Is the Climate in Crisis?

Dr Julian E Salt

Climate Solutions Consultancy

www.climatesolutionsconsultancy.com

Climate in Crisis?

Climate Change:-

- Science
- Evidence
- Politics
- Finance
- Technology
- Solutions
- Summary

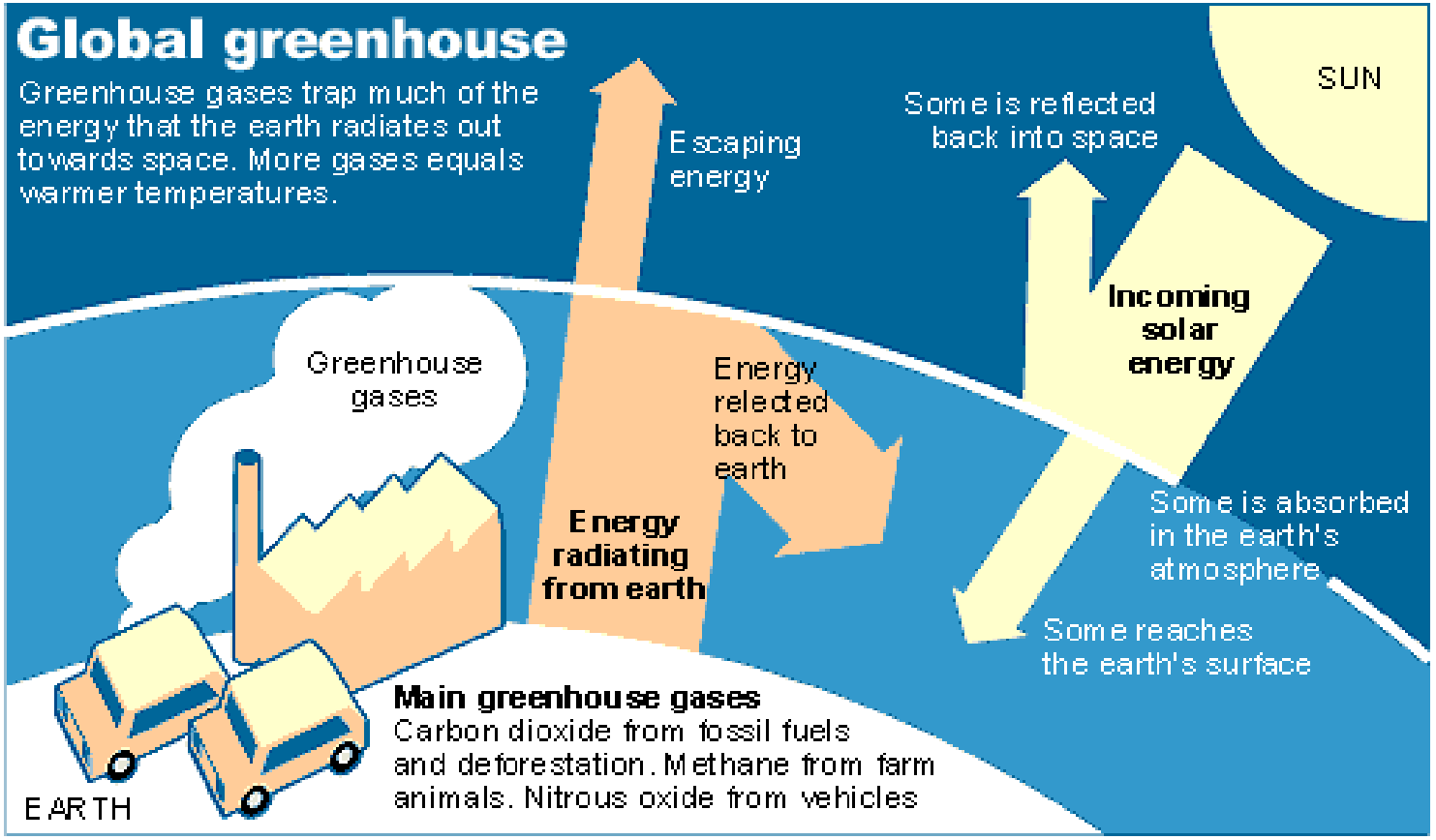
I. Science of Climate Change

- 1500 scientists
- GHG's: CO2,CH4, N20, CFC's, HCFC's
- Nett carbon + 6GT/yr
- Complexities (feedbacks, forcings, sensitivities, lifetimes)
- Heat is trapped
- Oceans/land warms up

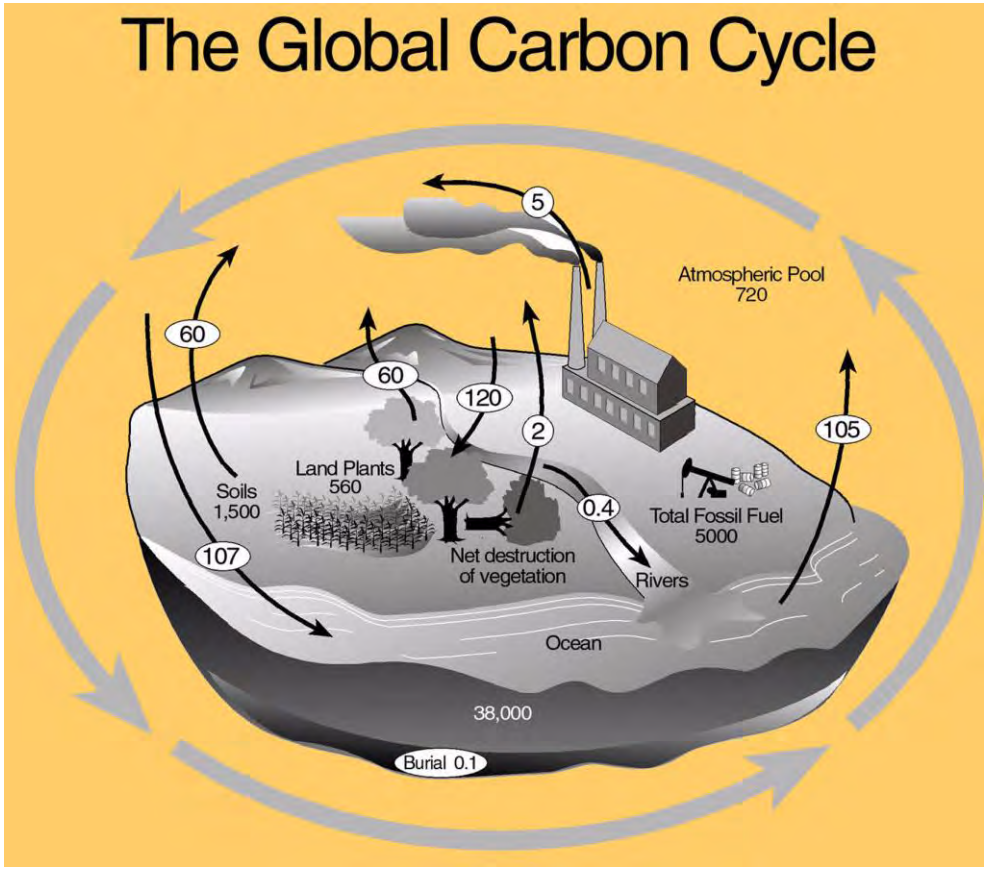
5-stage Process

- **Emissions** of GHG's
- Create a **Concentration** in Atmosphere
- That **forces** radiation to be retained
- Causing **Heating** of the Air
- Which in turn brings **Climate Changes** to all parts of the ecosystem (wind, rain, fires, oceans, ice-caps)

