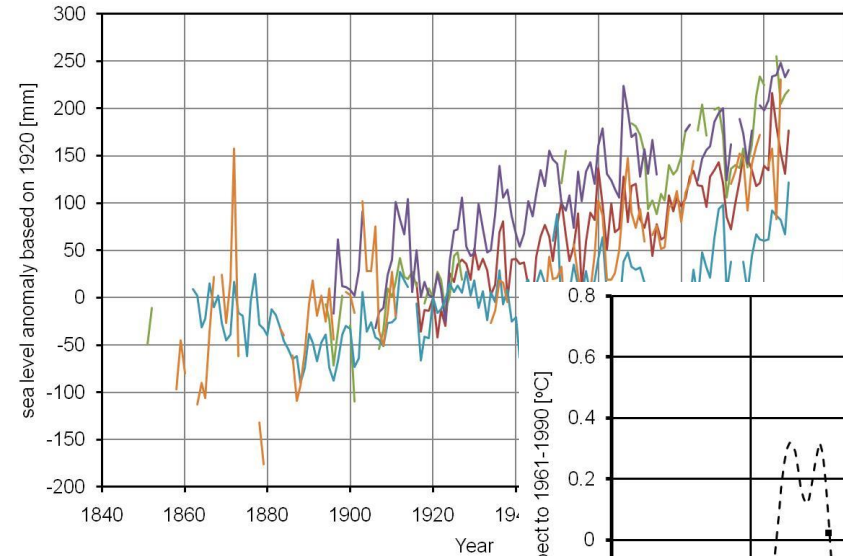


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- sea level rising

- temperature rising

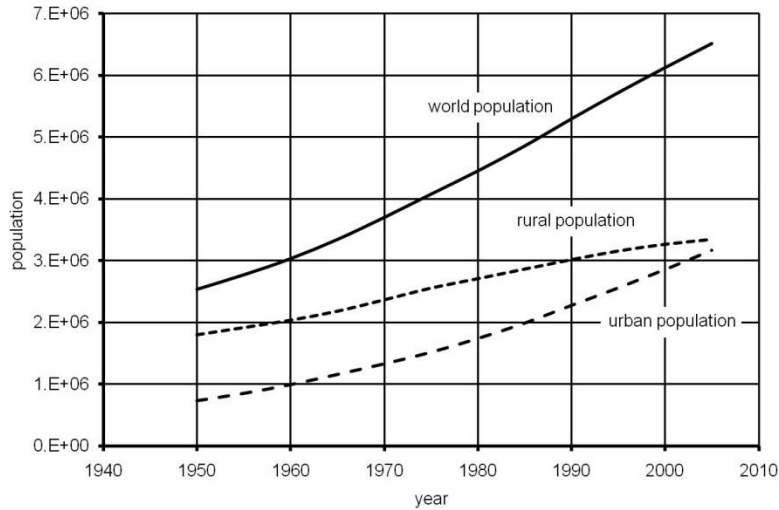
- greenhouse gases rising



Resource demand

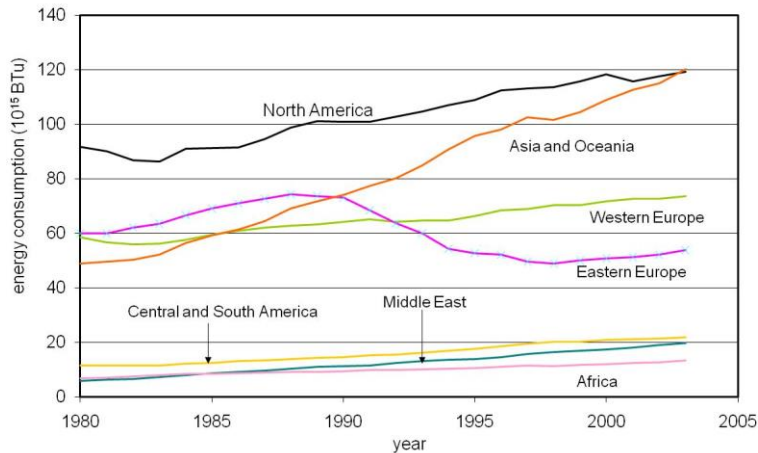


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- population increasing

- increase in mineral use



- increase in energy use

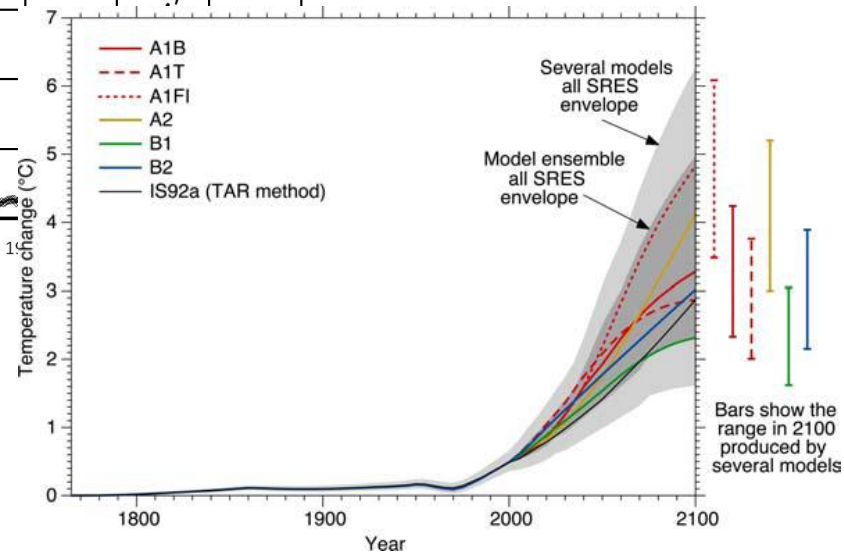
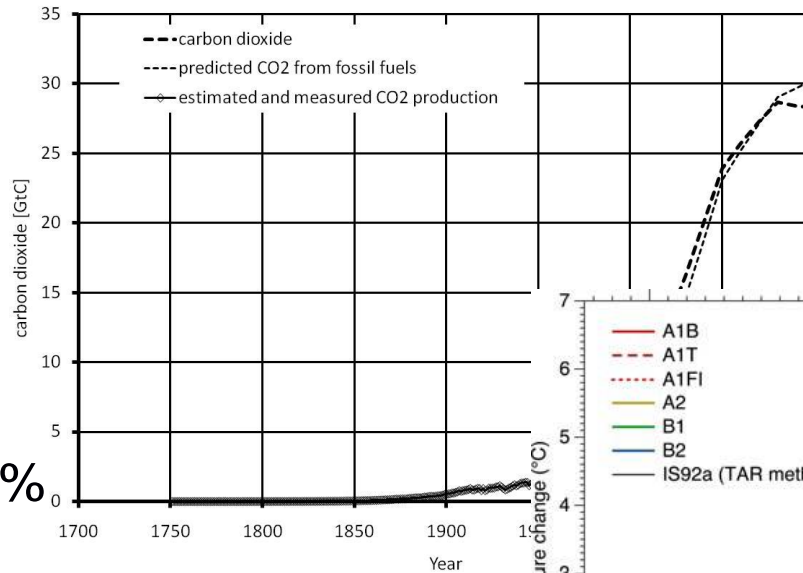
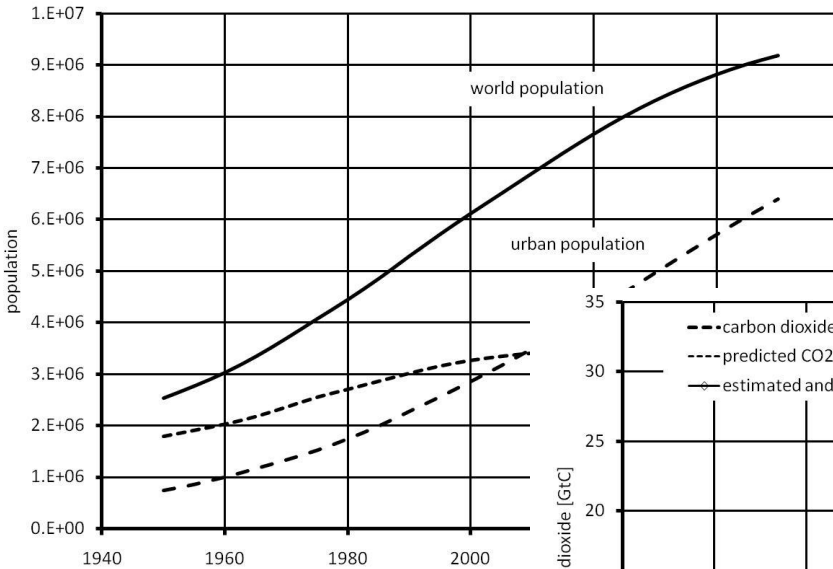
	1999	1776
Aluminium	77	0
Cement	895	12
Clay	304	100
Coal	7662	40
Copper	25	1
Glass	150	1
Iron ore	553	20
Lead	14	2
Phosphate	340	0
Potash	44	1
Salt	395	4
Sand, gravel and stone	21640	1000
Sulphur	111	1
Zinc	13	0.5
Oil	7782	
Gas	7803	
Uranium	0.25	

2050



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- 50% increase to 9B with urban population rising from 50% to 80%



- CO2 increase by 400%
- temperature rising by a further 2°C to 4°C

A demanding world



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- 1 billion people without access to safe water
- 1.6 billion without electricity
- 2.5 billion without adequate sanitation
- 1 billion without access to telephone services
- 1 billion rural poor without access to all-weather roads

