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# Now is the day, now is the hour
# See the fronts of battle lour…

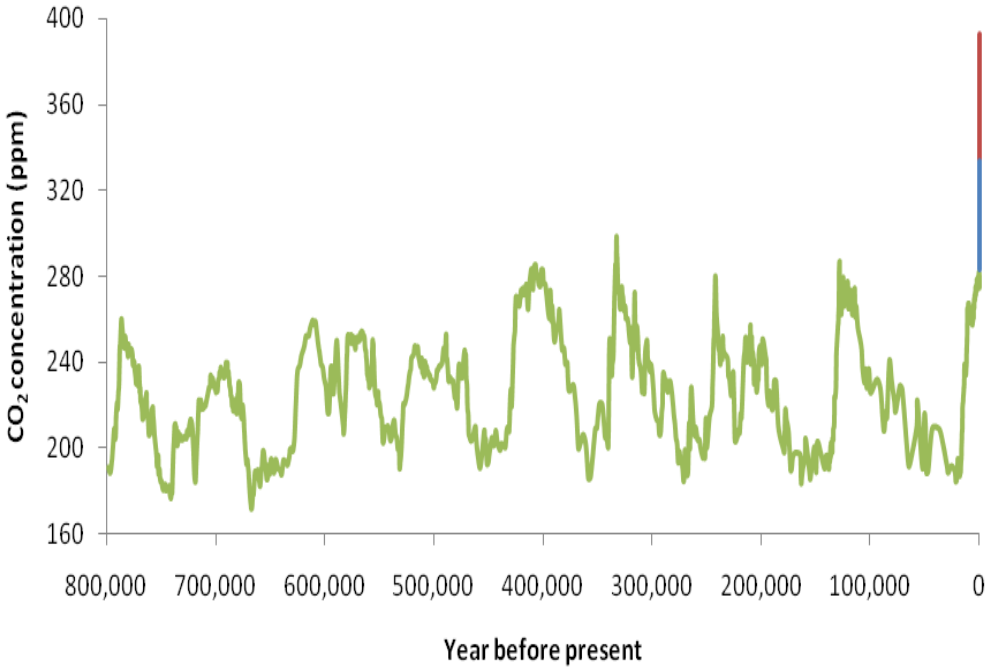
# See - the approach of Engineering's power!

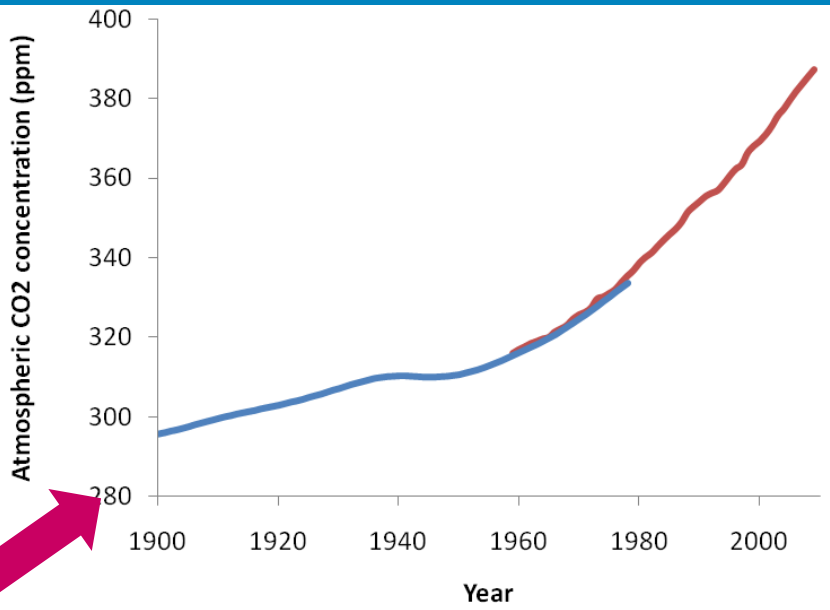

Professor Julia King CBE FREng
Vice-Chancellor Aston University Birmingham
Member of the Committee on Climate Change
UK Low Carbon Business Ambassador


Engineering Professors Council 17th April 2012

- The Battle Fronts: Climate Change and Economic Growth (or Rebalancing the Economy)
- The Opportunities: Green Growth
- Our Capabilities
- The Challenge

# Dramatic increase in emissions in the last century

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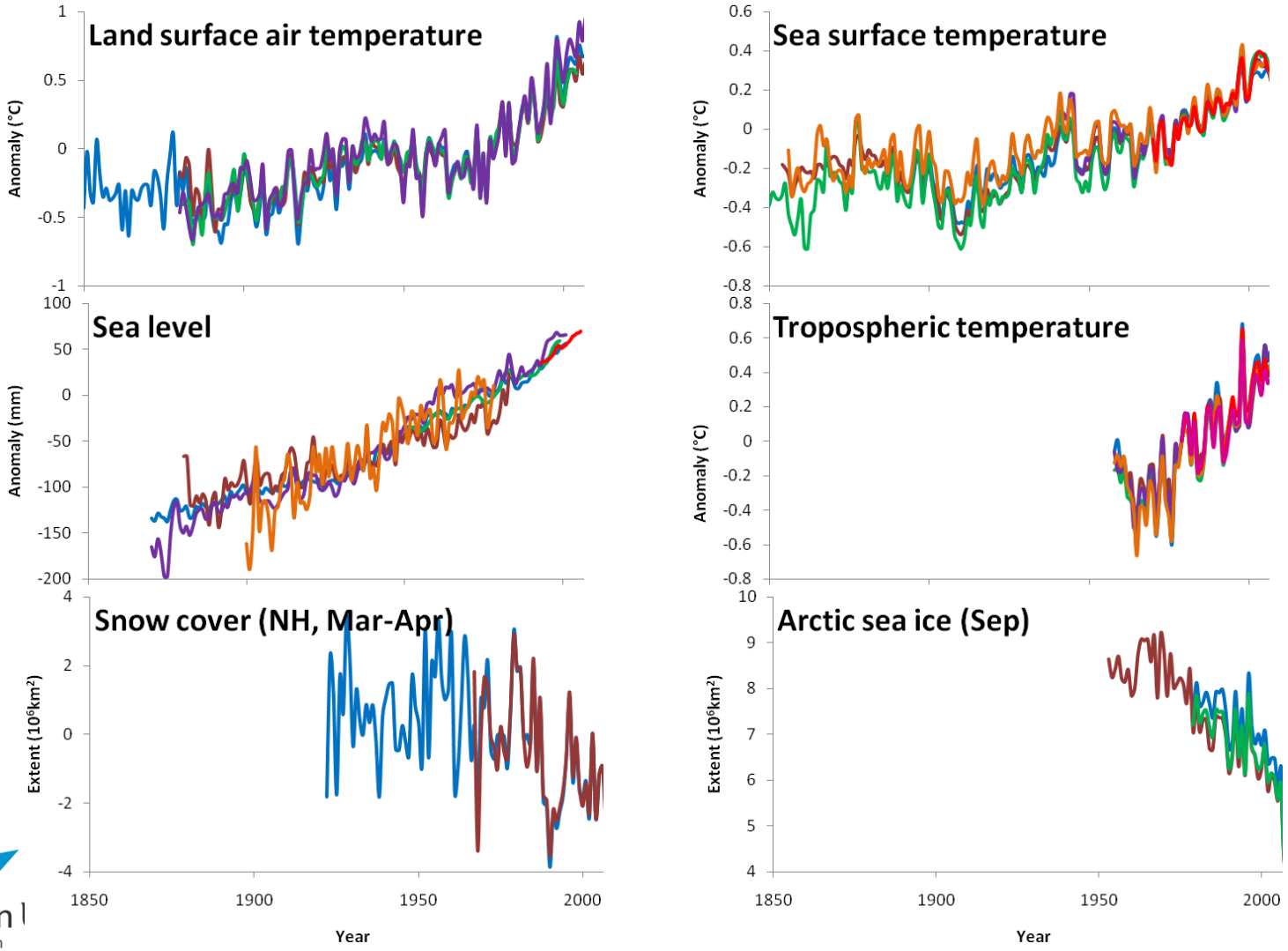
# The world is warming in response