Global Greenhouse Effect

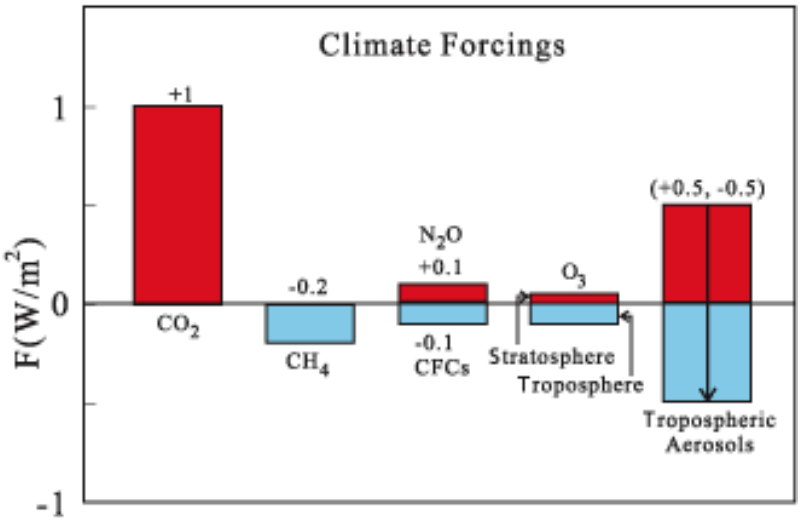


Global Carbon Cycle



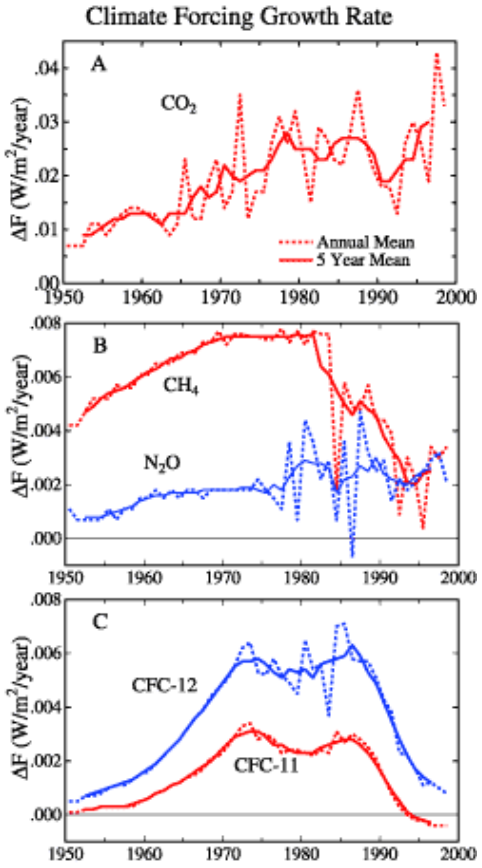
Climate Forcing

- Not all GHG's have the same forcing properties
- Overall CO2 is the worst gas
- Creating a nett heating effect of 1W/m2
- Must target CO2



GHG growth rates

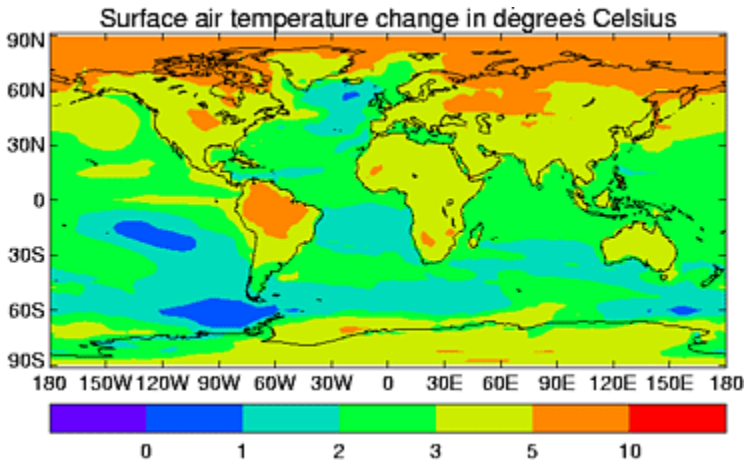
- GHG's are growing at different rates due to their varied sources
- CO2 is growing the fastest
- 380ppm (now)
- 275 ppm (pre-industrial)
- 450ppm (future)



Global Carbon Budget (GT-C)

Carbon Stocks

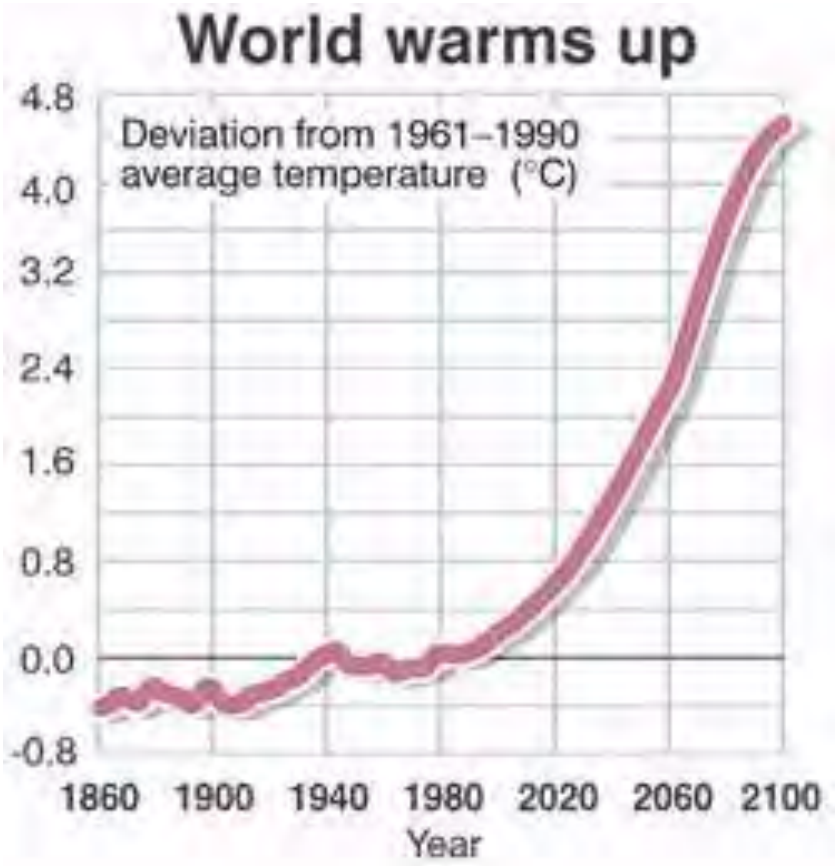
- Sediments (66,000)
- Deep Ocean (38,000)
- Soils (1,500)
- Ocean-surface (1,000)
- Vegetation (600)
- Atmosphere (600)
- Fossil combustion (6)



Other GHG sources

- CO2: transport and energy (oil,coal,gas)
- CH4: rice paddies, cows and plants/trees
- N2O: nylon production and power plants
- CFC/HCFC: fridges