(Jowitt, 2009)

- 70% increase in food supply by 2050
- Water to be redistributed by 2050
- 600% increase in energy demand by 2050

A challenging world



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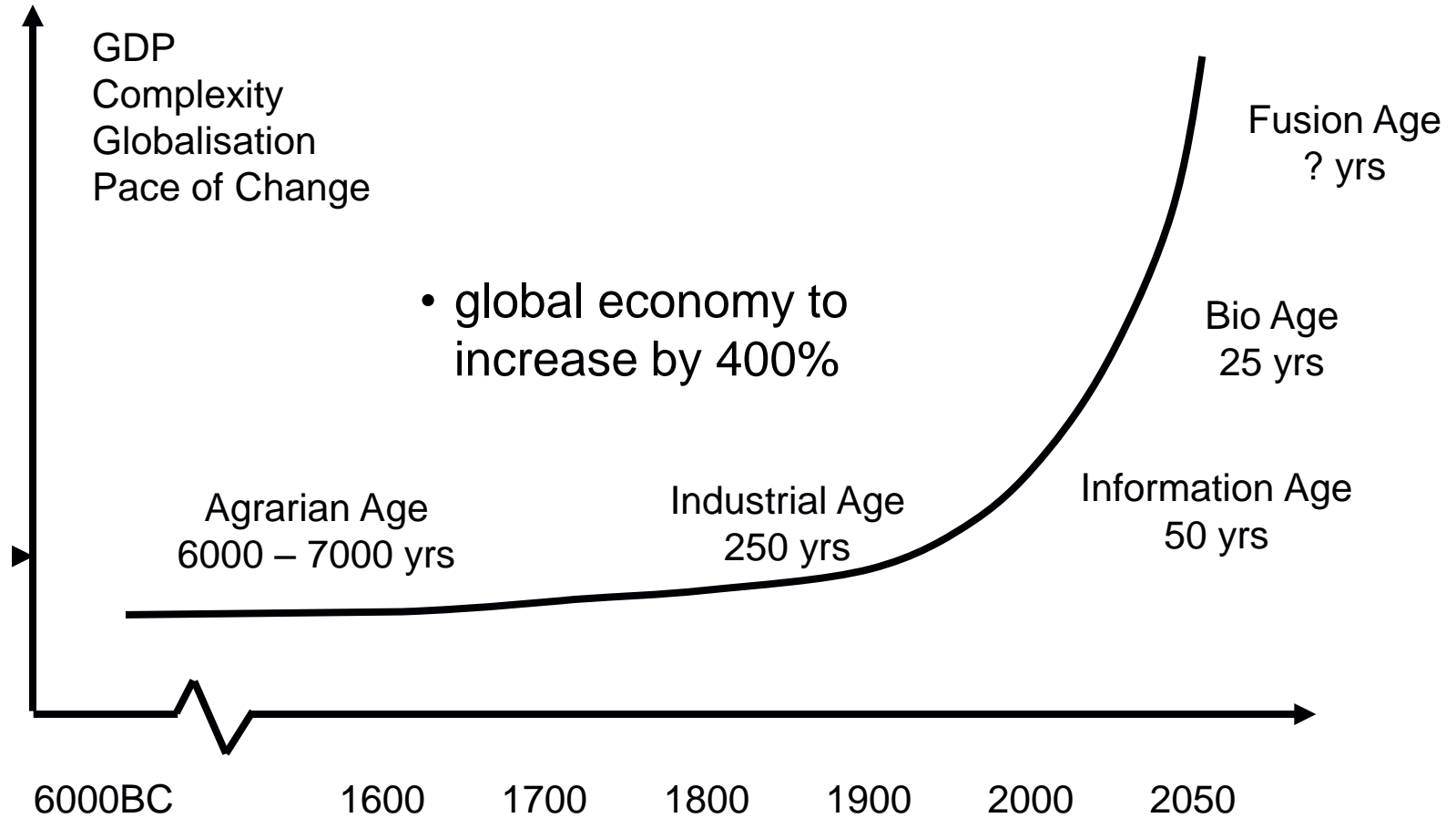
- Exponential increase in floods and droughts
- Increased frequency of extreme events
- Cubical increase in storm damage
- Quadratic increase in coastal damage
- 200 m people, 2m km² and \$1trillion assets within 1m of sea level
- 22 of top 50 cities under threat
- 200m people will migrate because of increase in temperature and loss of land
- Changes in soil conditions threaten stability of infrastructure (drought, rising groundwater, melting permafrost)

(Stern, 2005)

Pace of change



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Sustainable World



- *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (Brundtland, 1987)*
 - Resource depletion due to economic growth
 - Resource depletion due to poverty
 - Impact of greenhouse gases
- *A dynamic process which enables all people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the Earth's life support systems. (Forum for the Future, 2009)*