ARNDT ET AL. (2010) STATE OF THE CLIMATE IN 2009

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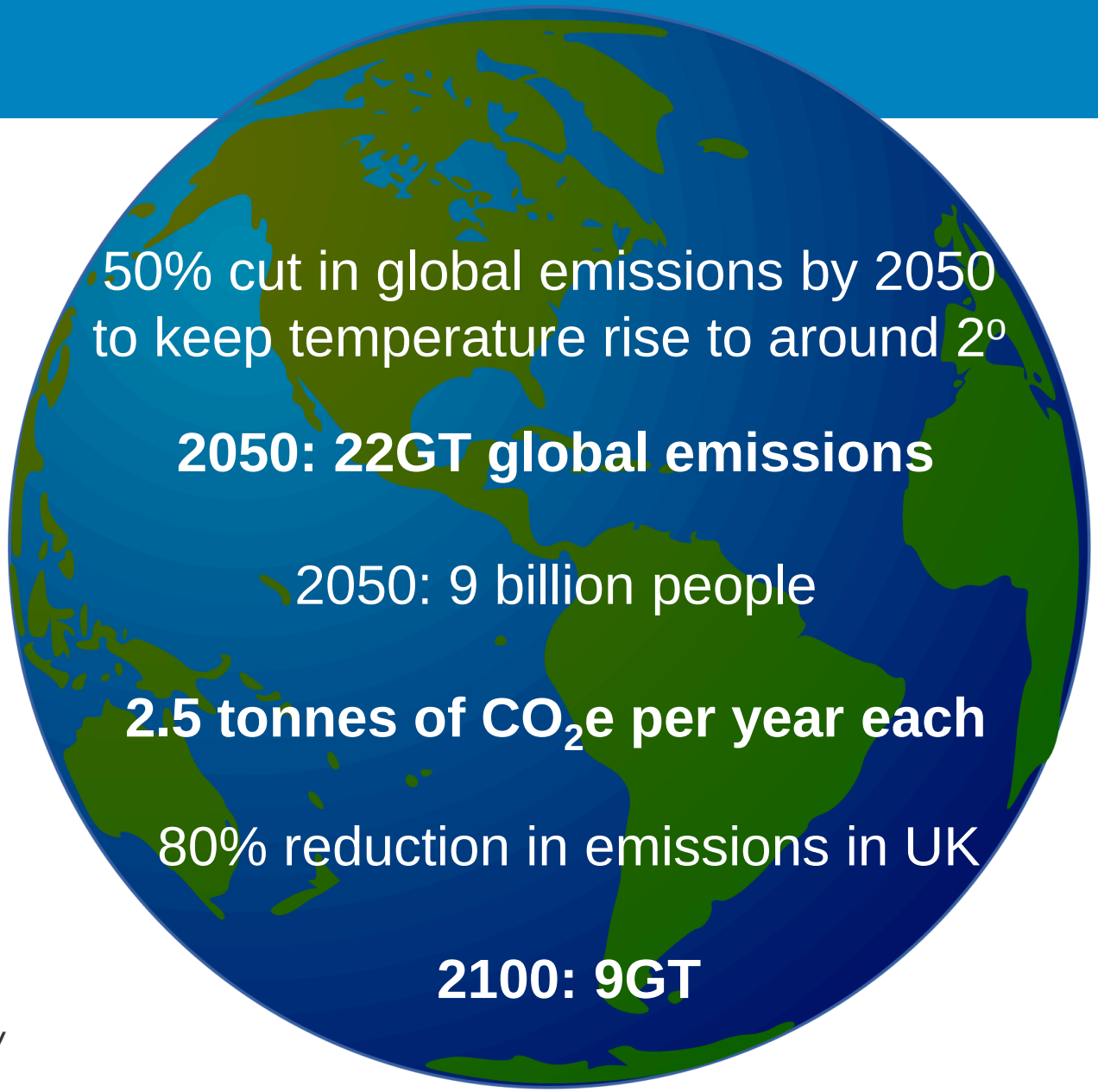
# The impacts of climate change

- **Business as usual: a high probability of global average temperature rise in excess of 4º, possibly as early as 2060**
- **Europe 8º warmer, 12º on hottest day**
- **Maize and wheat yields reduced by up to 40% at low latitudes**
- **Rice yields down 30% in China, India, Bangladesh, Indonesia**
- **2080 40% of the world's population has less than *3 litres of water a day***