II.Evidence of Climate Change



Top-5 Hottest Years

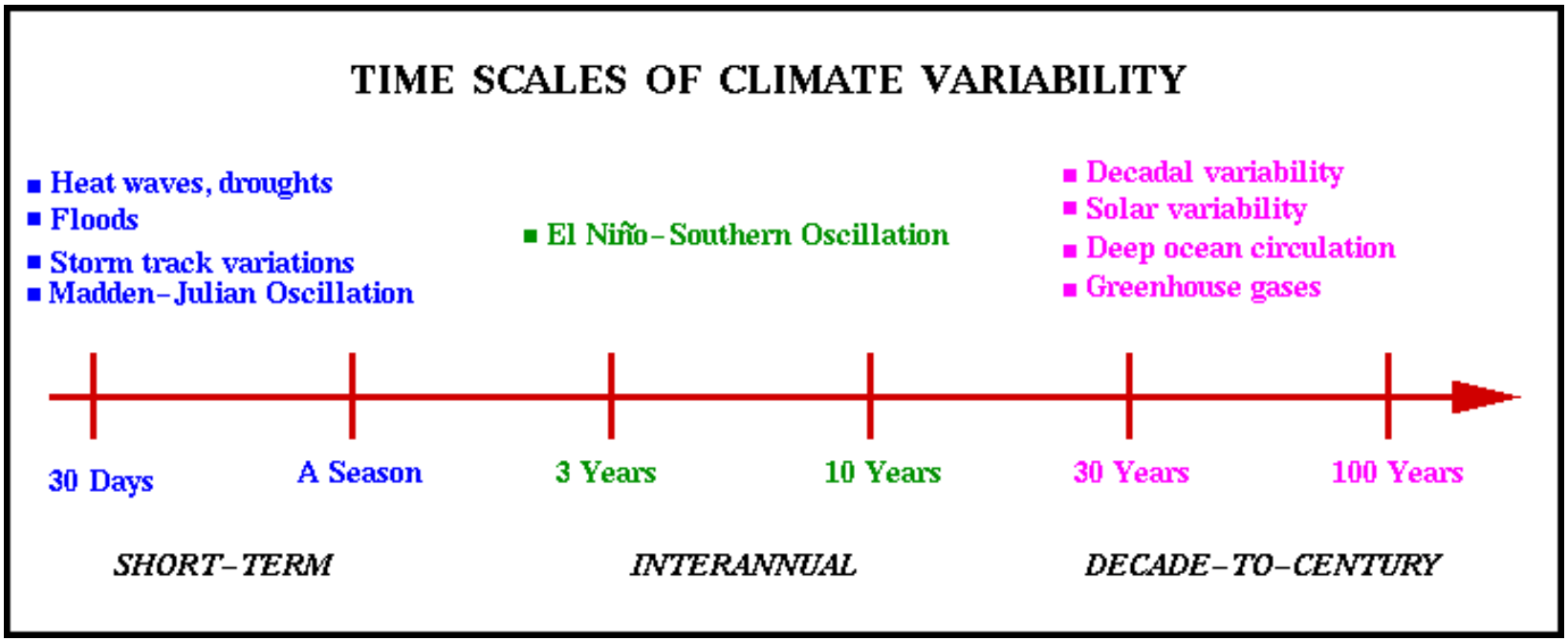
Top 5 Hottest Years

- 2005
- 1998**
- 2002
- 2003
- 2004

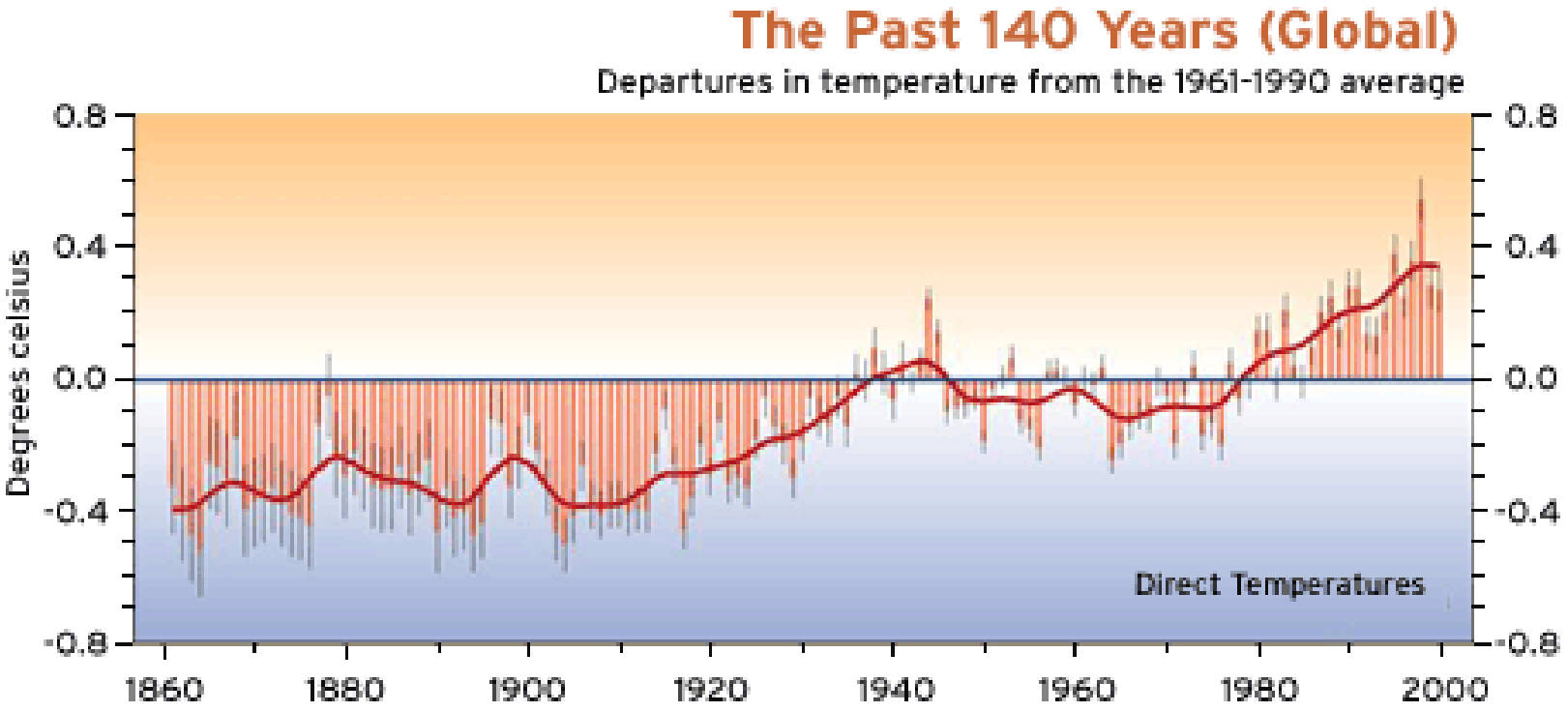
** El-Nino year causing additional heating

- Linkage to increased CO2 concentrations
- Residual heat/energy in oceans driving the atmospheric warming
- Ocean memory is decadal/centennial
- Atmosphere- 7 day memory!!