ICE Vision



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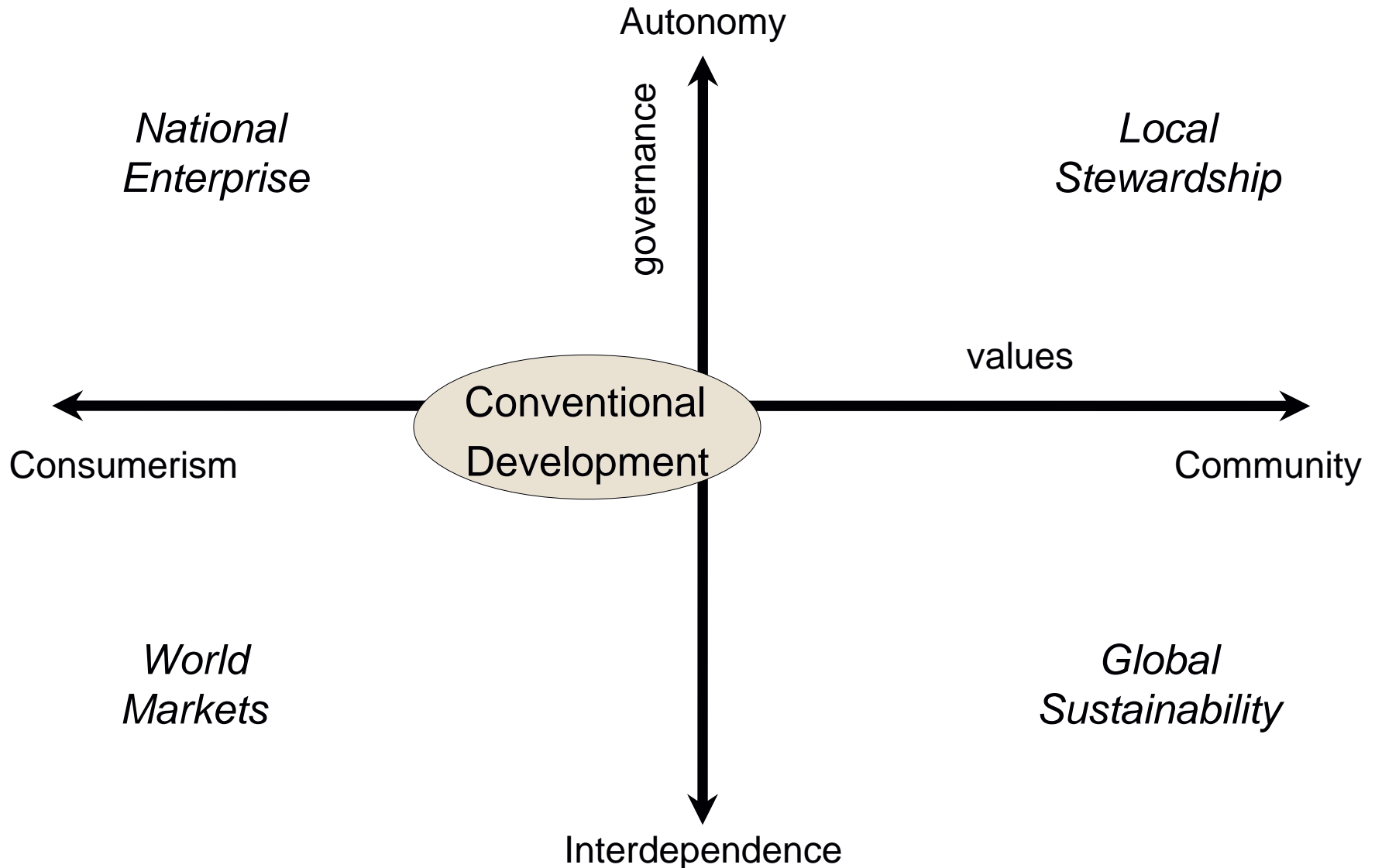


Civil Engineers at the heart of society,
delivering sustainable development
through knowledge, skills and professional expertise.