# $CO_2$ emissions reduction



50% cut in global emissions by 2050
to keep temperature rise to around 2º

**2050: 22GT global emissions**

2050: 9 billion people

**2.5 tonnes of $CO_2$e per year each**

80% reduction in emissions in UK

**2100: 9GT**

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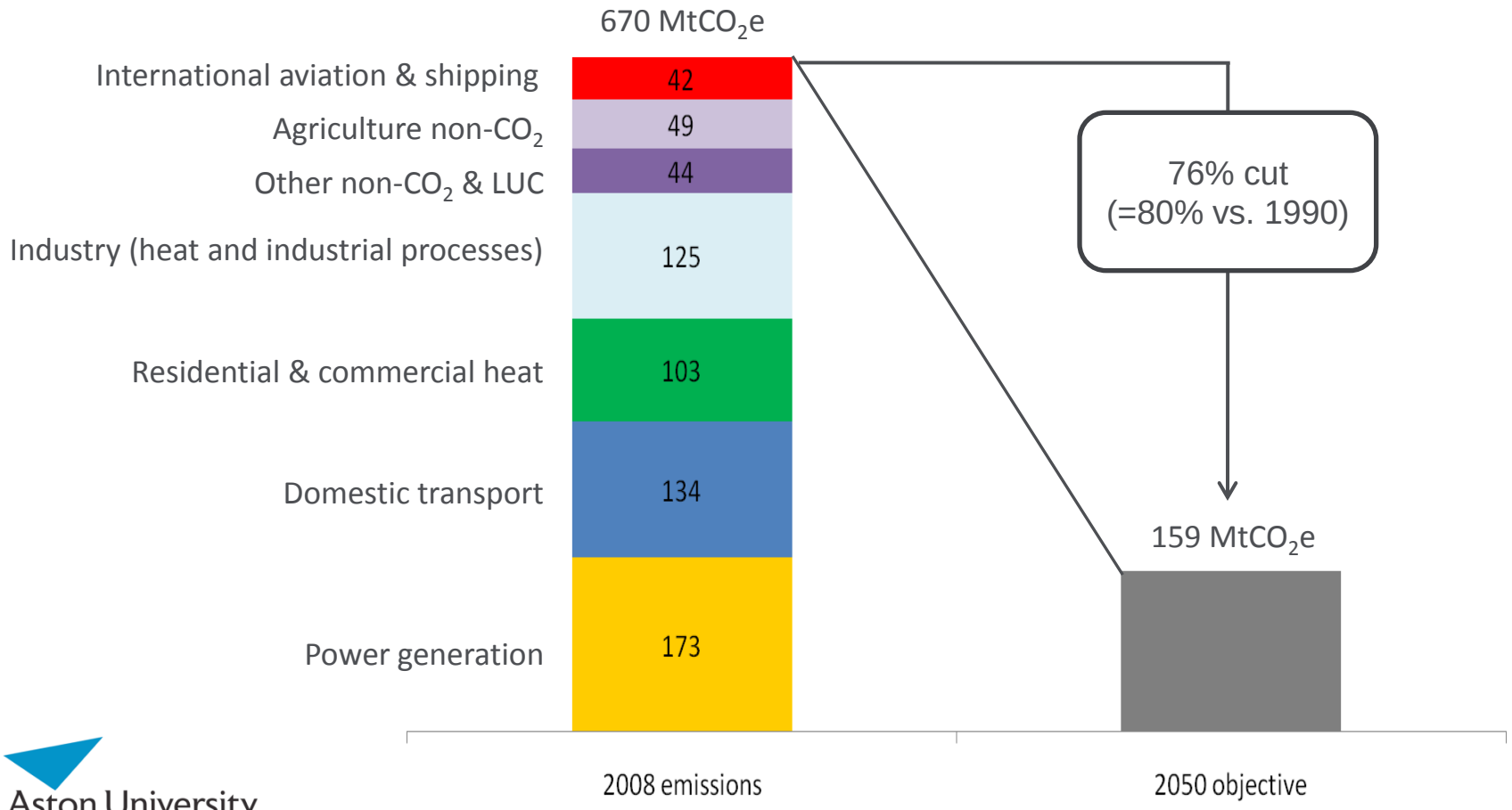
# Our challenge…

