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Meeting the Energy Challenge : Demand Side Considerations

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DEMAND SIDE CONSIDERATIONS

- **The ‘Big Picture’ (Built Environment)**
- **Transport**
- **Buildings**
- **Conclusions & Suggestions (to ‘seed’ discussion)**

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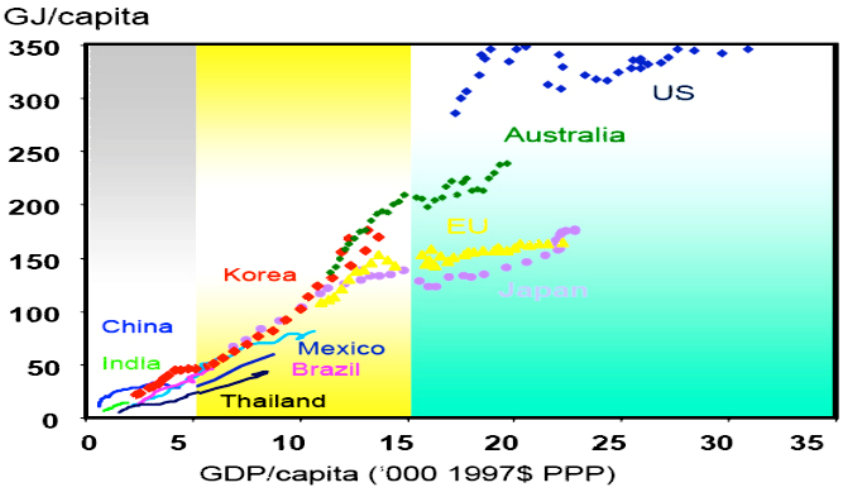
The Mitigation Challenge: Global 'energy hunger'



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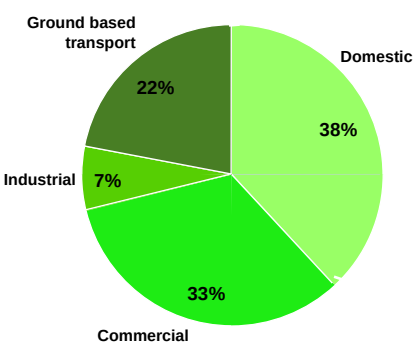
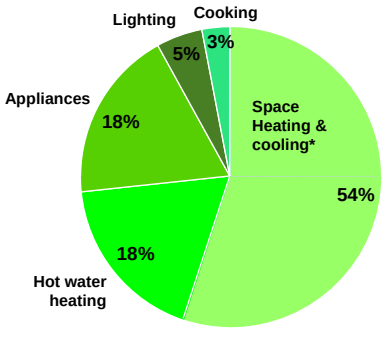
Where emissions come from: Domestic sector

2006 emissions from all sectors, excl. aviation
100% = 44.3 million tonnes CO_2



2006 emissions from the domestic sector
100% = 16.7 million tonnes CO_2



* Cooling in the domestic sector represents a small component, currently at <1%
Source: LECI; DEFRA; TfL Policy Unit analysis

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TRANSPORT CONSIDERATIONS

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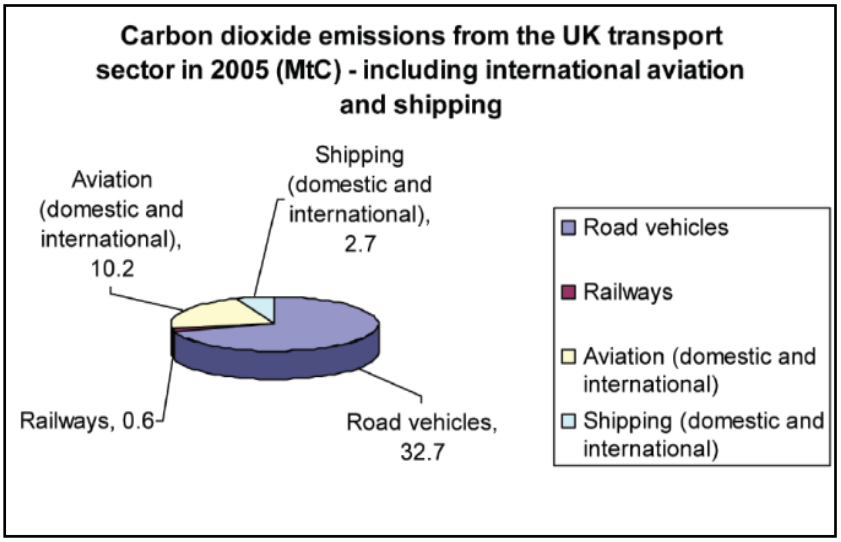
Where are the problems with transport?