The traditional place



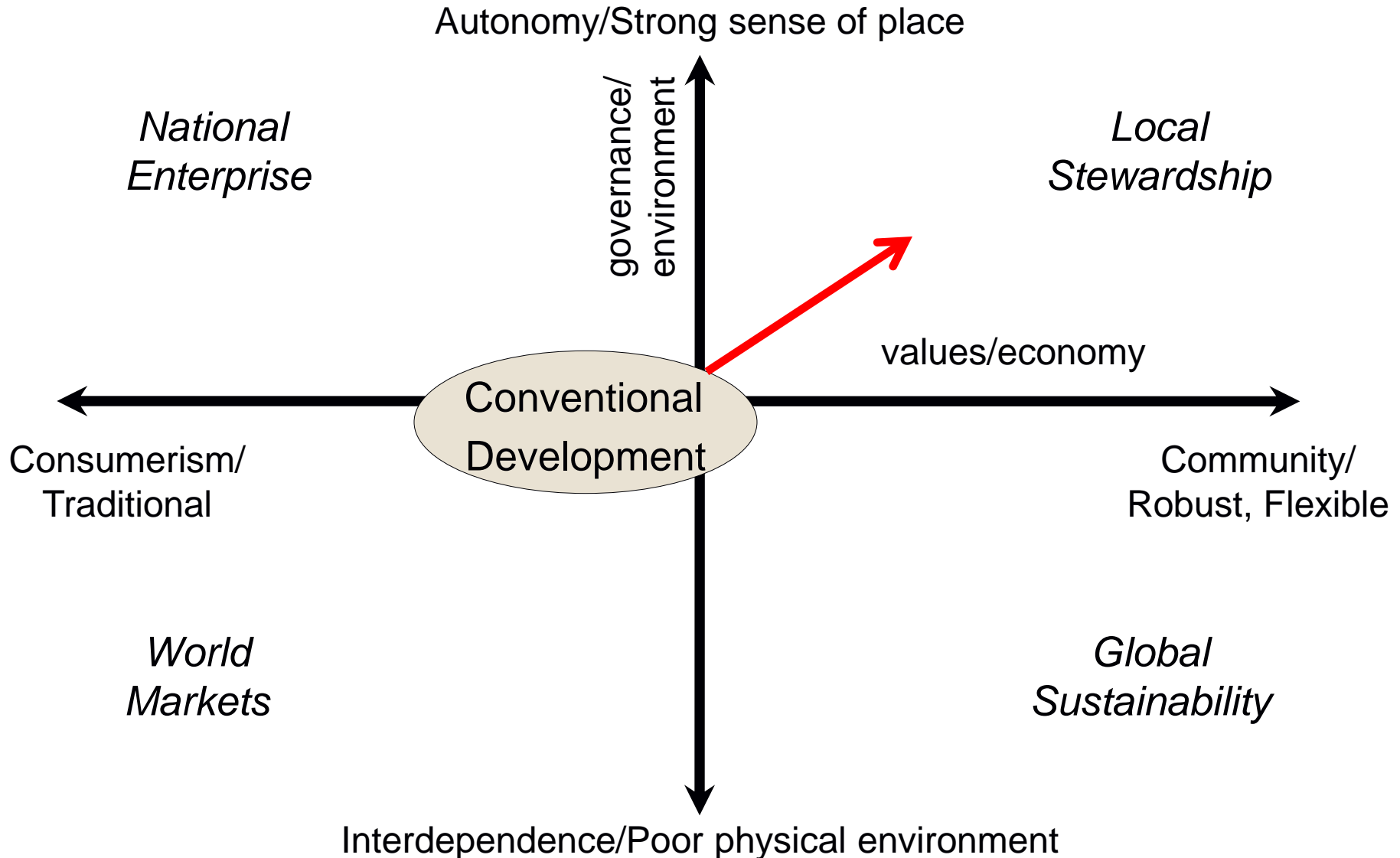
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A sustainable place



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Meaning of sustainable development



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- UK Government view of sustainable development in 2000
 - Social progress which recognises the needs of everyone
 - Effective protection of the environment
 - Prudent use of natural resources
 - Maintenance of high and stable levels of economic growth and employment
- Sustainable construction 2003
 - design for minimum waste
 - lean construction (& minimise waste)
 - minimise energy in construction & use
 - do not pollute
 - preserve and enhance biodiversity
 - conserve water resources
 - respect people and local environment
 - set targets (ie monitor & report, in order to benchmark performance)