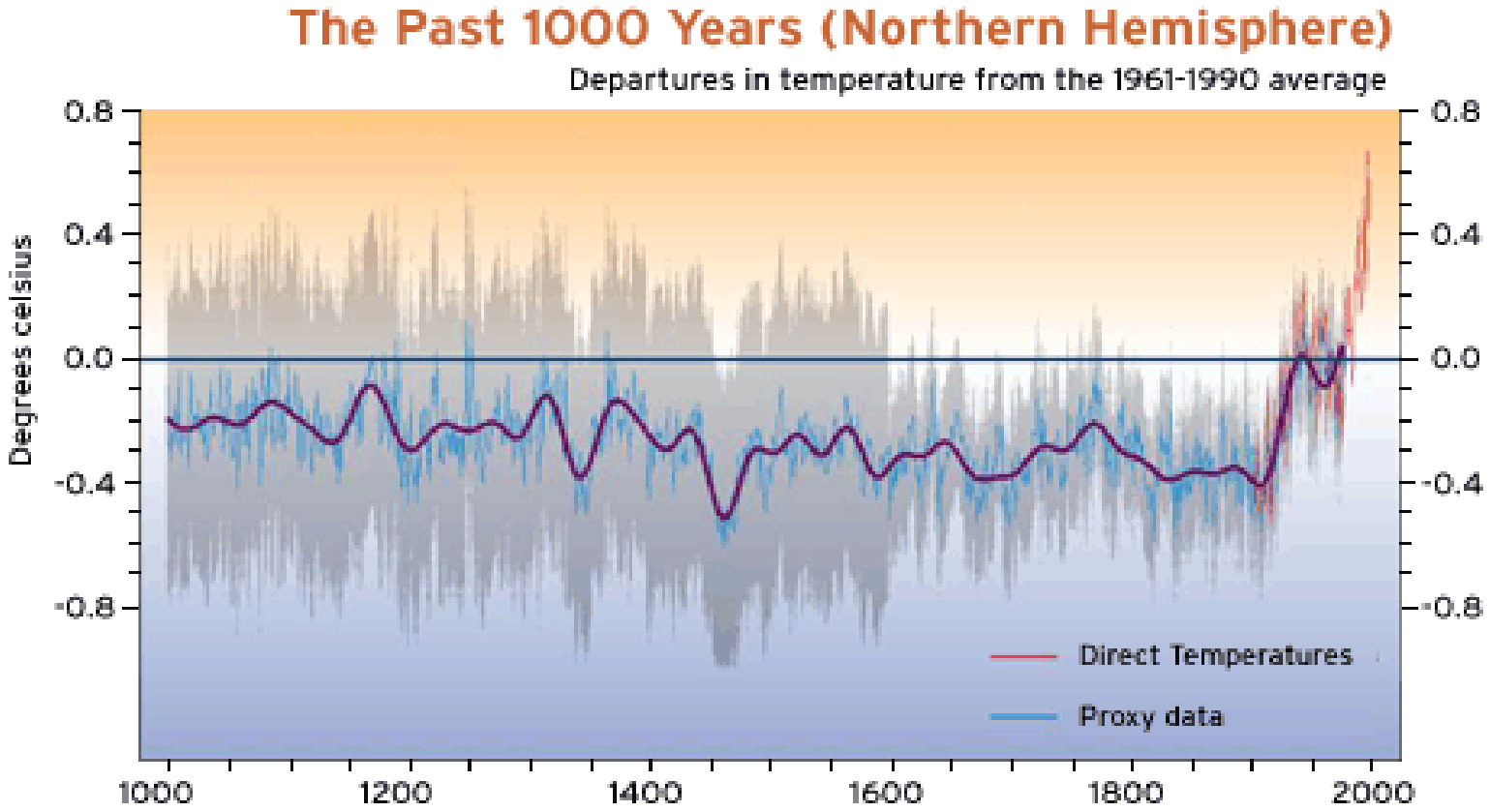
Climate vs. Weather



Temperatures from the PAST



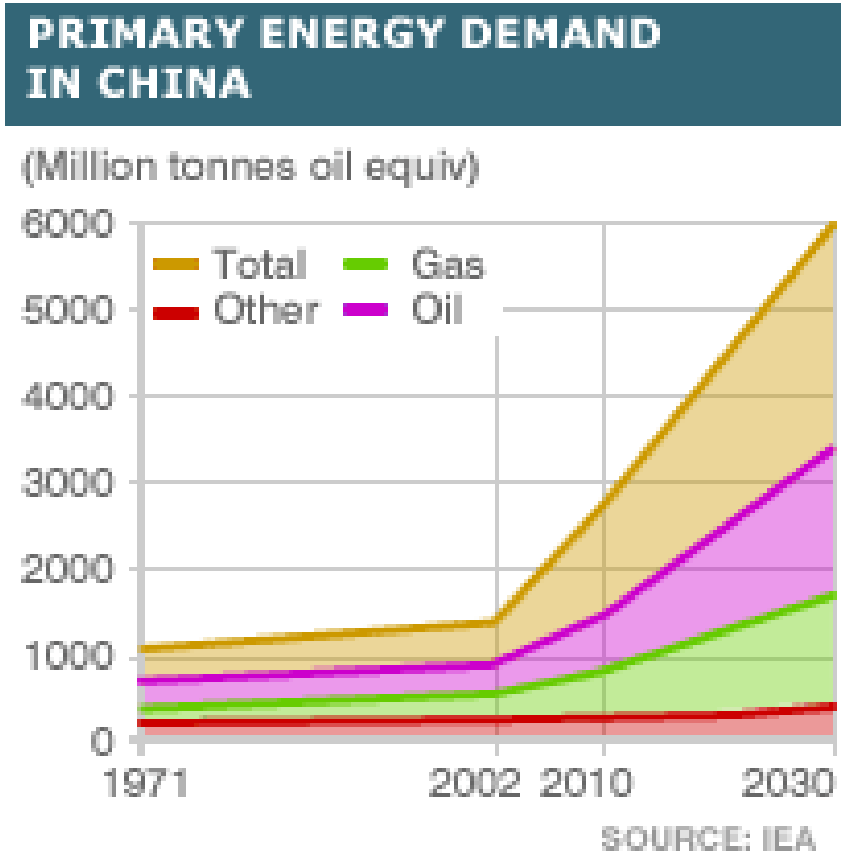
Further in the Past



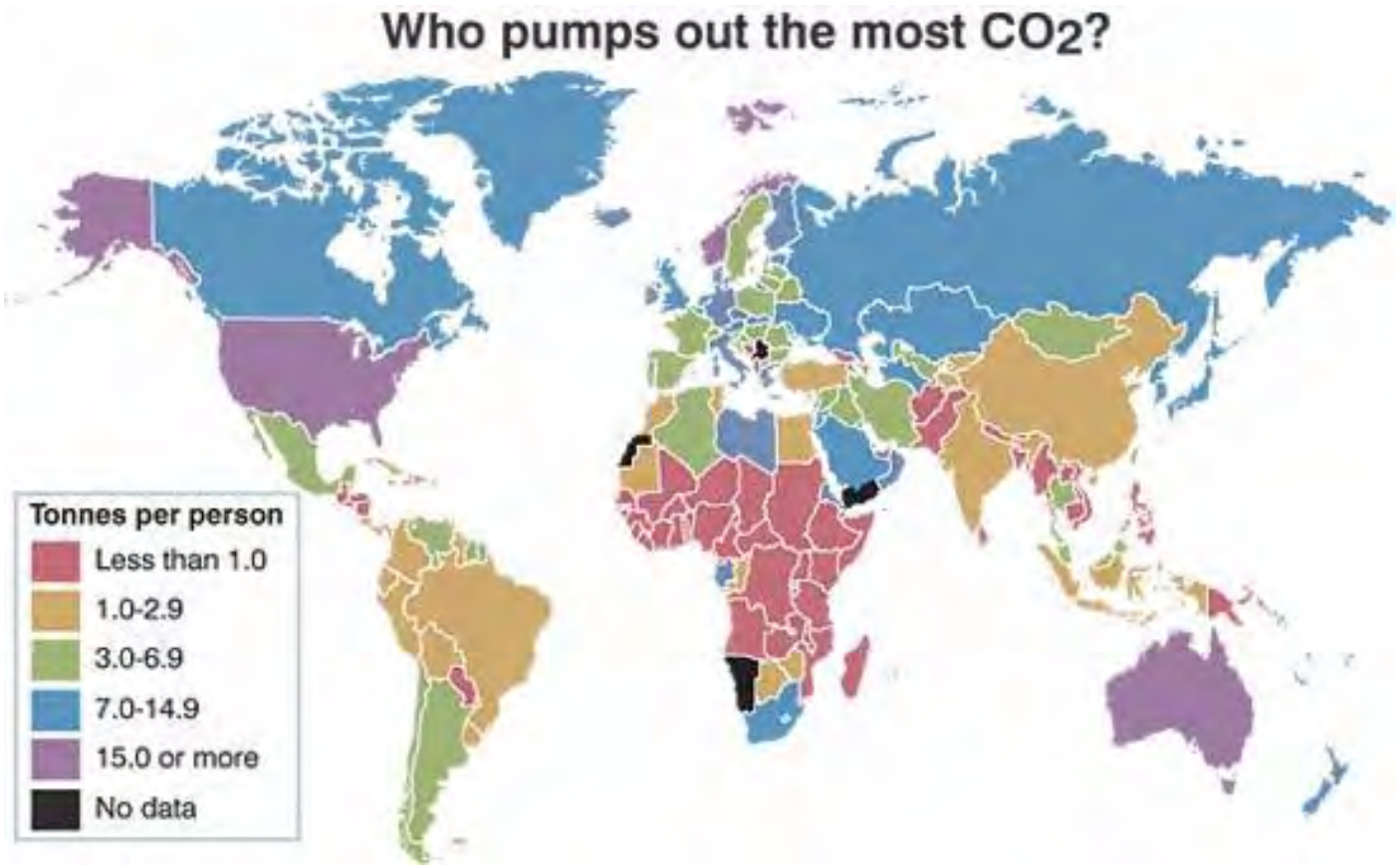
Fossil Fuel

- Oil, Coal and Gas
- Pre-industrial (280ppm)
- Present day (380ppm)
- Post-industrial (450ppm)
- Last time these CO2 levels existed - dinosaurs roamed!