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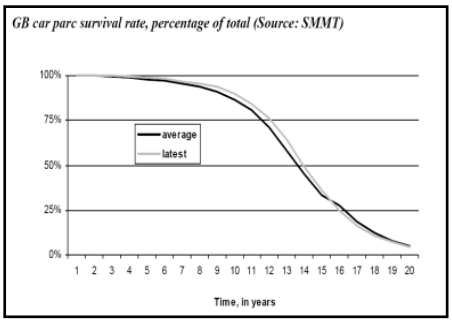
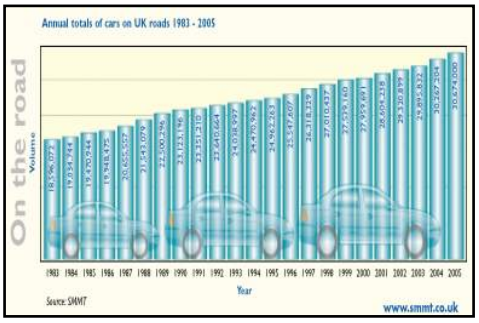
How many vehicles ?





It takes a long time to renew the fleet!

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Technological Advances – where do we put our efforts?

- Manufacturing 10 per cent
- Use 85 per cent
- Disposal 5 per cent (see Note 1)

CO_2 emissions through the vehicle life cycle

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Technological Advances...

- **Lightweight Construction**
- **Compact Design**
- **Alternative Fuels**

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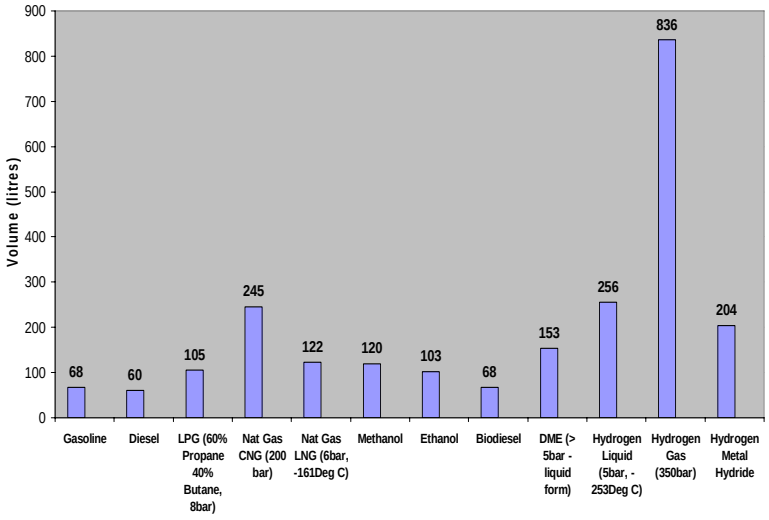
The difficulty with non-carbon based transport - Range!!



