

State of Science Review - Energy

Making A Material Difference - 1

- Energy Conservation for reduced emissions

Cheapest, cleanest, safest way is to use less energy

LED Traffic Lights:

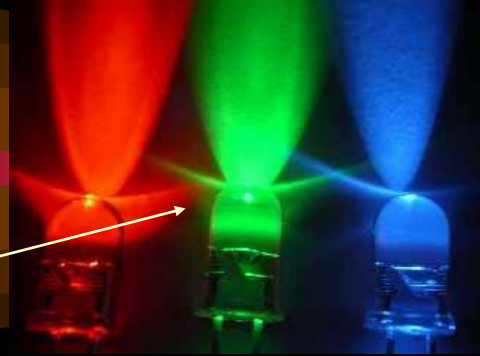
- US: 100M traffic lights. Switch to LEDs
- Save \$190M p/a; Reduce energy by 3bn kW/h
- Equivalent to eliminating emissions from 443,000 cars p/a

Lightweighting:

- Composite car body - halves petrol consumption
- Fuel cell technology - H₂O exhausted but:
3x larger & 4x heavier than equivalent petrol tank

LCD TV Technology:

Large plasma screen uses \$150p/a energy
LCD screen uses <\$15p/a energy
[LCDs screen now as large as plasma]



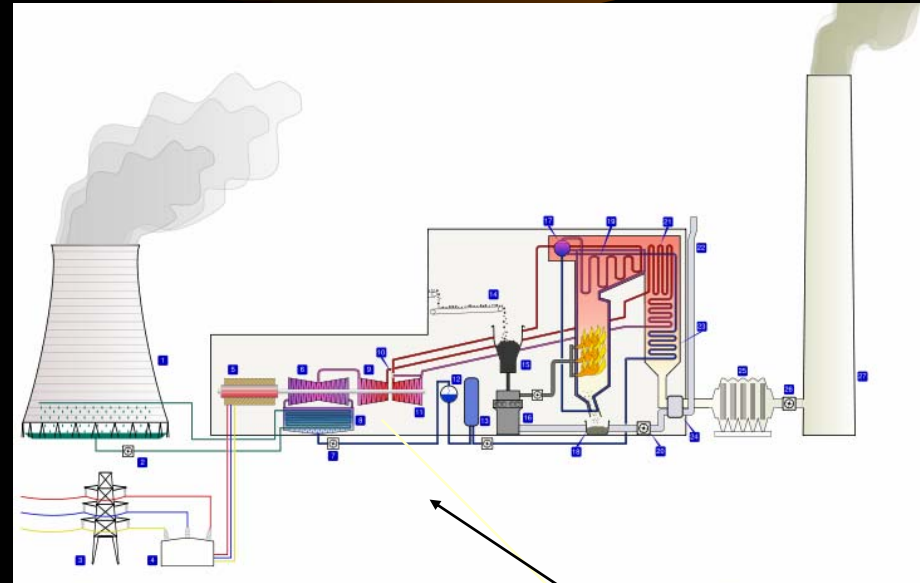
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Making A Material Difference -2 High Temperature Materials

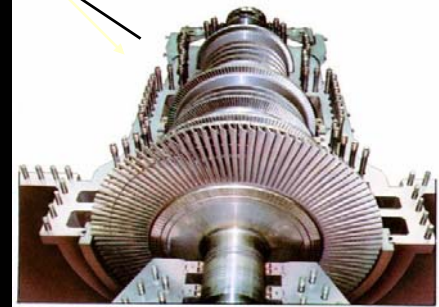


Turbine Technology (steam & gas)

- Over 90% of UK electricity generated by turbine power
- Exploit new high temperature alloys
- Coatings Technology - for everything!
[tbc, corrosion protection, new processes, Nano- & smart coatings etc.]
- Computer modelling
 - from atoms to engineering
 - for 'virtually' everything!
- Clean Coal Collaboration:
 - Alloy development (Europe)
 - China & India (25% of world's coal)
 - US FutureGen