China EnergyDemand - Typical



Who is to blame?



Oil in World

- 2 trillion barrels
- 1 trillion barrels gone
- 1 trillion barrels left
- 75 mbd (present)
- 110 mbd (2020)
- If all burnt, atmosphere will be wrecked (550ppm+)

Global Oil - Supply and Demand

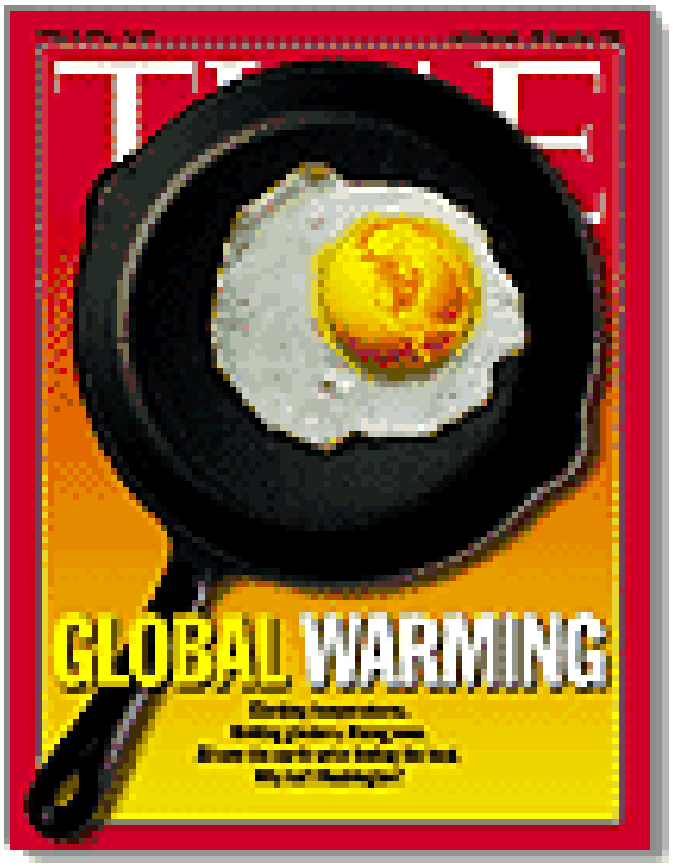
GOT OIL		USE OIL	
• SAUDI ARABIA	26%	• U.S.	25%
• IRAQ	10%	• JAPAN	8%
• KUWAIT	10%	• CHINA	5%
• ABU DHABI	9%	• RUSSIA	4%
• IRAN	9%	• GERMANY	4%
• VENEZUELA	6%	• S. KOREA	3%
• RUSSIA	5%	• ITALY	3%
• MEXICO	5%	• FRANCE	3%
• U.S.	3%	• ENGLAND	3%

Big Oil Profits

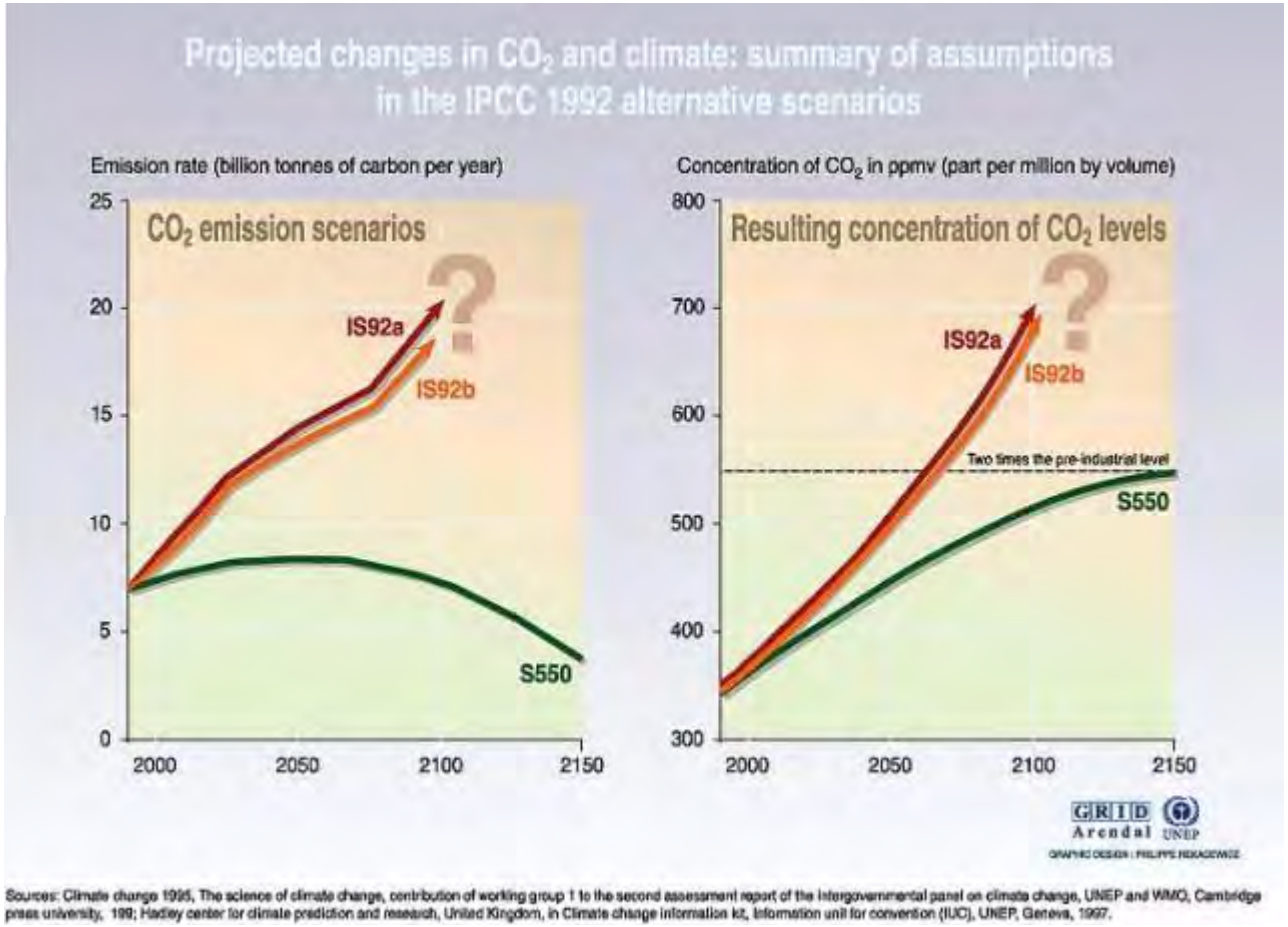
- Exxon: $36bn (2005) and $25bn [2004]
- Shell: $23bn (2005) and $17.6bn [2004]
- BP: $21.7bn (2005) and $16.4bn [2004]
- What price for the damage to the planet?

Dangerous CO2 level?