**they have to deliver an 80% reduction in emissions in their working lives**

# The UK's 2050 target

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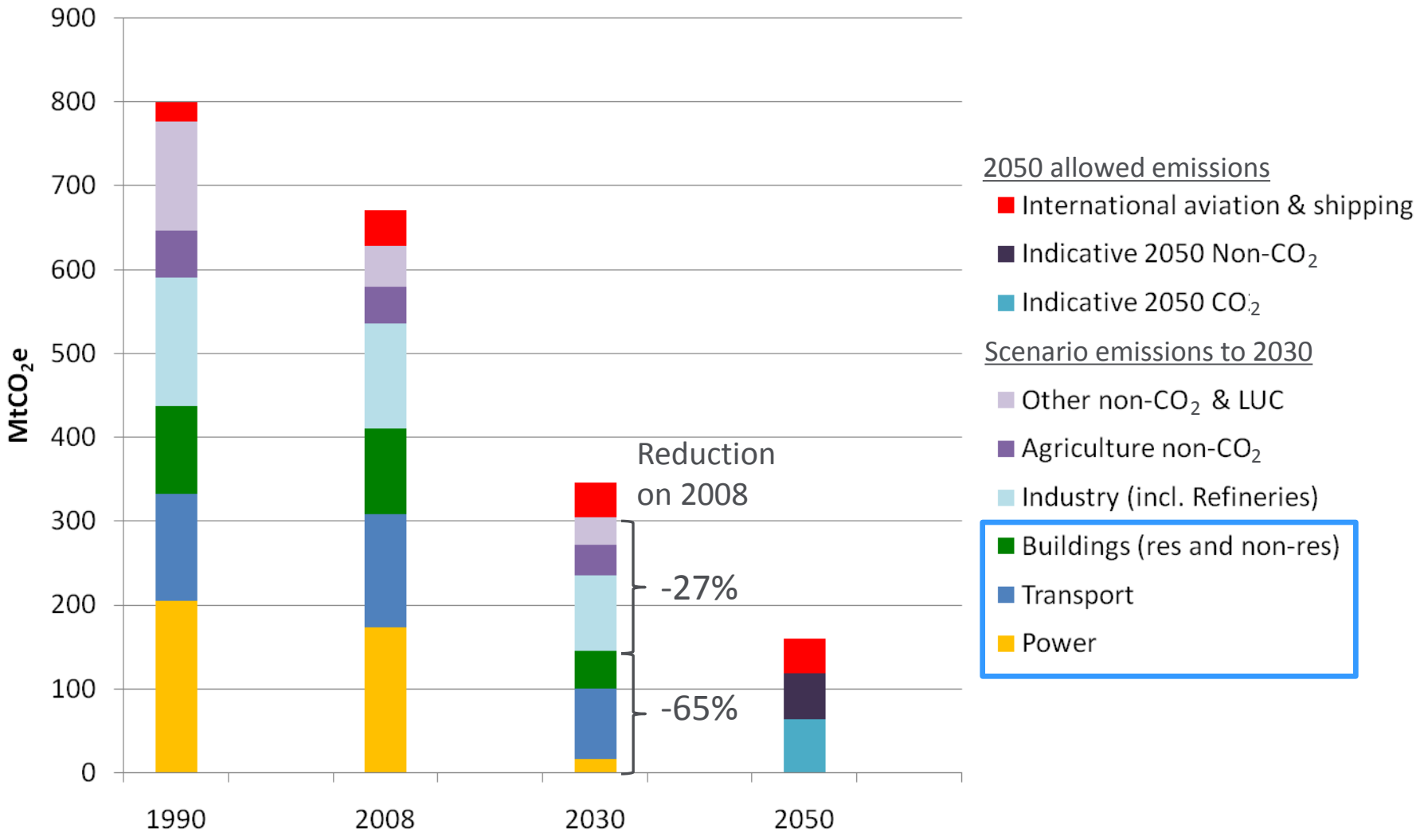
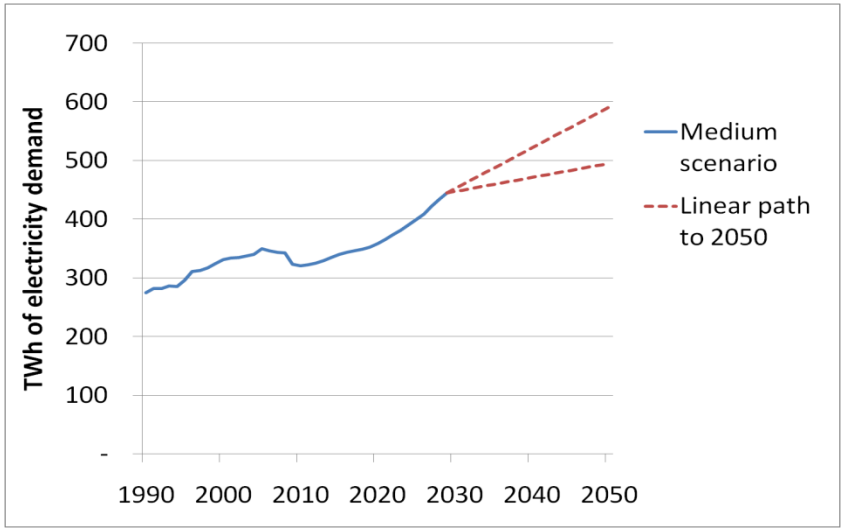
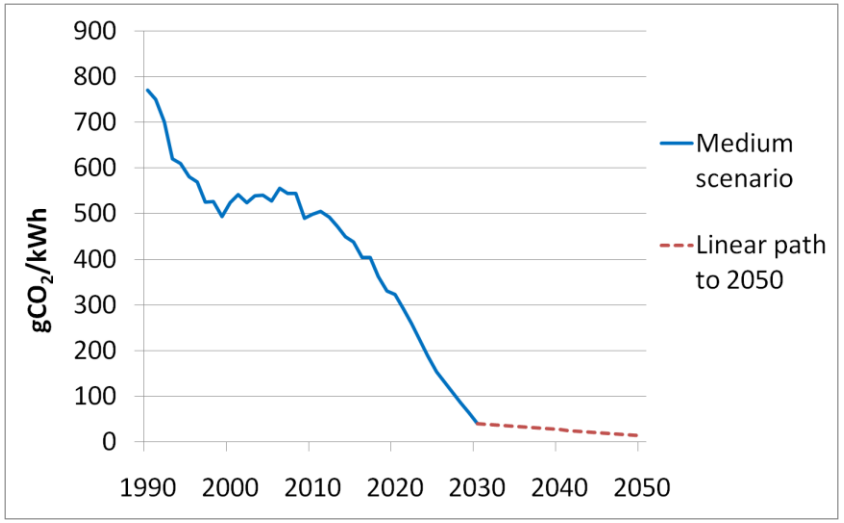
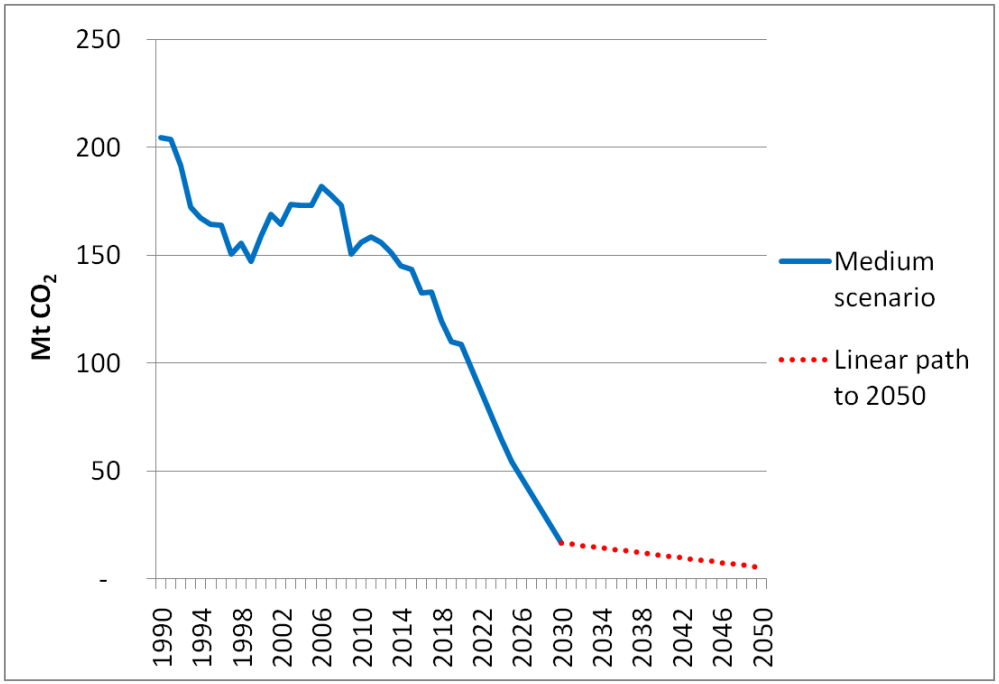
# Areas delivering major reductions to 2030