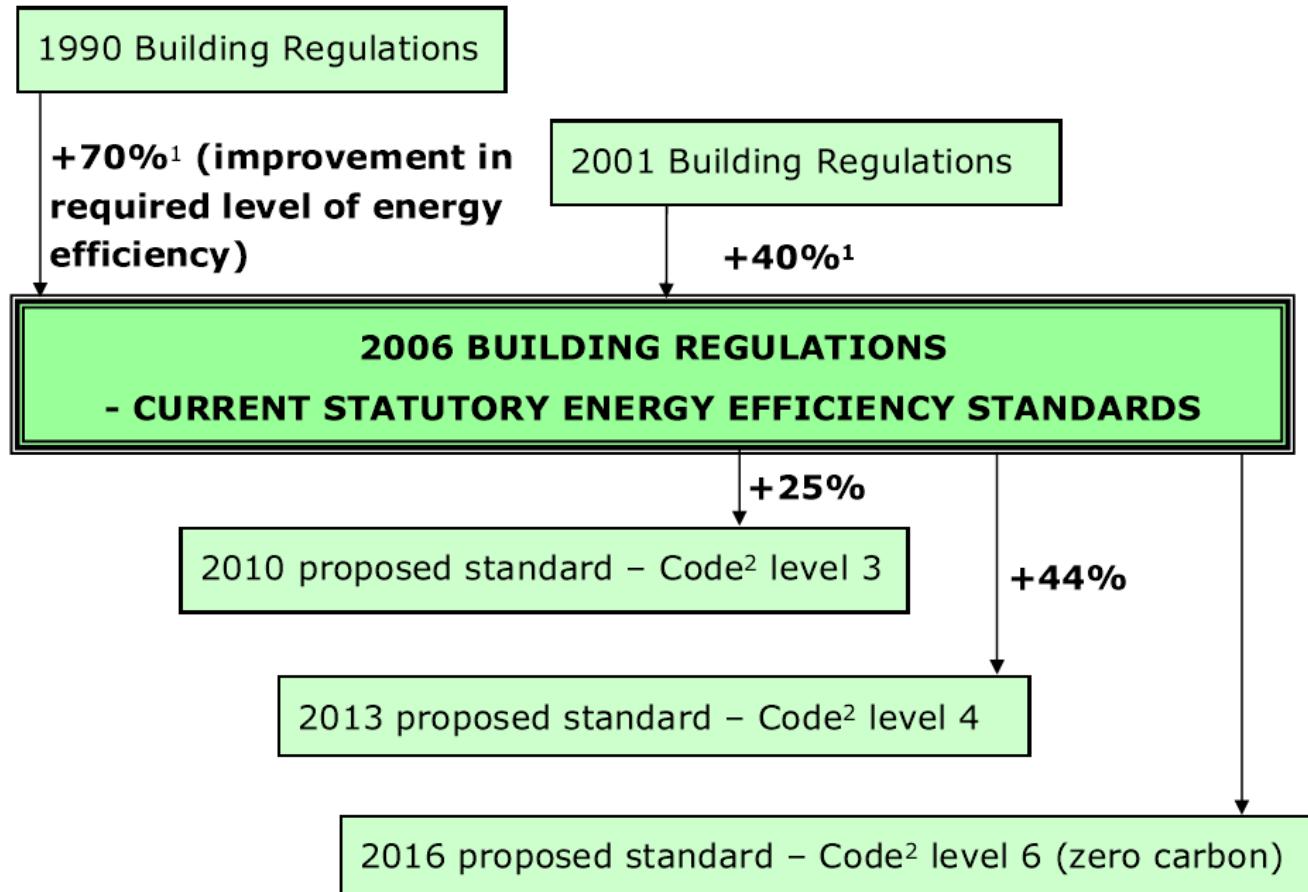
- Sustainable construction is an aim that can be achieved through an incremental approach
- But there is much evidence that even that approach is too slow
 - Of 123 contracts reported, only 54% had a sustainability clause
 - Of the top ten contracts (by value) only 6 had a sustainability clause
 - Only 3.1% of total spend on catering contracts had a sustainability clause
- 9 of the 21 Depts still do not include clauses regarding 'Quick Win' product standards in all contracts

(BERR Mar 2008)

Regulation is the driver for change



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Drivers for change



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+2.8m in UK
1996-2016

200m
population
migration
by 2050

	Carbon Emissions		Water Reduction	Waste Reduction	Population
Driver	Energy White Paper		Water shortage and continuing increase in population	Energy White Paper	
Targets	Zero carbon by 2016 for new build 80% reduction in existing build by 2050		Reduction of 25% of water consumption by 2020 from the current water usage of 150 litres per day.	50% reduction in waste disposed from Construction Projects by 2012	
Policy	<i>Climate Change Act</i> <i>Code for sustainable homes</i> <i>Code for Sustainable Communities</i> <i>Committee on Climate Change</i> <i>Building a low carbon economy</i>		Waterwise and Govt Water Reduction Targets	Waste and Resources Action Programme (WRAP)	
	New Build Zero carbon housing by 2016 Zero carbon schools by 2017 Zero carbon Public Buildings by 2018	Existing Stock 80% reduction of 1990 CO2 levels by 2050			

The 'headless' chicken



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- *The number and strength of policies under consideration continues to grow faster than the number and strength of policies actually adopted, reflecting a general pattern of growing concern, but more talk than action* (International Energy Agency, World Energy Outlook, 2007)



The Educational Perspective

Our graduates



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- Will face
 - Climate change
 - Demographic growth
 - Resource depletion
 - Scarcity of renewable resources
- Will have to
 - Adapt the existing environment
 - Create a new environment
- Using
 - New ways of working
 - New tools
 - New ways of thinking