- Present warming has been +0.7C
- Committed warming is +0.6C
- Future warming is +0.7C
- Total Warming is at least +2.0C



Dangerous CO2 Path



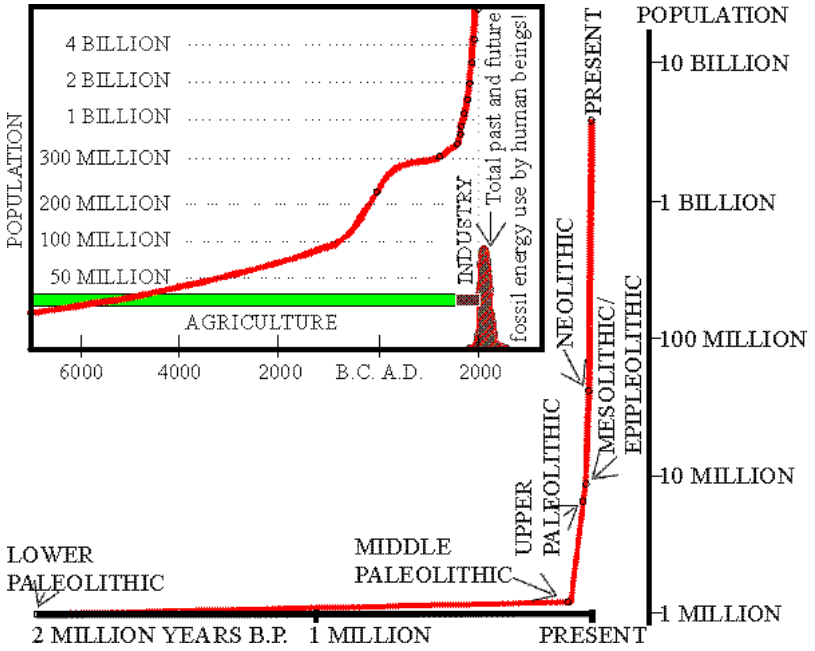
Sources: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 199; Hadley center for climate prediction and research, United Kingdom, in Climate change information kit, Information unit for convention (IUC), UNEP, Geneva, 1997.

IPCC

- IPCC calculated that in order to stabilise ghg concentrations at a safe level, need to:-
- reduce emissions of ghg's by 60% by 2100 based on a 1990 baseline!

Have we got enough time?

- Present rate of GHG emissions is unsustainable
- End of Fossil Age
- What happens next?
- Sustainable Path
- Renewables
- Nuclear



What does 1-2C temp rise mean?

Temp rises and sensitivities for ecosystems/species

- 1C: specific risks increase significantly
- 1-2C: risks across board increase significantly
- 2C: risks increase very substantially

- tripling poor harvests in Europe/Russia
- mass-migration from N.Africa
- 2.8bn people-water shortage
- summer arctic-ice totally melted
- malaria in USA

Point of No Return ?

Timeline of events

2005: Kyoto in force

2012: Kyoto runs out

2030: Oil begins-run out

2035: Renewables ready

2040: +2C warmer !!

2070: Amazon is dead!!!

2100: + 3C warmer??

"By 2030 it will be possible to sail to the North Pole by boat, as the greatest warming on the planet is occurring at the Poles"

James Lovelock, GAIA

Dr James Hansen-NASA

- *"Significant emissions cuts could be achieved with existing technology and that without leadership by the US, climate change would eventually leave the Earth a different planet"*

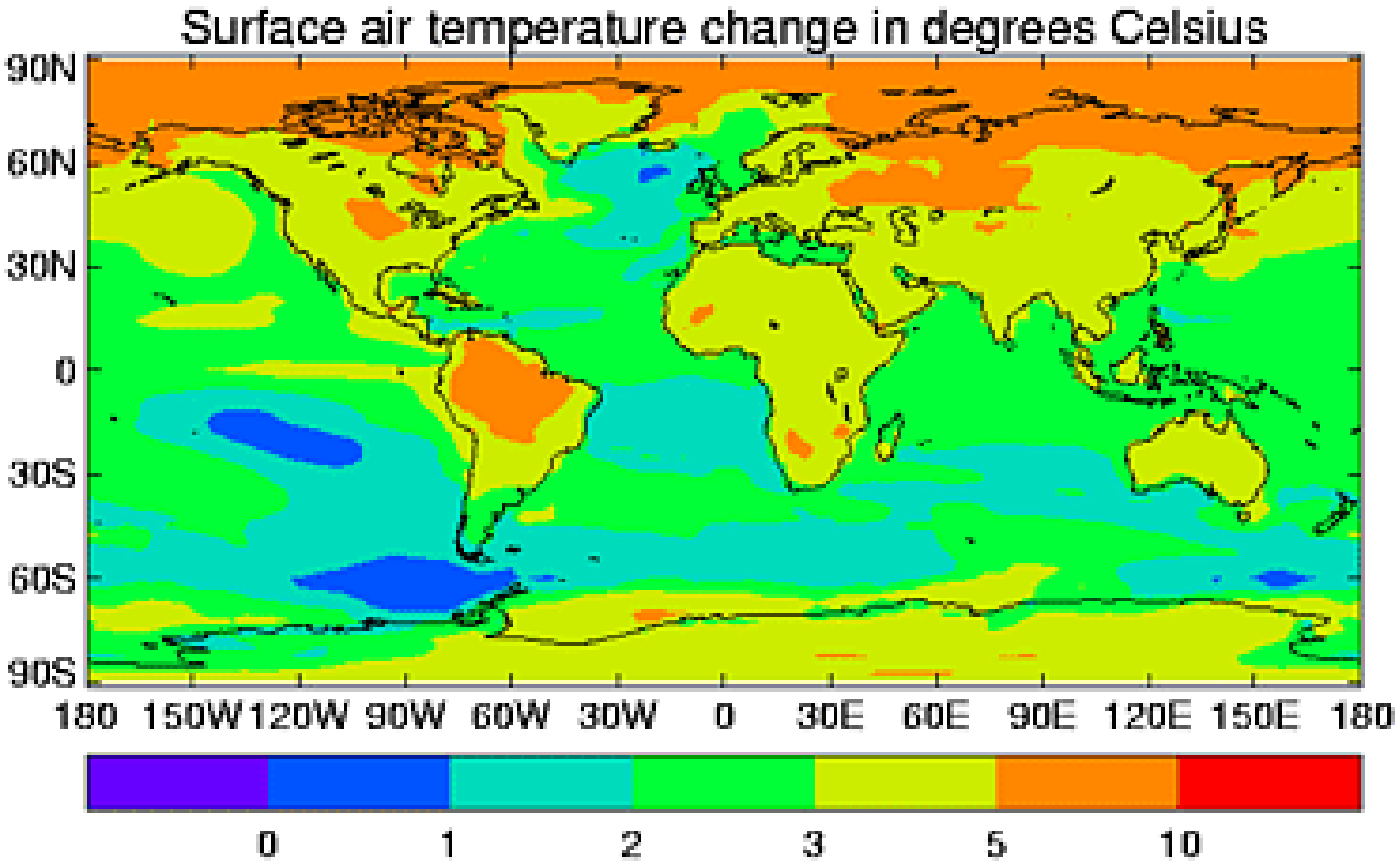
President Bill Clinton

- *"Climate change is the world's biggest problem"*
- *"We need a serious global effort to develop a clean energy future to avoid the onset of another ice-age"*