# Power sector: 80-90% reduction in emissions by 2030



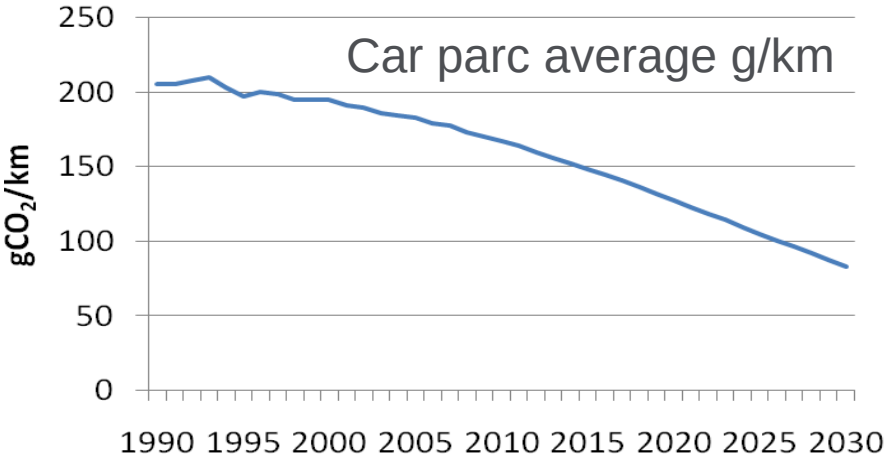



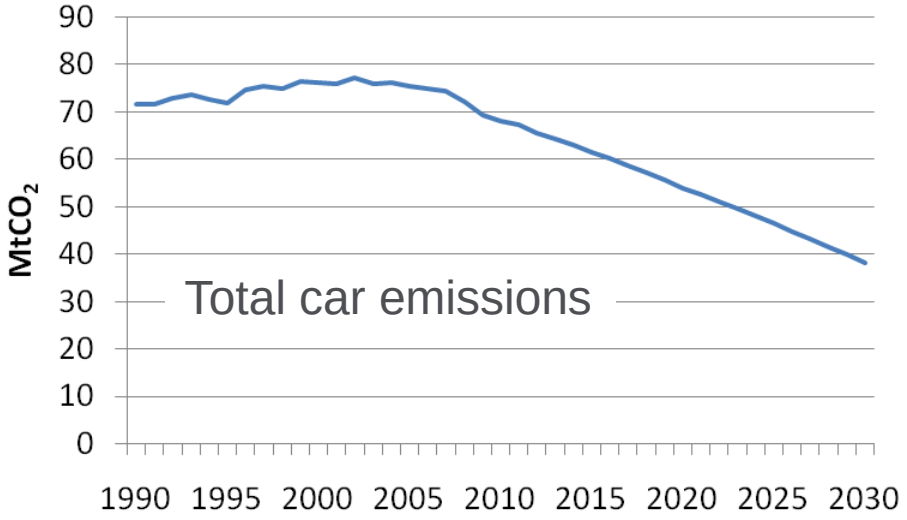

Source for 2050: range of MARKAL model runs for CCC (2010)

# 2030 scenario for transport: 44% reduction

A 44% reduction in transport emissions to 67Mt in 2030 through:

- Behaviour change
- Vehicles: 80g cars, 120g vans, 17-28% reduction for HGVs
- New cars: 50g/km
- Biofuels: 12% of liquid fuels
- Hydrogen buses reach 50% of new vehicles

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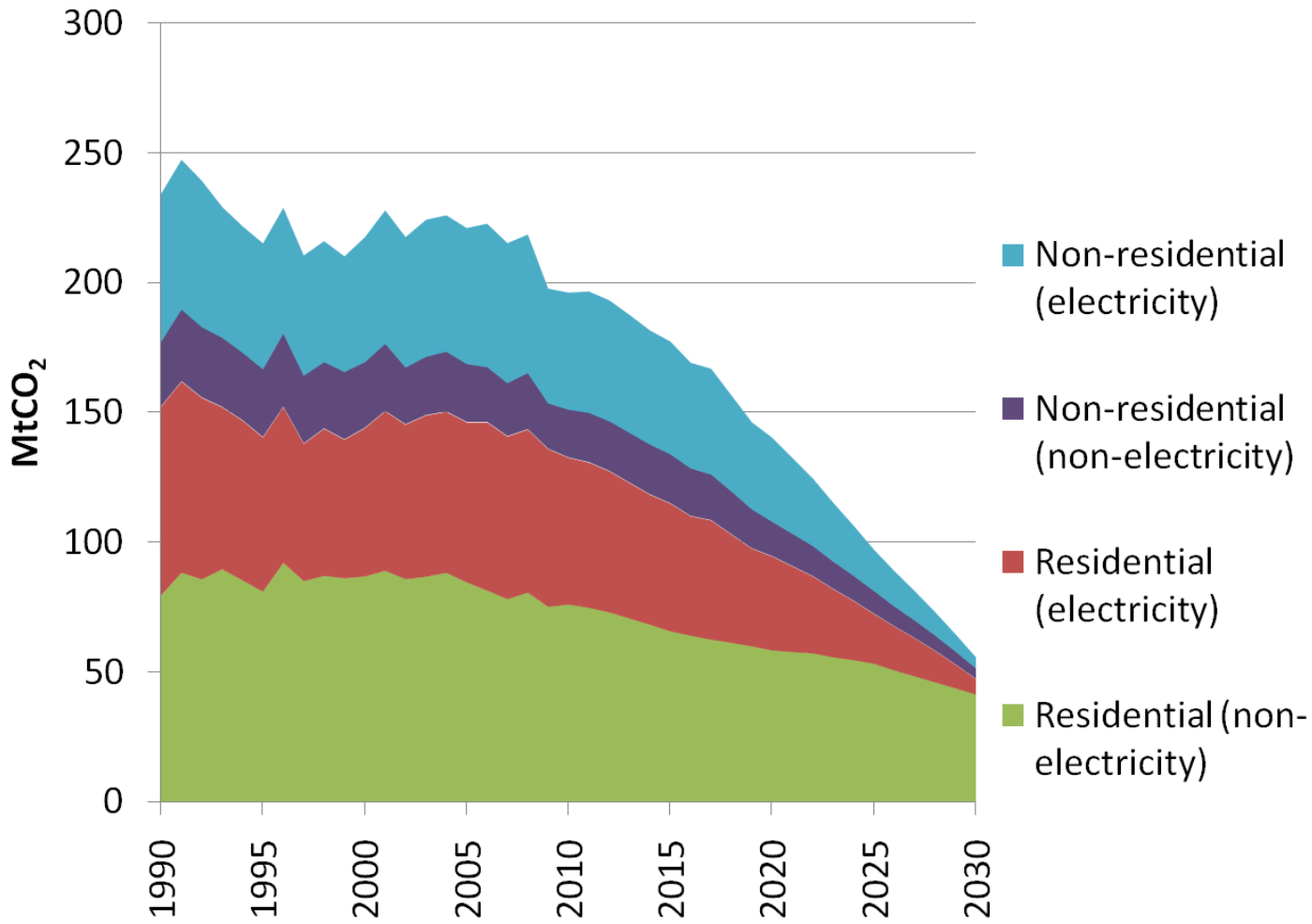
# Buildings: 70% emissions reduction to 2030 from improved efficiency and shift to use of electricity