Volume of fuel and storage for different energy carriers

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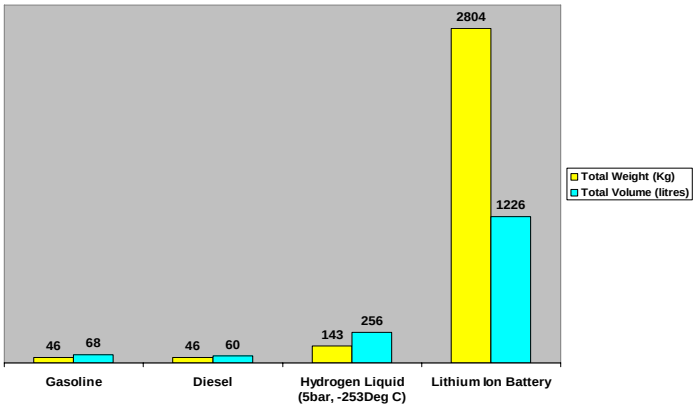
Volume of fuel and storage for different energy carriers – different scale!



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Transport Fuels	Kg CO_2 equivalents emitted/GJ in fuel	% saving in GHG* vs fossil fuel reference
Ultra Low Sulphur Diesel/Petrol	87	-
Biodiesel from OSR	41	53%
Biodiesel from recycled veg oil	13	85%
Ethanol from wheat grains	29-45	49-67%
Ethanol from sugar beet	40	54%
Ethanol from wheat straw	13	85%

*Includes Carbon Methane and Nitrous Oxide, Source: Sheffield Hallam Report 'Carbon and Energy Balances for a range of biofuel options' 2003

Credit: Professor Roland Clift, CES, University of Surrey

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RENEWABLE TRANSPORT FUELS OBLIGATION

Subject to Consultation that……..

- **Biofuels are produced in a sustainable way delivering maximum carbon savings with minimum adverse environmental impacts.**
- **Biofuels blends higher than 5% will not lead to mechanical problems in vehicles.**
- **Costs to consumers and the wider economy will be acceptable.**

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LAND CONSTRAINT?

- **Current global cropland** **≤1.8 Gha**
  cropland + pasture **5 Gha**

- **Land needed to produce current fossil energy use (400EJ)** **3-6 Gha**

- **Land availability *is* an active constraint!**

Credit: Professor Roland Clift, CES, University of Surrey

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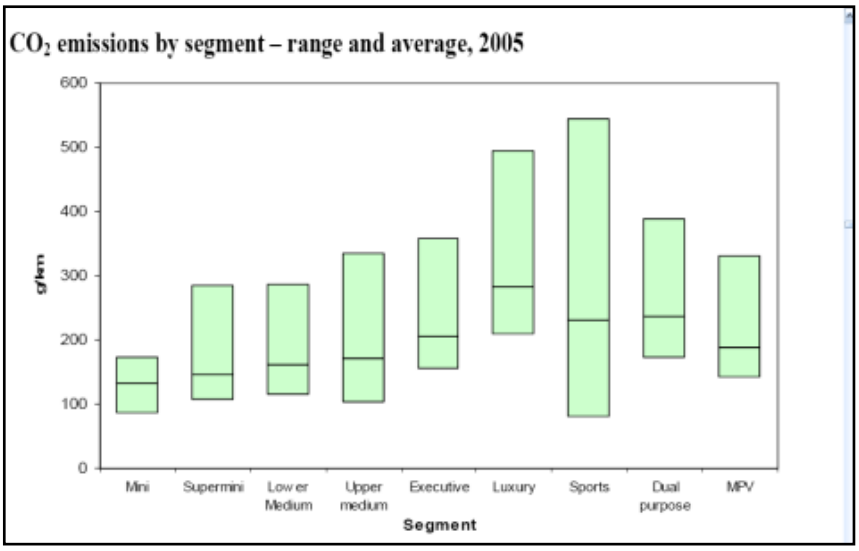
Are there other ways?



