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Energy Challenges and Opportunity

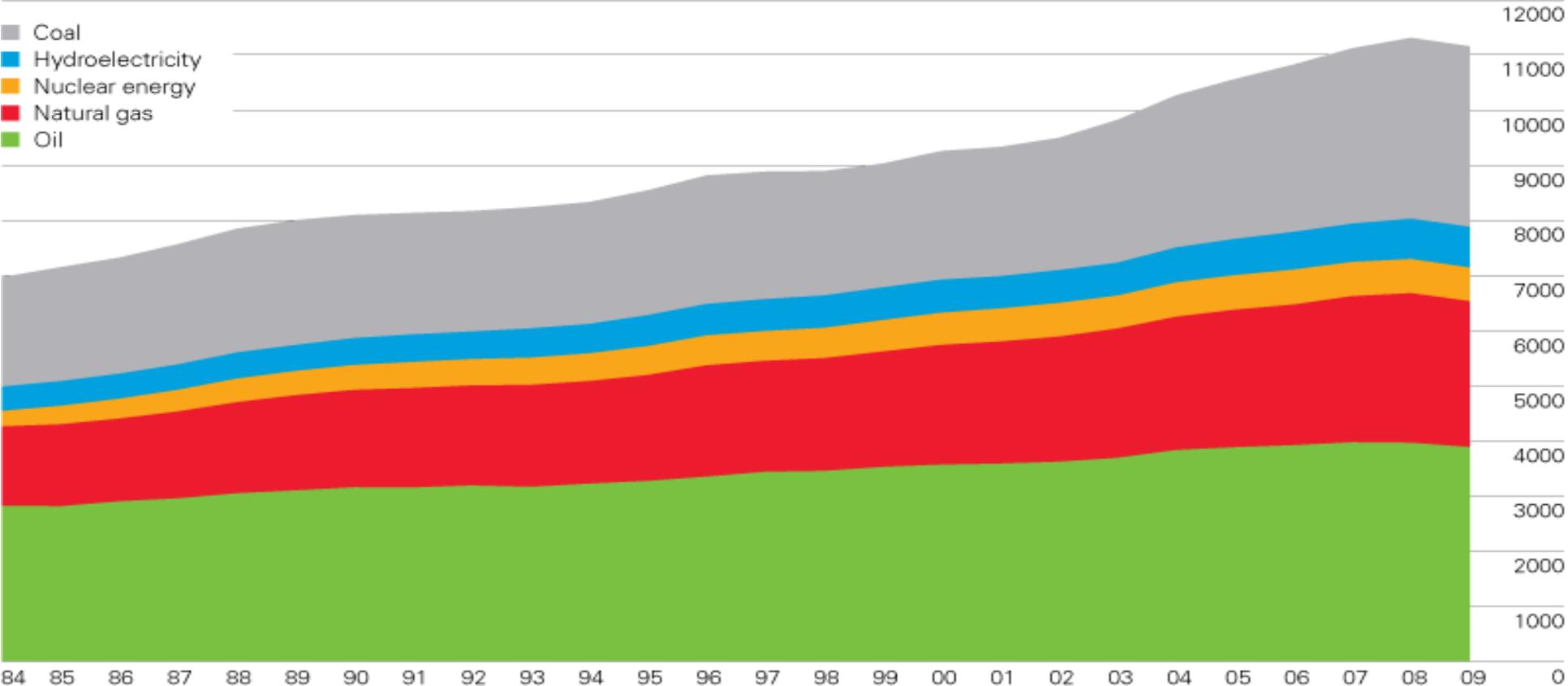
Malcolm McCulloch

March 2010



What's the problem?

World consumption Million tonnes oil equivalent



World primary energy consumption fell by 1.1% in 2009, the first decline since 1982. Consumption was weaker than average in all regions. While oil remains the leading fuel (accounting for 34.8% of global primary energy consumption), it continues to lose market share. Coal's share of global energy consumption was the highest since 1970.