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# Green Growth

- The UK Green Economy today
  - more than £112bn, up to 10% of GDP
  - accounts for over 900,000 jobs, 3% of all jobs
  - accounts for £10.8bn of exports, 5% of all exports

- 92% of UK business leaders think green growth is an opportunity for their own business

- UK investment in the Green Economy
  - a third of UK businesses are already investing in R&D for green products and services
  - the UK ($11.2bn) ranked third globally in clean tech investment, behind the US ($18.6bn) and China ($34.6bn) in 2009
  - the UK ($0.5bn) ranked third in VC/PE investment behind Brazil ($0.7bn) and the US ($3.9bn)



Data from UKTI

# Rebuilding our electricity supply

- By 2020
  - an extra 23GW of wind, making a total of 27GW
  - 3 new nuclear plants
  - carbon capture and storage demonstrated
- By 2030
  - further development of nuclear, renewables and CCS on coal and gas
  - emissions 5g/kWhr vs 500g/kWhr today
  - 97% low carbon generation vs 26% today
- New electricity market arrangements
  - investor confidence
  - delivering solutions at least cost to the consumer

# Delivering the low-carbon vehicle fleet: 60% of new sales in 2030 are new technology

| | 2030 | | | |
|---|---|---|---|---|
| | Share of new car sales | | Share of miles | Emissions Intensity |
| Conventional cars | 40% | → | 70% | × 80-125 g/km |
| Plug-in hybrids | 40% | → | 20% | × 50 g/km |
| Pure electric vehicles | 20% | → | 10% | × 0 g/km |

**Average emissions intensity in 2030**

**New cars purchased: 52g/km (versus 146g/km today)**

**All cars on road: 81 g/km (versus 173g/km today)**

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# New vehicles and new fuels

- Internal combustion engine vehicles with emissions of 70g/km
- Battery pack prices halved to $200 per kWhr
- Low cost fuels cells
- Dramatic vehicle weight reduction
- New fuels
  - Non-food biofuels
  - Hydrogen and hydrides


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# The Green Deal for energy efficiency and heat
# The Green Investment Bank for district heating

- Insulation:
  - cavity wall: 8 million more installations by 2020
  - solid wall insulation: 2 million installations by 2020
- 14 million more high efficiency boilers by 2020
- Increase in renewable heat: heat pumps, biomass boilers, solar…
- Smart meters
- District heating, waste to energy…

# Low carbon homes: energy efficiency and heat

- Whole house packages £10,000 - £20,000 per house, 4 million houses, £60 billion business
- Creating over 100,000 jobs in the next 10 years
- Opportunities for new businesses: technology consultancy, project management, installation…
- Policy: Green Deal, RHI, FITs…


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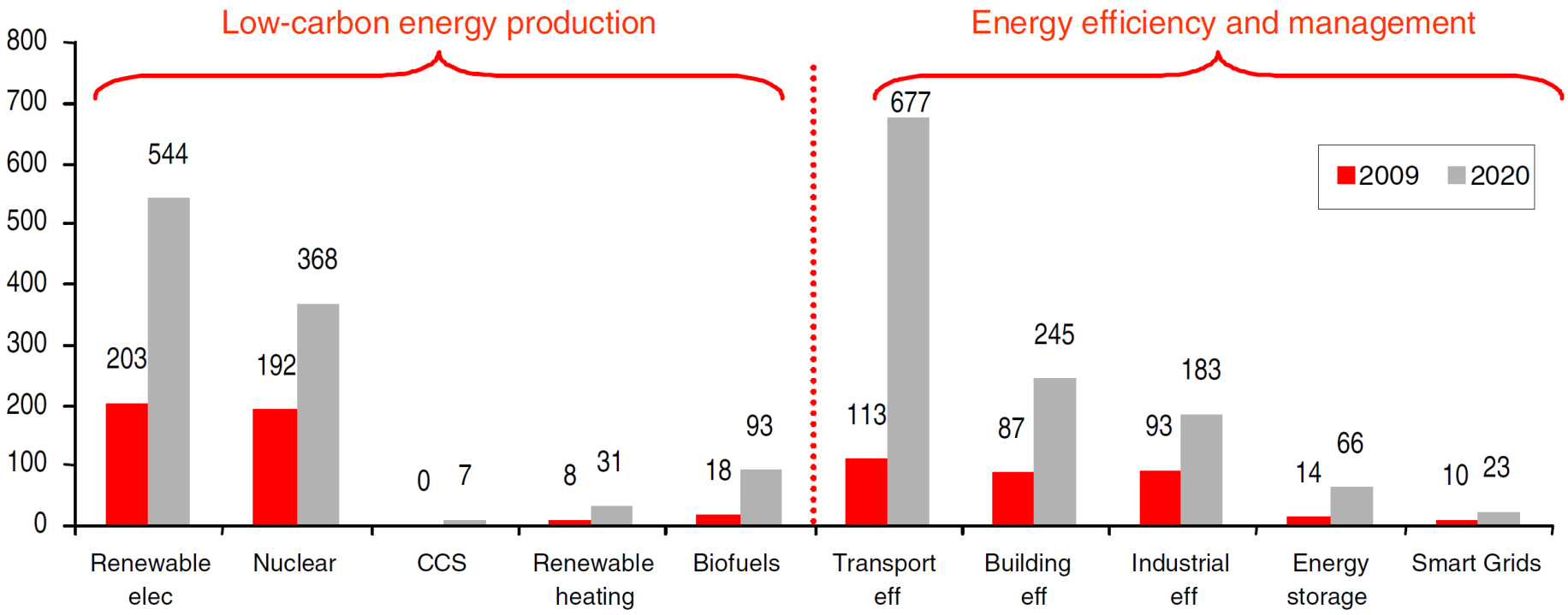
# A global market: over £4 trillion by 2016

## Global markets: 2009 and 2020 $bn




Source: HSBC estimates

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2010
6.5 billion people
850 million cars
2050
9 billion people
3 billion cars?