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BUILDINGS CONSIDERATIONS

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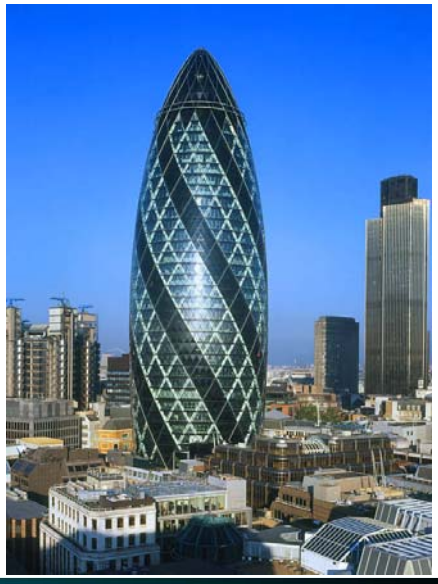
Buildings consume energy!

- **Commercial buildings**
- **Industrial Buildings**
- **Residential Buildings**



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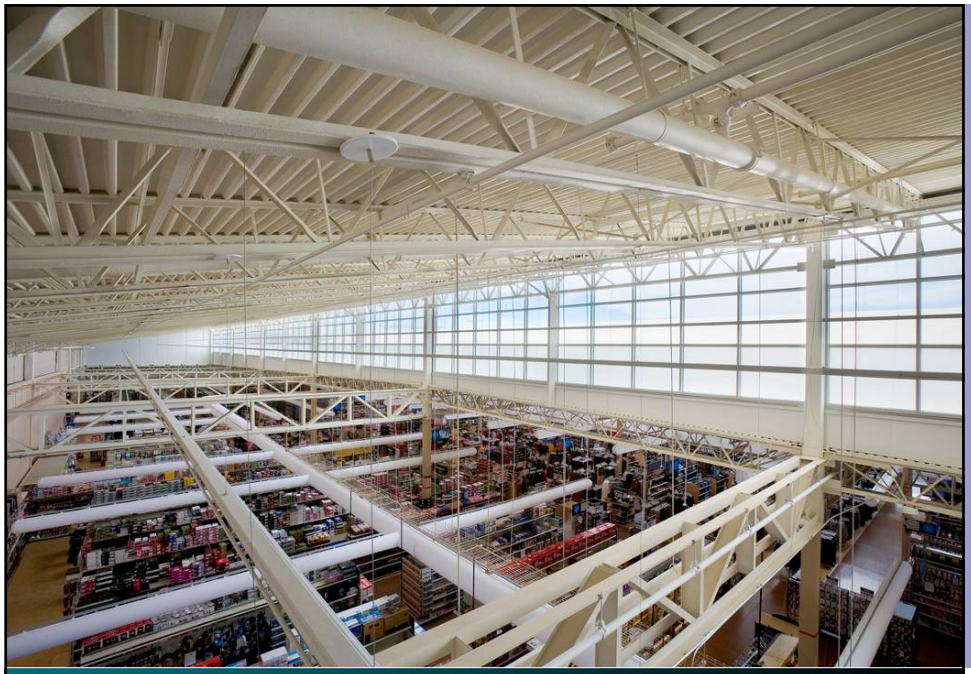

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Retailer Study - Phase 1
Energy Reduction Goal (35-45%)

First Iteration of Climate Specific Design

- Radiant Floor:
  - **Reduce costs by prefabrication of modular mats off site.**
  - **Develop control strategy to optimize active and passive use of slab, offset time of peak power consumption.**
  - **Optimize slab thickness**
- Refrigeration Heat Reclaim System Performance:
  - **Heat reclaim integrated with low temperature condensing boilers and heating coils.**
  - **Series arrangement allows for low water flow and low pressure drop condensers**
- **Results:**
  - **HVAC systems reduced energy consumption by 1,400,000 kWh over baseline or by 15% of baseline total consumption.**
  - **Refrigeration Energy reduction 10% of baseline total.**