11.3 Gtoe = 4.74×10^{20} J 2.24 kW per person

Source BP statistical review of world energy 2010



Strange Question



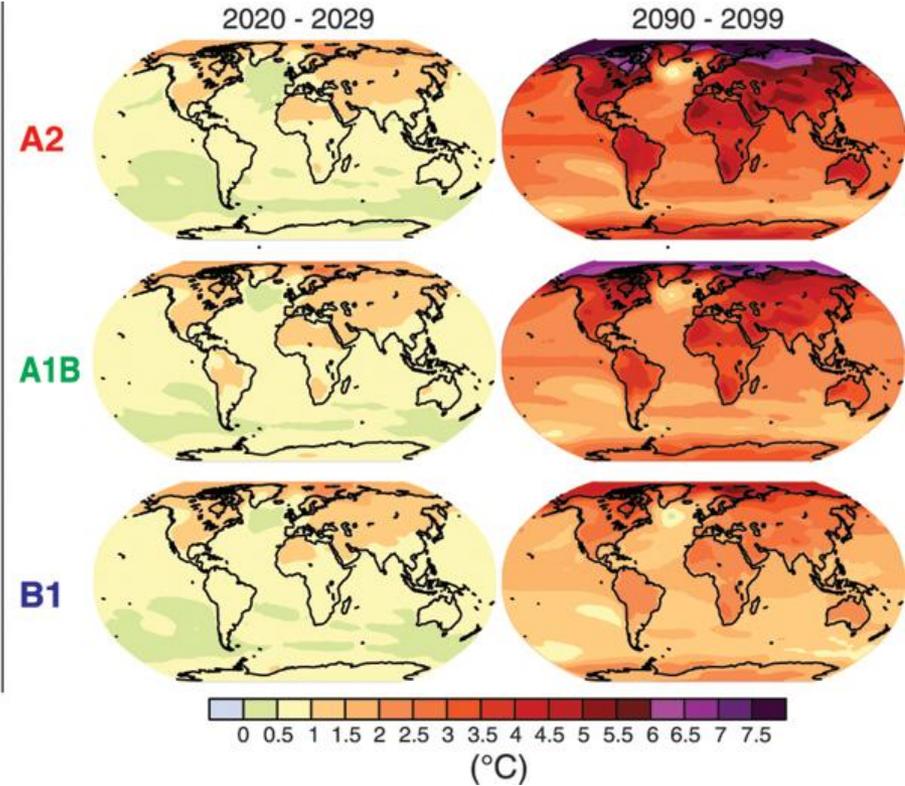
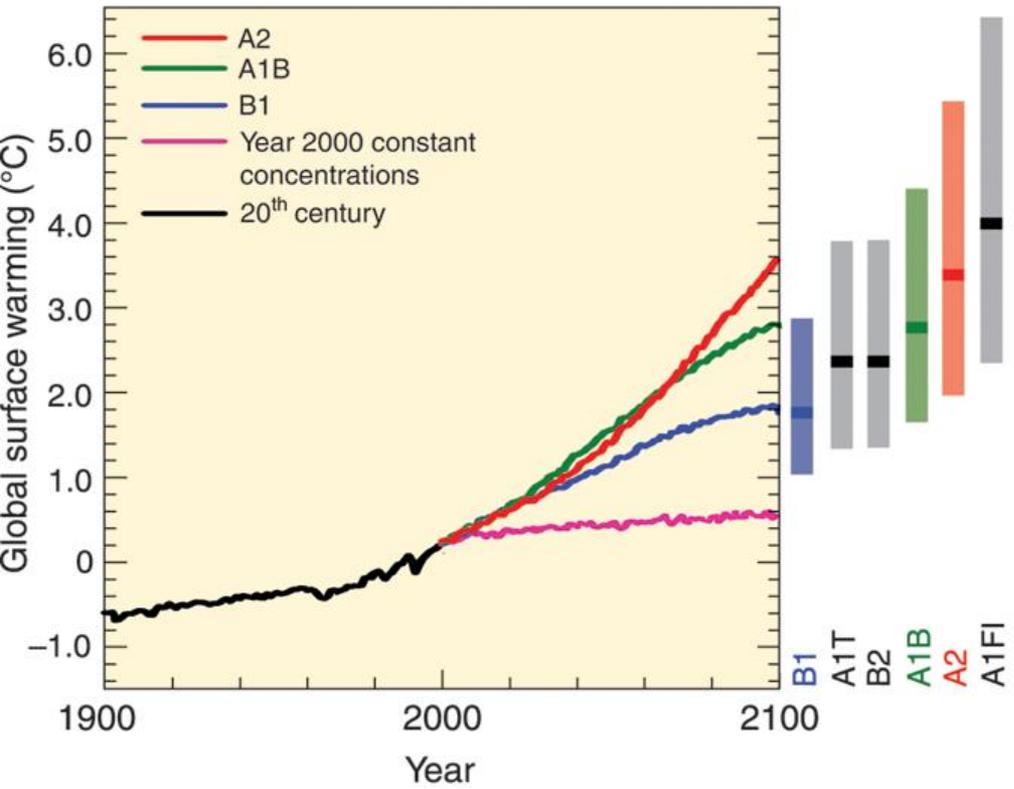
What went wrong at the cliffs of Dover?