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# The UK's low carbon proposition


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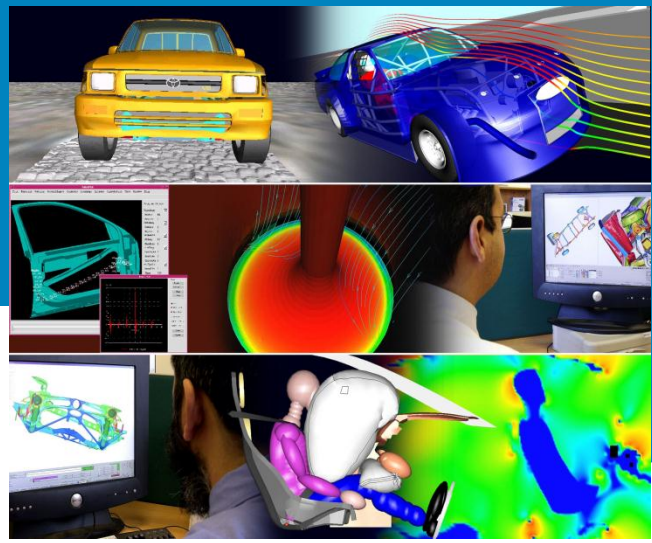
# The UK is at the forefront….

- Largest, fastest growing small wind market in Europe
  - With 10% of global players
- The CC divisions of top global management consultants
  - Environmental financial transactions
  - Environmental risk
  - Calculating Carbon Footprints
  - Carbon management and advice from the Carbon Trust
- From 2016 all new UK homes will be zero carbon standard
  - Non-domestic buildings from 2019
- UK companies leading international sustainable building projects
  - Arup: carbon neutral temperature control for the Qatar World Cup in 2022
- Leading positions in automotive technologies and in aerospace
- Leading UK research: eg 1st in the world for marine energy patents, 24 universities involved in marine energy research

# Marine energy

- A strong academic base
- World class testing and demonstration sites: European Marine Energy Centre (Orkney) and Wave Hub (Cornwall): onshore testing at NAREC (Blyth) and QinetiQ (Hampshire)
- The world leader in marine energy technologies, home to:
  - 23% of all global wave developments
  - 27% of all global tidal stream developments
  - 50% of global investment in marine energy technologies (£72 million investment, 2004-08)
- Wave and tidal stream energy potential for 15% - 20% of UK electricity demand
  - supporting 16,000 jobs
- We have 10 - 15% of global tidal resource and 35% of Europe's wave energy resource

# Low Carbon Cars



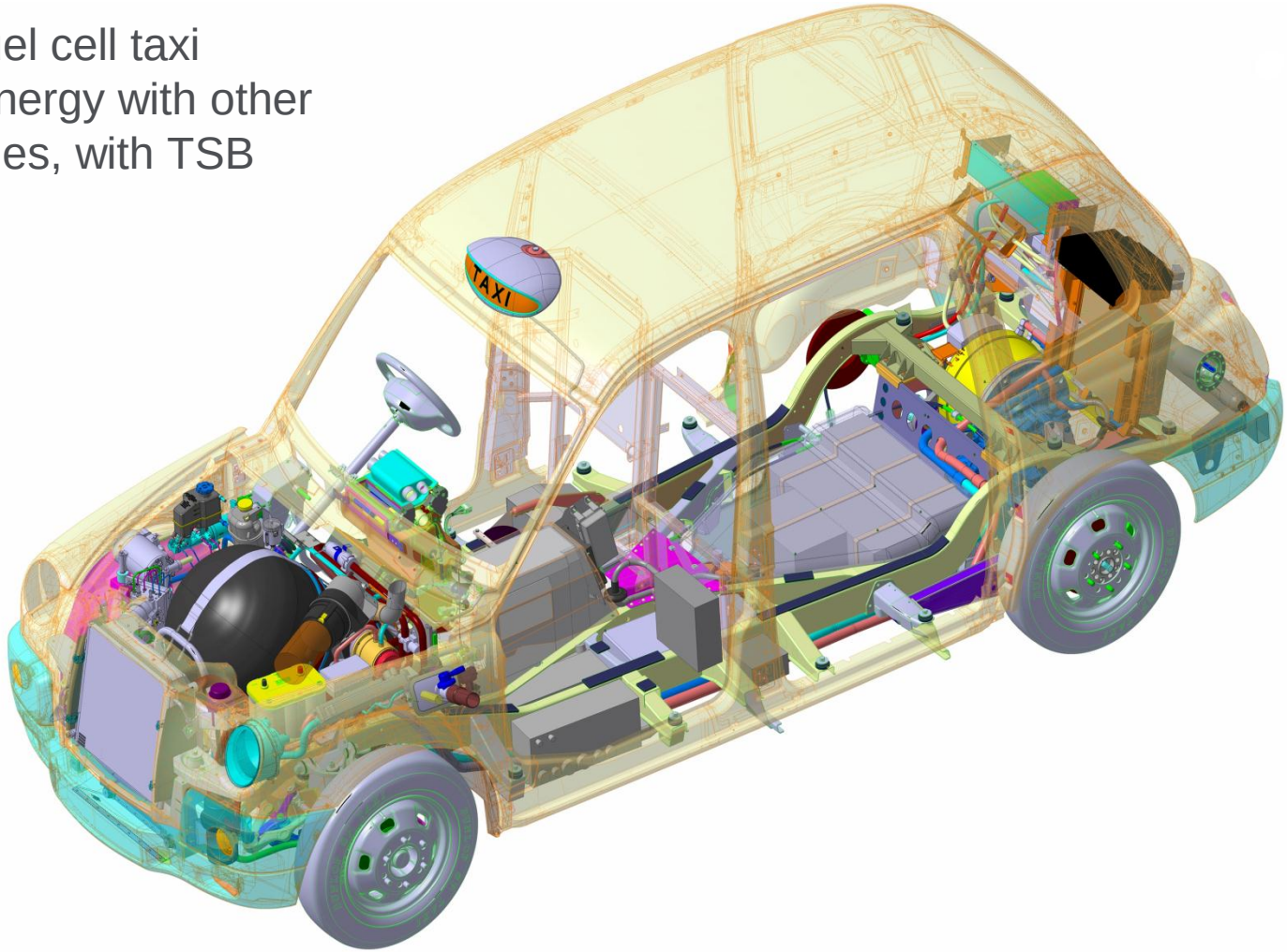
- UK automotive: over £1.5 billion per annum R&D
- UK R & D Centres
  - JaguarLandRover
  - Tata
  - Shanghai Automotive International Corporation
  - Ford
  - Nissan
- World-leading motorsport, design, test, development, consultancy
  - Ricardo
  - Lotus
  - MIRA
  - Millbrook
- Production: includes 30% of European engines
- Investment:
  - Nissan: £420m investment in low carbon vehicles and batteries, including the Leaf
  - Toyota: Auris hybrid, first mass production of a hybrid in Europe
  - Ford: investing £1.5billion in R&D on low emission and more fuel-efficient vehicles
- 3,000 companies in the low carbon vehicle supply chain
  - Materials, Fluids, Manufacturing, Engines and Components, Drive Trains, Energy Recovery and Storage, Charging, Alternative Fuels, Emissions Control, Systems Integration & Power Management, Design, Simulation, Fuel Cells and End of Life Vehicle Recycling**...**