The province of the engineer



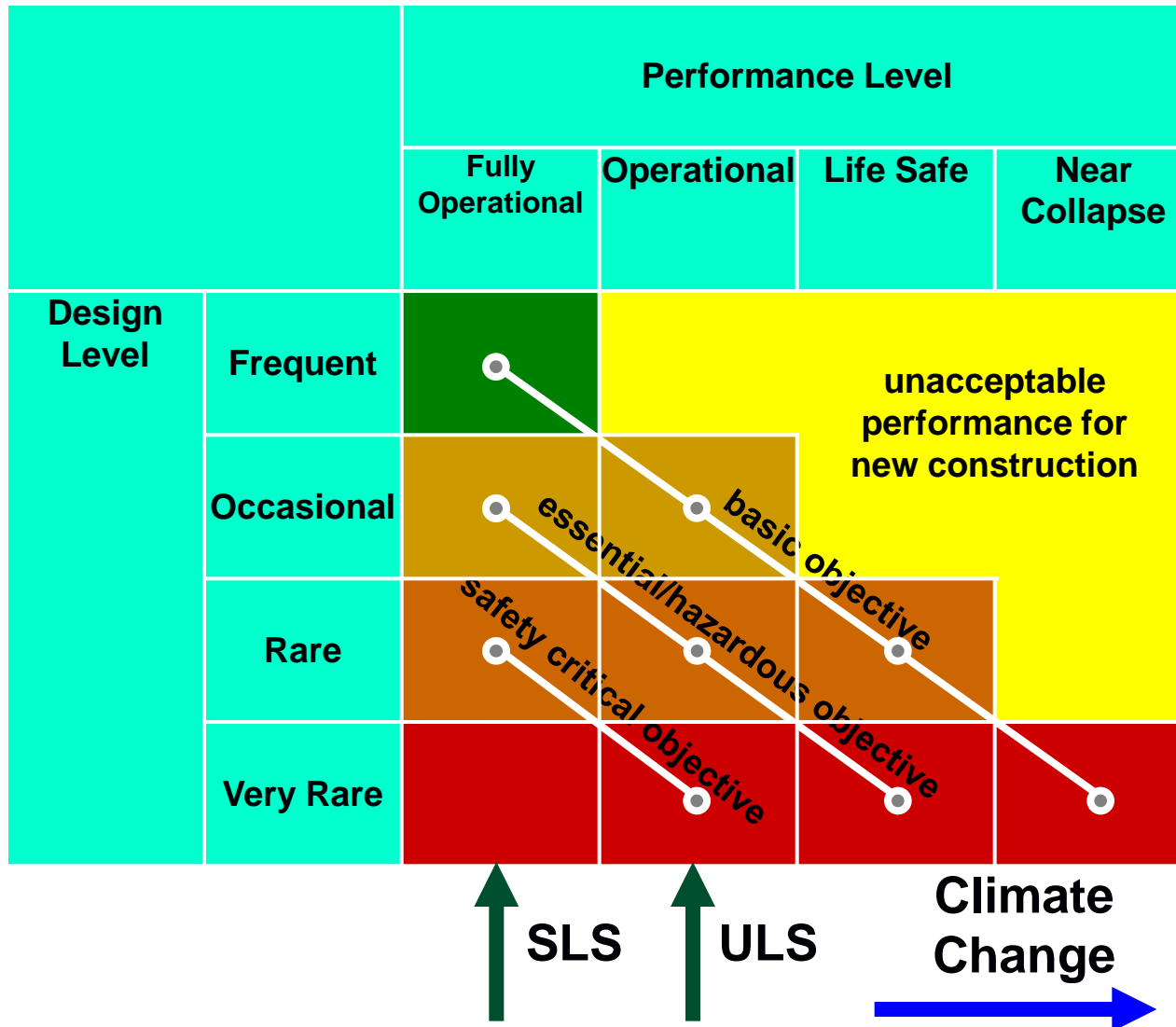
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- *The art and science of directing the great forces of nature to the benefit of mankind* (Tredgold, 1828)
- *The province of the Engineer is to control the forces of nature and apply them to useful purposes, an object which is effected by means of pieces of material suitably connected and arranged. The protection of life and property from destructive forces is accomplished by pieces rigidly connected with one another which transmit their action to bodies which are not injurious.* (Cotterill, 1906)

Design criteria for performance



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New Orleans
1:200

London
1:1000

Amsterdam
1:10000

Climate Change

The habit of mind



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- *The heart and soul of a university education is instilling the habit of mind that you retain after you have forgotten everything that you were taught (Inglis, 1908)*
- *A habit of mind is knowing how to behave intelligently when you do not know the answer and it means having a disposition toward behaving intelligently when confronted with problems (Costa and Killick, 2008)*
- Demonstration through application an understanding of knowledge (JBM)

Principles of sustainable communities



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- Contribute to society
- Apply professional judgement
- Go beyond legislation and codes
- Efficient and effective use of resources
- Holistic view
- Manage risk

Generic skills



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- Inclusive visioning
- Project management
- Leadership
- Creative thinking
- Team working
- Making it happen
- Change management
- Financial management and appraisal
- Stakeholder management
- Analysis
- Decision making
- Learn from mistakes
- Communication
- Conflict resolution
- Client/user awareness