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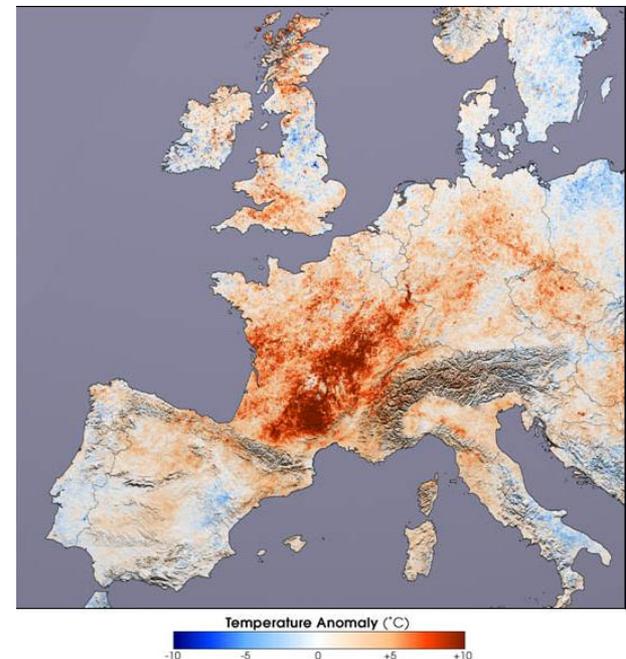
Future temperature





The Cost

- UK floods, autumn 2000
 - Insurance: **£1bn**
- European floods 2002
 - 37 deaths
 - **\$16bn** direct costs
- European heatwave 2003
 - ~30,000 deaths
 - **\$13.5bn** direct costs
- Katrina – 2005
 - **\$84 billion**
- Flooding July 2007







What is going wrong?

Energy is but one symptom of deeper problems. (Water is the next.)

- x Disconnection to real cost.
- x Once through resource use.
- x Growth in expectation and population.

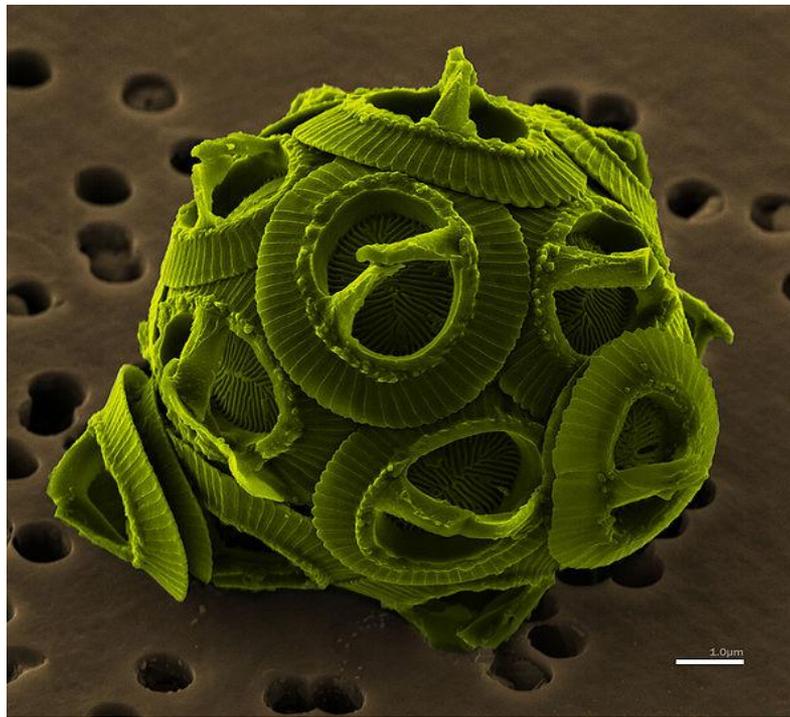


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Strange Question



What went wrong at the cliffs of Dover?