Turbine Technology
at the high temp.
heart of electricity
generation



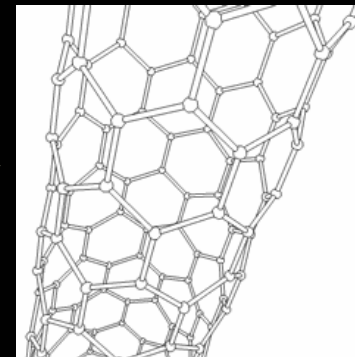
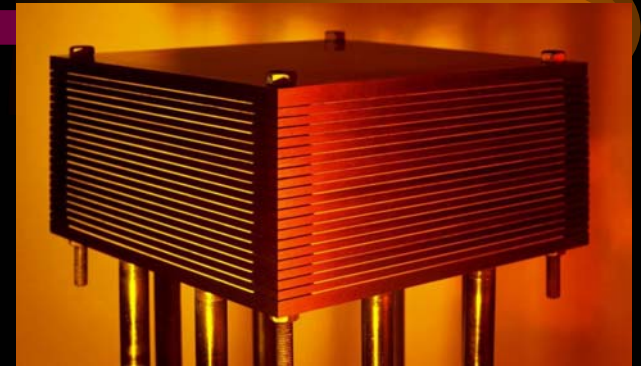
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Making A Material Difference - 3 Fuelling the Hydrogen Economy

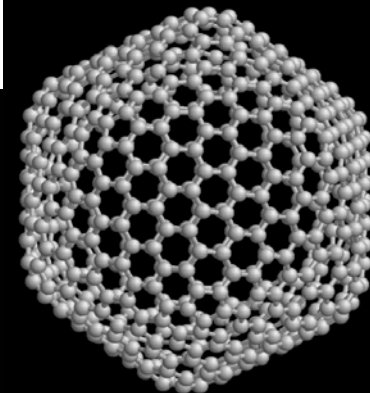
Fossil Fuel & Hydrogen - Combined Heat & Power

- Combine gasification with fuel cell
 - more 'bang for your buck' (electricity actually)
 - transitioning the change from hydrocarbon to H₂
- Material Madness: Convert all cars to fuel cells & consume 4x world supply of Pt!
New catalysts & membranes
- Hydrogen Storage?
 - Metal hydrides? (heavy). Nanotubes & Buckyballs Absorb hydrogen; filter CO₂ - trillion pores per sq.in [water desalination etc.] Nano-spheres & tubes are the new magic material of the 21st century.

Solid Oxide Fuel Cell
SOFC

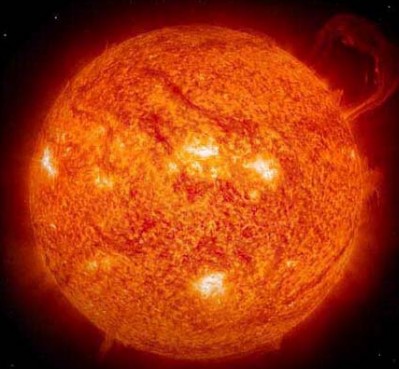


nanotubes
50,000 times finer than
a human hair



Making A Material Difference - 4 Solar Energy - Functioning Well

- Enough of the sun's energy reaches the earth's surface in ½hr. To meet the world's energy needs for a year
Why don't we use it?
- Large area Si single crystal wafers (semiconductors) are efficient at converting sun into electricity but they are expensive [produced in \$2bn fabrication facilities]
- How about cheap and cheerful polycrystalline silicon? Low efficiency.
- Materials to the rescue. Nanostructures galore!
 - Quantum dot solar cells (buckyballs + CdSe)
 - nanocrystalline titanium dioxide (white paint)
- Storage in supercapacitors based on ... [you've guessed it - nanostructures]



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Making A Material Difference - 5 Wind and Waves

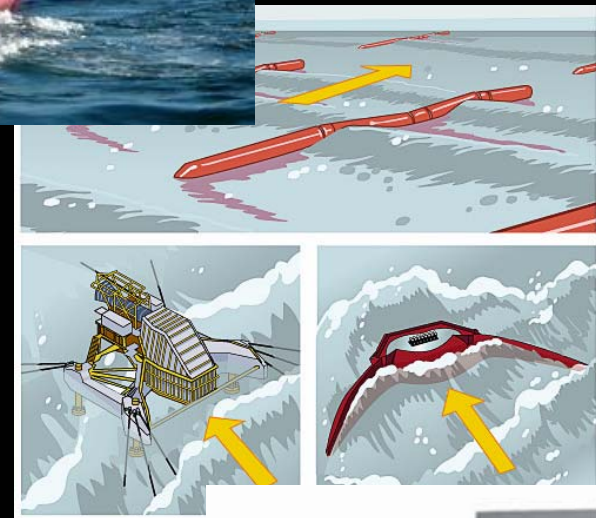


Pelamis

- For wind and waves - corrosion resistant composites

By 2050:

- High strength composites with carbon nanotubes [increase strength/stiffness tenfold]
- Smart structures:
 - Composites change shape (morphing)
 - Respond to aerodynamic buffeting (aeroelastic tailoring)
 - Condition monitoring. Fit & forget.
- Energy Storage - supercapacitors [nanostructures]



LIMPET