# Lightweighting: reducing inertia

- A benefit for stop-start driving
- Around 0.7% efficiency improvement for 1% mass reduction
- Typically up to 10% efficiency improvement
- Claims for 38% mass reduction delivering 33% efficiency improvement on a large car
- Polymer composites, aluminium and magnesium alloys, MMCs, plastics, metal and plastic foams…and RECYCLING
- New Jaguar XJ: chassis and *whole body* in Al (50% recycled) and Mg alloys and composites.  Result: 180kg lighter than a 7 series BMW, 40mpg, 184g/km

# Intelligent Energy: Fuel Cells

Hydrogen fuel cell taxi Intelligent Energy with other UK companies, with TSB funding

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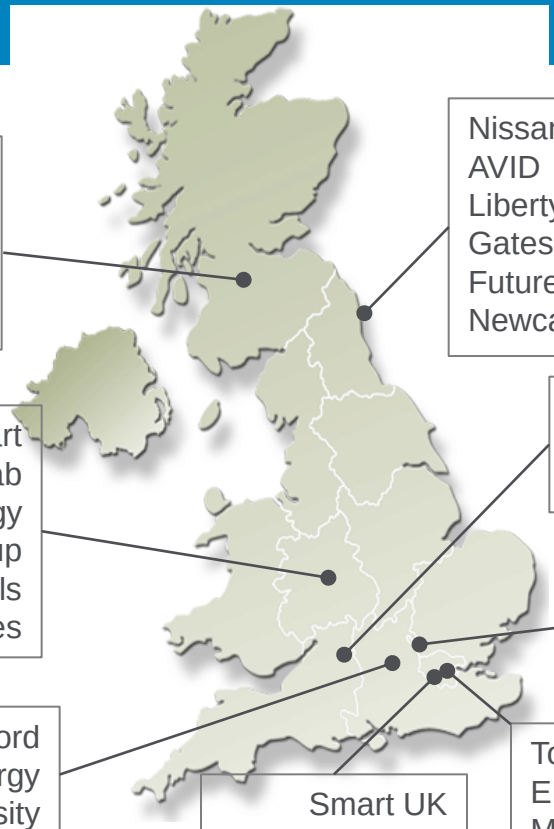
# Hydrogen

- Solid hydrogen: Cella Energy
  - $NH_3BH_3$, ammonia borane, in a polystyrene nanoscaffold
  - 6wt% hydrogen
  - Micron scale fibres and particles
  - Hydrogen released below 80$^{o}$C
  - Petrol: 13kWhr/kg
  - Hydrogen: 39kWhr/kg
  - 6wt%: 2kWhr/kg

# Innovative Research and Demonstration: TSB Ultra Low Carbon Vehicle Demonstrator



Allied Electric Vehicles
Scottish Power
Axeon Batteries
Strathclyde University
Glasgow City Council

Nissan, Smith Electric Vehicles
AVID
Liberty Electric Cars, Peugeot
Gateshead Council
Future Transport Systems
Newcastle University (TORG)

Jaguar Land Rover (Tata), Smart
Mitsubishi, Microcab
Eon Energy
Arup
Coventry and Birmingham City Councils
Aston and Coventry Universities

BMW Mini-E
Scottish and Southern Energy
Oxford Brookes University

Delta Motorsport, Westfield Sports Cars
Ecotricity Cars, Lightning
AEA Technology
Green Motion Eco Car Hire

Ford
Scottish and Southern Energy
Strathclyde University

Smart UK
Nudge Advisory

Toyota
EDF Energy
MET Police, Transport for London
GCDA

# Motorsport and Formula 1

- 8 F1 teams in UK – 67% of F1!
- 4,000 specialist motorsports companies
- Green motorsport
- Formula Student
- Formula 1 in Schools

# Sustainable aviation

- $3 billion in R and D per annum
- Greener, lighter, safer, more efficient
- Boeing 787 Dreamliner with Rolls-Royce engines, delivers 20% improvement in fuel efficiency
- Bombardier C Series aircraft:100km on 2.3 litres of fuel
- Lightweight materials:
  - alloys
  - composites
  - advanced forming techniques
  - next generation research
- Biofuels
- Advanced aerodynamics and design
- New aircraft concepts
  - integral contra rotating fan

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# Engineering today

- 25% of the UK economy – 3 x financial services
- £1trillion in 2009/10
- 5.6 million employees
- Over 500,000 businesses

# Engineering tomorrow

- Delivering change on a huge scale: fastest growing part of the economy
- £500bn spend in the next 20 years to maintain infrastructure
- £100bn for low carbon developments
- Proportion of the population of working age drops from 65% in 2010 to 59% in 2030
- 580,000 retirements from engineering jobs in the next 10 years
- Skills Councils and EngineeringUK:  2.22 million new engineering skilled employees in the next 5-10 years

# Engineering graduates

- 22,000 engineering graduates per annum
- 26% non-EU and affected by visa changes
- About 50% of the rest go into engineering jobs: 8,000
- Over 10 years: 80,000, versus 2.2 million
- 33% of employers are already reporting difficulty recruiting engineering skills

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# Now is our day: we can deliver the future…


- National scholarships for engineering
- Business-funded scholarships for engineering
- More funded undergraduate places
- A better deal for overseas students
- National funding for graduate apprenticeships
- National support for a drive to raise the profile of engineering in schools
- 100% support for students taking a conversion year at university
- ….

‘*Young engineers have the world in the palm of their hands, the appetite for them is insatiable*’

Mark Elborne CEO General Electric UK

The Independent 15.2.2012

(and he is a lawyer)