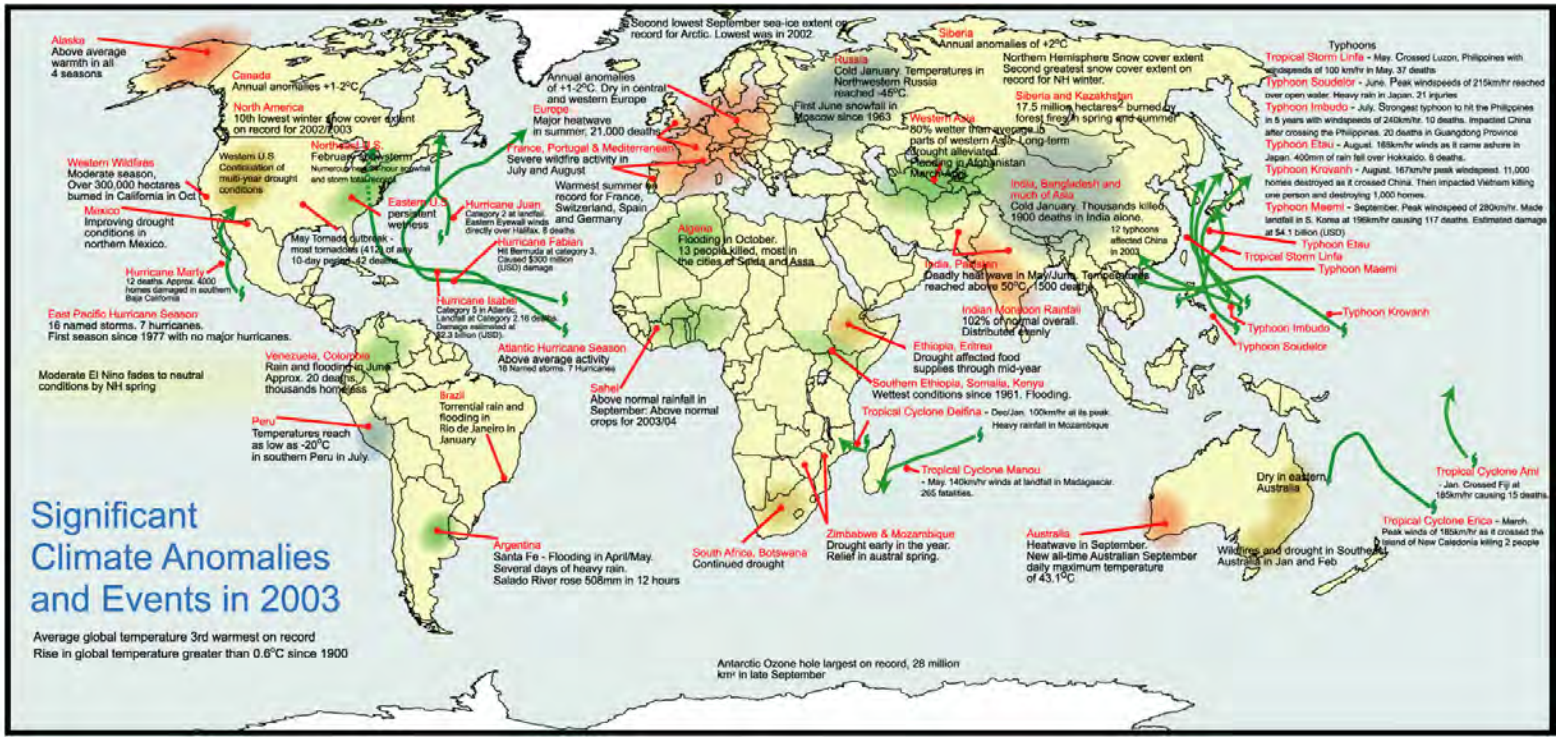
Prime Minister Blair

- *"The threat posed by climate change may be greater than we thought"*
- *Global warming is advancing at a rate that is unsustainable"*

Warmer World



Global Effects!!

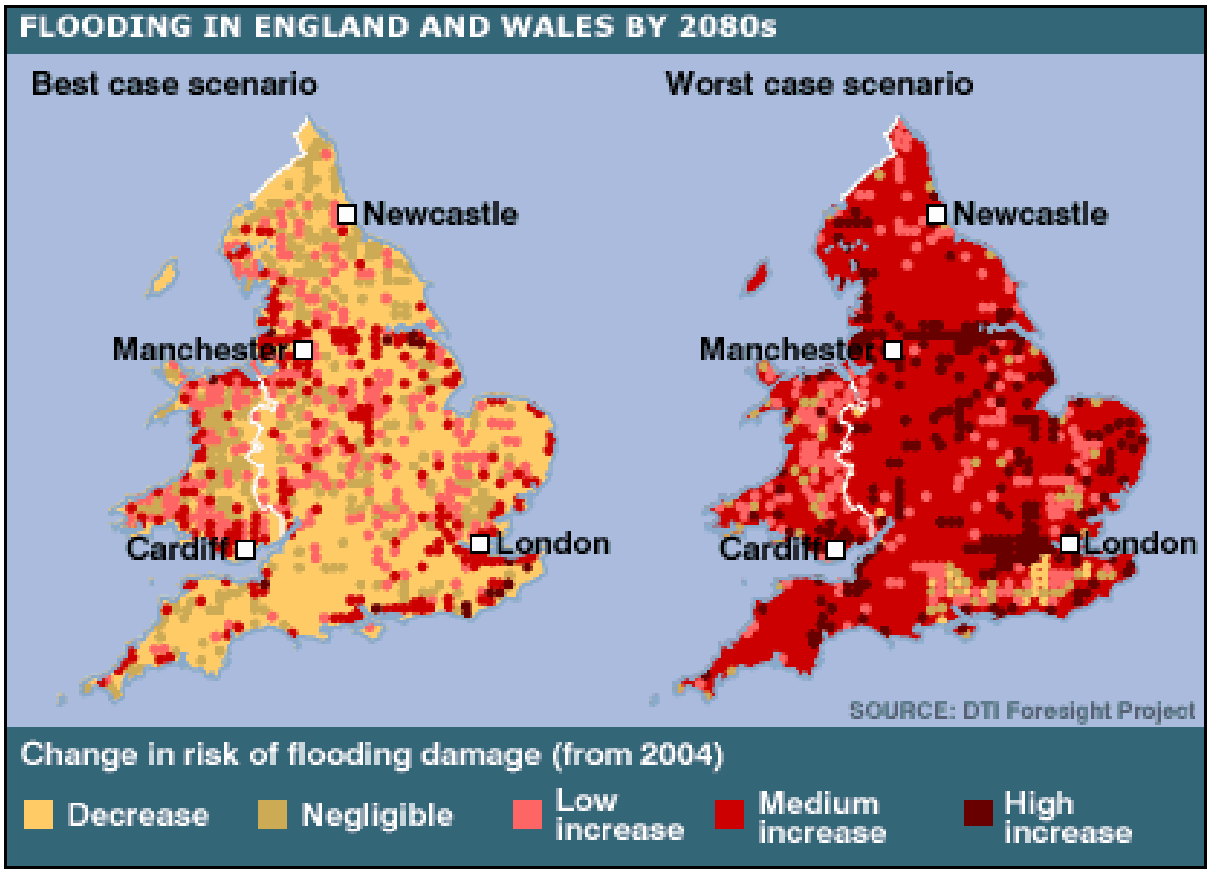


Effects of Global Warming

Increased:-

- rainfall/flooding
- storms/hurricanes
- drought/fire/heatwaves
- meting ice-caps/glaciers
- diseases
- poverty/famine

Flooding


FLOODING IN ENGLAND AND WALES BY 2080s
Best case scenario
Worst case scenario
Newcastle
Manchester
Cardiff
London
Newcastle
Manchester
Cardiff
London
SOURCE: DTI Foresight Project
Change in risk of flooding damage (from 2004)
Decrease
Negligible
Low increase
Medium increase
High increase

Floods

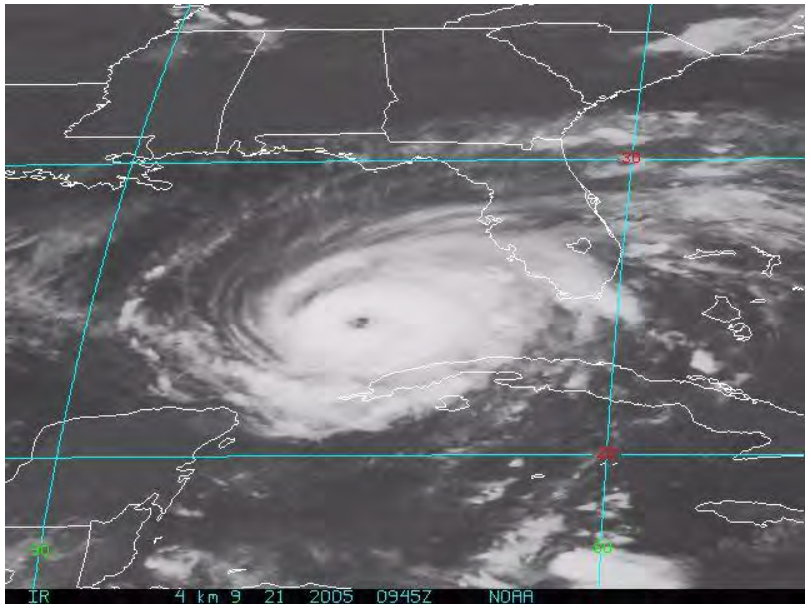
- Germany 1995
- Czech Rep 1995
- UK 2000
- Swiss Alps 2003
- N.France 2004
- UK 2004 (Boscastle, Carlisle)
- New Orleans 2005