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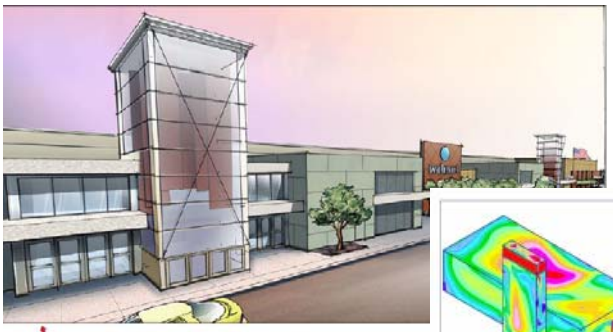
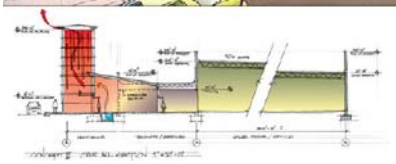
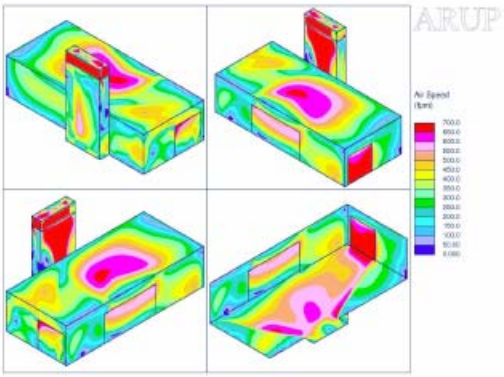
Solar Chimney Vestibule







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1998: pilot project of 32 Passive Houses at Kronsberg

Energy consumption just 15 kWh/m² p.a.

Target met! Residents very satisfied

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Code for Sustainable Homes & Building Regulations

- **Government consultation in early 2007 on enhancements to Building Regulations based on CSH**
- **Relates to CSH energy standards only**
- **Implementation as part of Building Regulations**

Date	2010	2013	2016
Energy/carbon improvement as compared to Part L (Building Regulations 2006)	25%	44%	zero carbon
Equivalent energy/carbon standard in the Code	**Code level 3**	**Code level 4**	**Code level 6**

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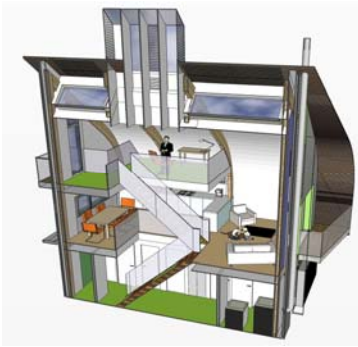
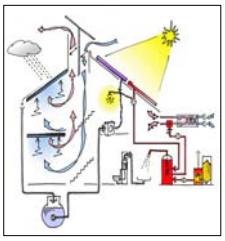
Kingspan Lighthouse

- **Level 6 Code for Sustainable Homes**
- **First built example June 07 completion**
- **Off-site 07 at BRE**
- **Zero Carbon using on-site renewables**
- **80 L/person water use**





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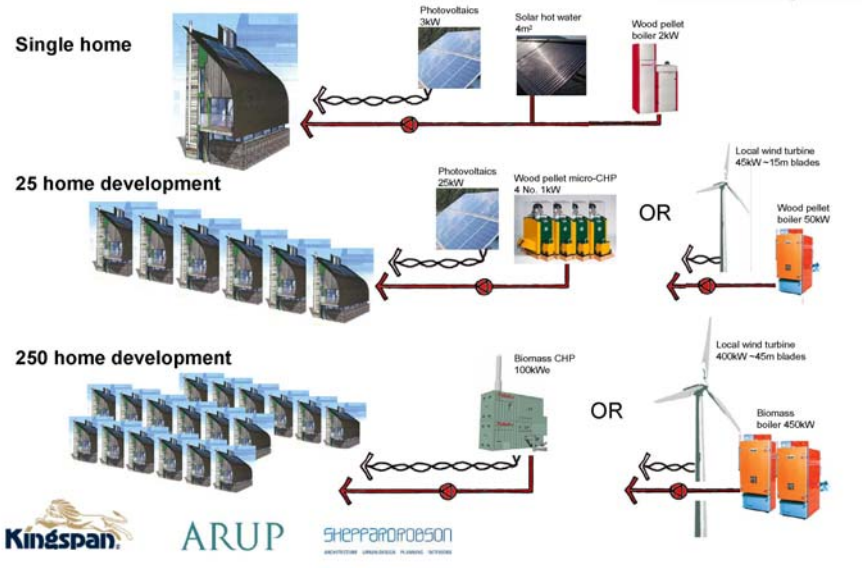