One of the few times nature did not close the cycle.

- Coccolithophores produce Calcium Carbonate shells that are not consumed by other creatures.



Decrease total CO₂ in land transport

- Increasing population.
- Richer population.
- Larger commuting distances.
- **Achieve 20gCO₂/km**





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Boundary

- Can achieve over 5500 mpg
- 1.30 g CO₂ per km (factor 100)
- BUT...





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LifeCar

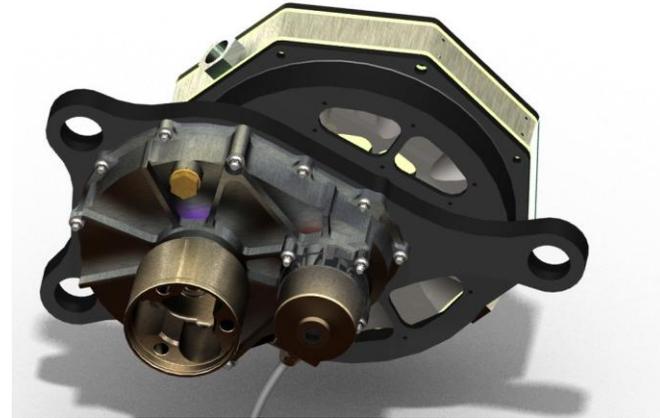






LifeCar

- H₂ sports car
- 20 kW fuel cell
 - 49 gCO₂ /km
- 0-100kph, 6s
- Ultracapacitors
- Range 350km
- 650 kg
- Collaborators:
 - Morgan Motors, Linde, Qinetiq, Cranfield, River Simple.





Other projects



- ADDZEV
 - Corsa delivery
 - Through the wheel hybrid
 - Urban delivery
 - Advanced lead acid battery



- Hyrban
 - H₂ commuter.
 - Launched Q1 2010



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Oxford Yasa



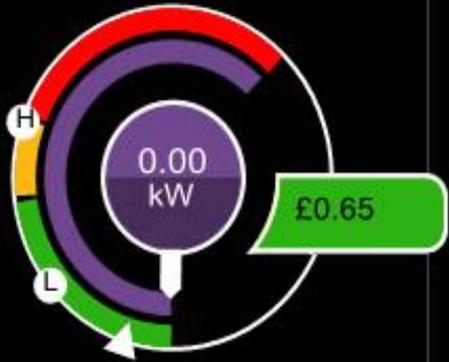


Domestic Sector

- Challenge
 - Minimizing waste of electrical energy.
- Technology
 - Ultra-smart electrical metering.
 - Enables live 'itemised billing', and high value energy services.



Current Electricity Used (All appliances)



Appliance Groups:



Change Appliance Group:



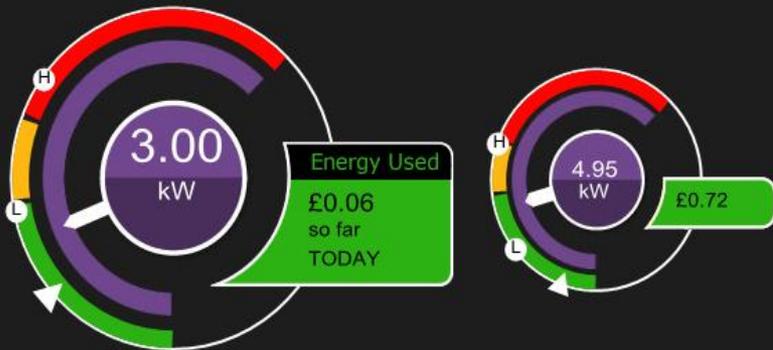
■ = Active ■ = Inactive

(Hot Drinks)

- Total
- Kettle

Electricity

Usage by Day



▶ = Energy used so far H = High L = Low





Tidal Energy Generation

- Challenge
 - Scalable tidal stream energy.
- Technology
 - THAWT: a scalable tidal flow device.
 - Devices of order 10MW – 100MW
 - Direct drive generators
- Spinout
 - Kepler Energy





Tidal Energy Generation