- Tools to benchmark performance
 - Key performance indicators
 - Design quality indicators (e.g. CIC DQI)
 - Life cycle assessment
 - Whole life costing
 - Carbon footprint (e.g. EA carbon calculator)
 - Sustainability assessment (e.g. BREEAM, LEED, CEEQUAL, Green Mark, Green Star and GBI)
- Design tools are still in the development stage
 - Carbon critical design
 - Decarbonising the industry/buildings

Some concepts



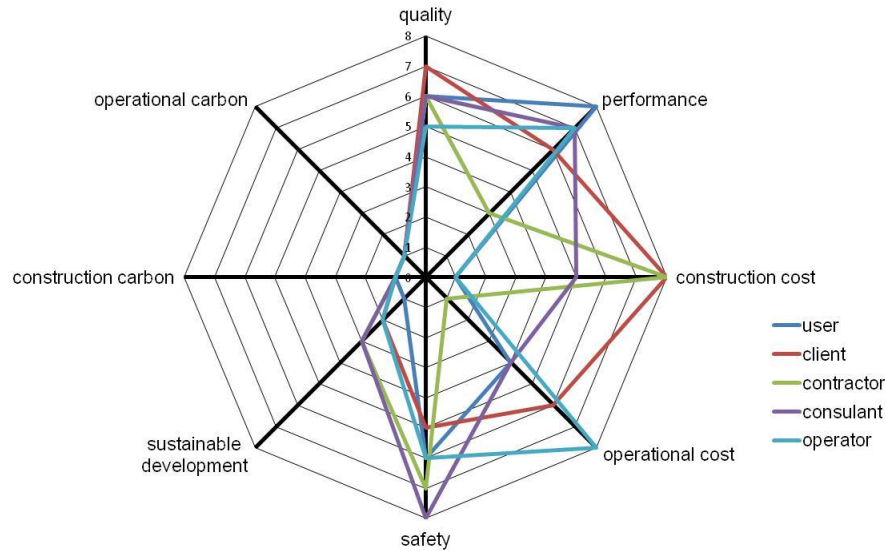
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- Sustainability is about systems
- Civil engineering is about creating a macro environment but sustainability is about the micro environment
- Carbon critical design implies a paradigm shift in the approach to design
- Rate of change and level of uncertainty is such that design for adaption and develop for mitigation
- Time for high tech solutions may not be available; low tech solutions aligned with behavioural change
- Civil engineers will have to make use of hard and soft skills

Design criteria



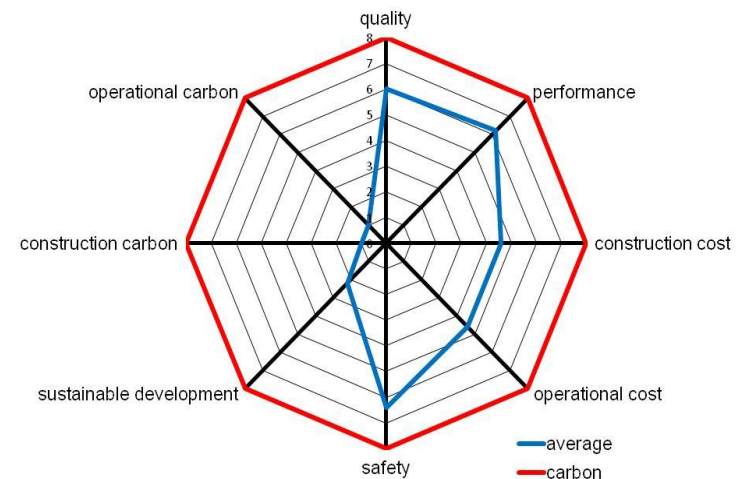
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1 construction costs
5 maintenance costs
200 operating costs
RAEng



whole life cost assessment
and
whole life carbon assessment





Concluding Remarks

Concluding remarks



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- Climate change
 - Is a sub set of sustainable development
 - Is forcing the rate of change
 - Requires a paradigm shift in design
- Sustainable development
 - Means a systems approach
 - The concept is in the developmental stage
- Tredgold's definition still applies though the benefit to mankind needs to emphasise future generations taking into account the pace of change and the level of uncertainty
- Graduates need to develop a 'habit of mind' especially in this theme because of the rapidly changing environment in which we now operate

The educational perspective



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- JBM is reviewing the meaning of design, health and safety, sustainable development and ethics
 - Identify the evidence and questions
- Graduates need to understand the context of sustainable development (including climate change)
- Their understanding needs to be assessed through application
- Design has to focus on dealing with uncertainty, minimising use of primary resources, being adaptable to a changing environment, be holistic taking into account the true cost of sustainable development
- What are the questions we should be asking students?
- What evidence should we be looking for?