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Electricity generation	Kg CO_2 e/GJ energy generated	% saving in GHG v fossil fuel reference
Grid Electricity	162	
Electricity from straw	66	59%
Electricity from miscanthus	26	84%
Electricity from SRC wood chip	25	84%
Electricity from forest residue	22	86%
Gasification of forest residue wood chips	7	95%
Gasification of SRC wood chips	8	95%
Small Scale heating	**Kg CO_2e/GJ heat energy generated**	**% saving in GHG v fossil fuel reference**
Oil fired heating boiler	105	
Combustion of woodchip	7	93%

Credit: Professor Roland Clift, CES, University of Surrey

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THE PROBLEM WITH BIOMASS

- **SRC (willow or poplar)** **10-30 Dry Tons/ha/yr**
- **Miscanthus** **10-18 Dry tons/ha/yr**

- **Perennial Crops on 10% of arable land and 50% of improved/set-aside grassland could only satisfy around 10% of current electrical demand.**

- **We need to pursue enhanced yield techniques to increase yields or enable use of lower quality land.**

Credit: Professor Roland Clift, CES, University of Surrey

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Trends






Stratford	King's Cross	Central Milton Keynes	Northstowe	Heart of East Greenwich	Gallions Park
20	20	50	50		100

% CO_2 mitigated

Time

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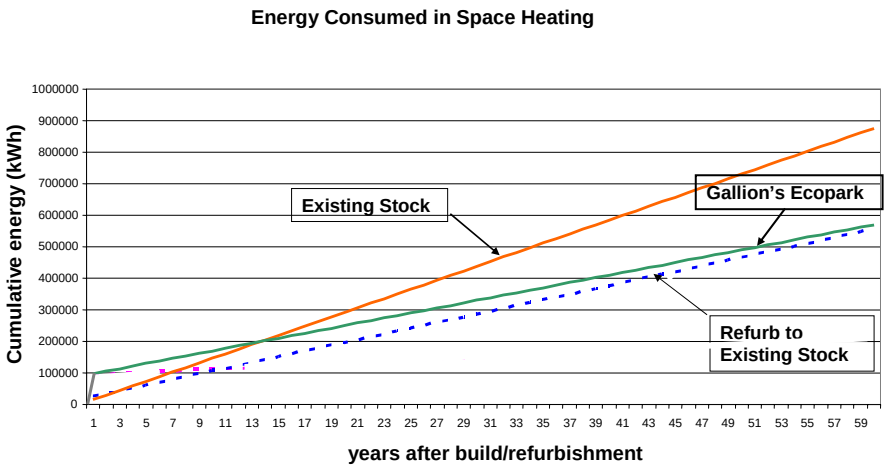
Refurbish or replace?



Credit: Brenda Boardman, ECI, University of Oxford

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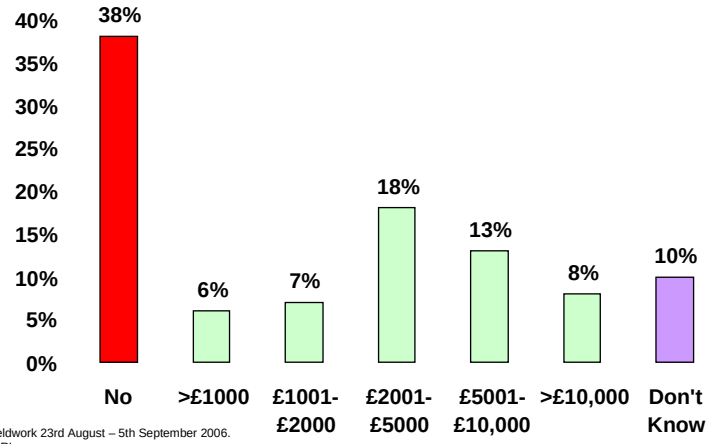
Ipsos MORI Opinion Poll 2006:

Q. Would you be willing to pay more for a home in a sustainable housing development?



Base: All (501), fieldwork 23rd August – 5th September 2006.
Source: Ipsos MORI

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CONCLUSIONS AND SUGGESTIONS

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integrated urbanism

Human and Environmental Health
Economic Vitality and Individual Prosperity
Energy
Housing
Nutrition and Urban Rural Linkages
Mobility and Access
Education and Culture
Governance and Civic Engagement
Water
Materials and Waste
Ecological Footprint

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Integrated Urbanism – where might we go?

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64% reduction in energy demand with no emissions from energy for power / heat, saves

350,000 tonnes of CO2 per year


Sustainable eco-city

- **Energy demand 600 GWh/year**
- **No CO2 emission from energy for power and heat**

Conventional approach city

- **Energy demand 1650 GWh/year**
- **350,000 tonnes of CO2 emission**

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Improved accessibility reduces travel distances by 1.8M km. With zero emission transportation this reduces CO2 emissions by

400,000 tonnes per year



Sustainable eco-city

- **Daily travel: 4.2 million km**
- **Zero CO2 emissions**
- **Average trip length 24 km**

Conventional approach city

- **Daily travel: 6.0 million km**
- **400,000 tonnes CO2 emissions/year**
- **Average trip length 56 km**

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And, for established economies?

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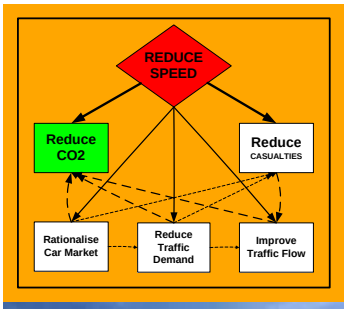
And another low cost option (but politically difficult)

Guaranteed carbon savings and it costs nothing in technology or time to market



1.4 – 2.0 litre petrol cars emit 14% less CO_2 at 70mph than at 80mph

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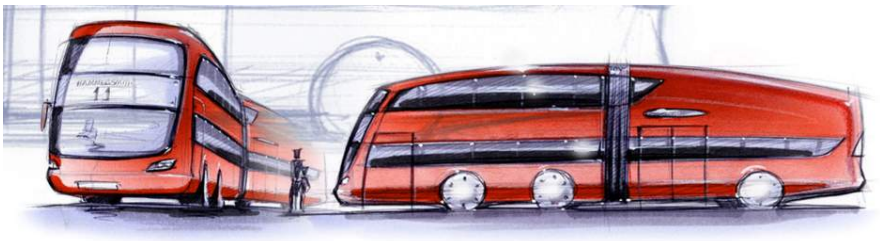
So Lets be Bold ...

- **The outside lane of the motorways are for 75mph coaches only**
  - They are chauffer driven double decker offices on wheels
  - They operate from key hubs outside major cities
  - They have fast links to the city centre
- **The other two lanes are 60mph (aggressively enforced) passenger car and HGV lanes**
  - Heavily tolled roads, with graduated speeding fines for repeat offenders



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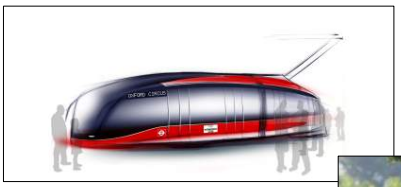
And the city can be ...

- **Vehicles used on short stop-start drive cycles can run on energy carriers such as electricity**
  - The vehicles will interact with infrastructure to even out city energy demands (smart charging, energy storage capability)
  - Priorities set via transport planning to encourage modal shift
  - Welcome back to the trolley-bus!
  - Electric urban car fleet available to the community paid for through local taxation.



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And the buildings?

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And the buildings?

Intervention!

- **Incentives**
- **Taxes**
- **Regulations**

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Thank you!

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