Storms

- Increased CO2 in the atmosphere
- Traps more heat
- Allows for more water to be retained in air
- When released creates a large storm effect
- Stronger winds/waves

Hurricanes

- 2005 - most active season since 1851
- 13 Atlantic hurricanes
- 3 Cat-5's in 2 months!
- 1,300 dead
- $100bn storms (Katrina)
- More to come (next 10 yrs)



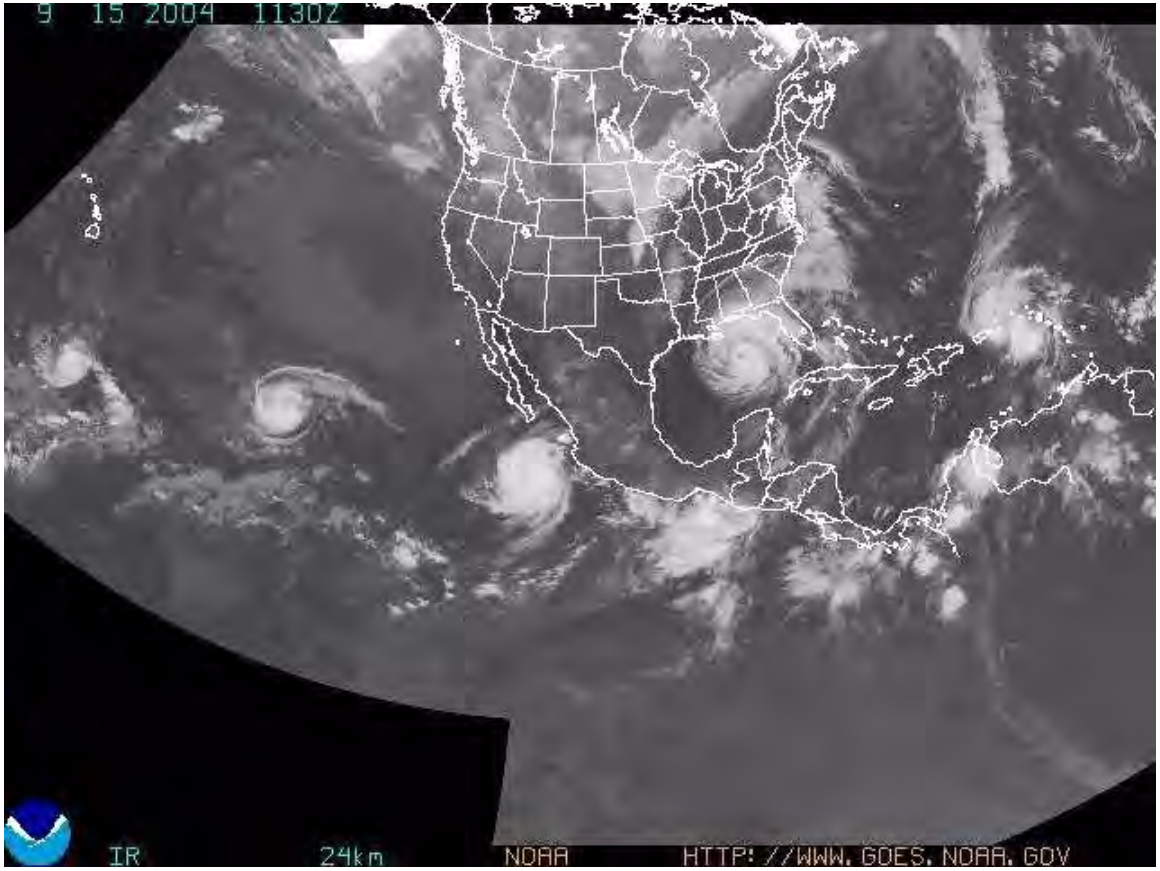
Katrina

- Katrina was a Cat-5 heading for major metropolis
- $100bn damages
- Oil infrastructure wrecked 2-3 years (400 rigs)
- Psychological blow to mighty USA

Al Gore

- *"Katrina is the first sip, the first taste, of a bitter cup that will be proffered to us over and over again"*
- *"It is up to us to tackle climate change and that does involve the government"*

One after another!



Storm Cycles

- Every 20,30,40 yrs
- 10 year period - very active
- Since 1995 oceans +2-3C warmer than normal
- 87 million at risk on Gulf and Atlantic coasts

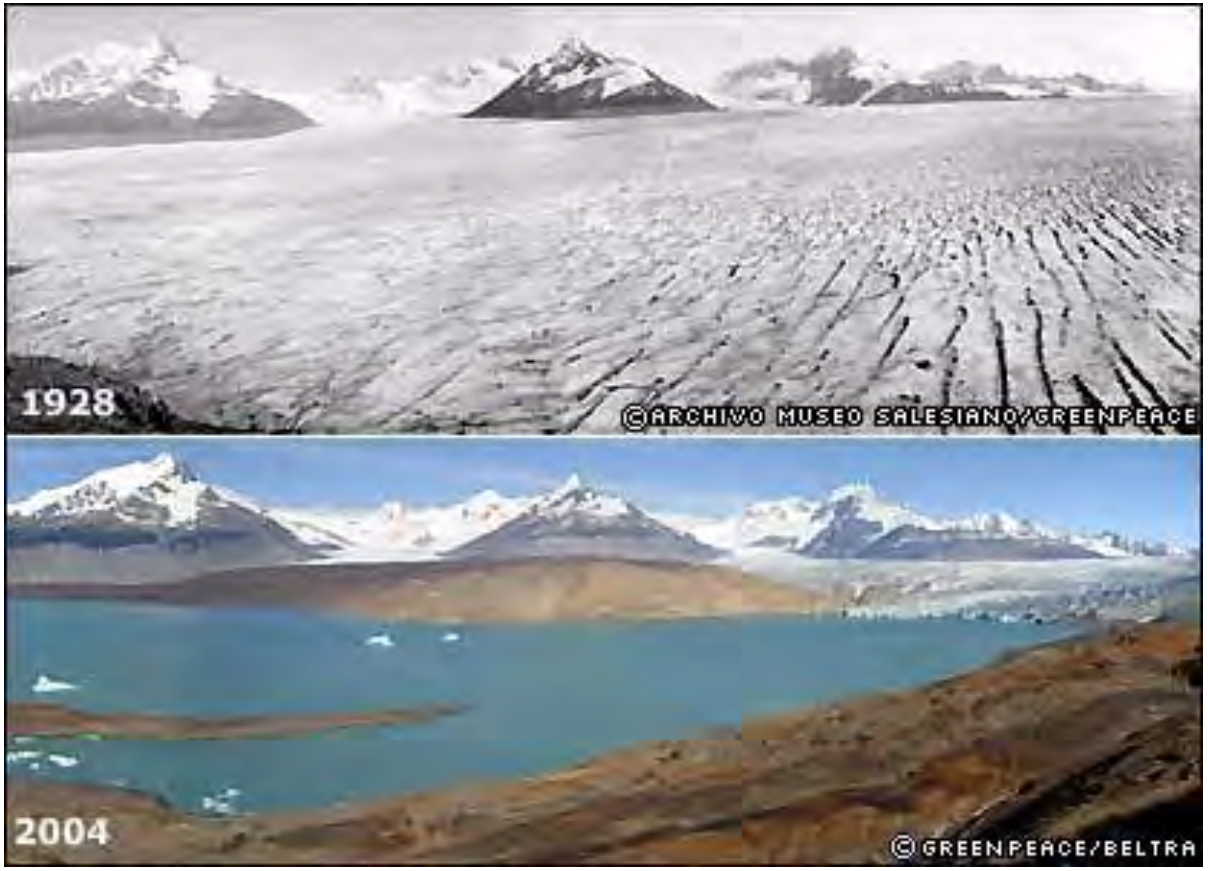
Coastal Erosion/ Seas Rising

Sea level rise

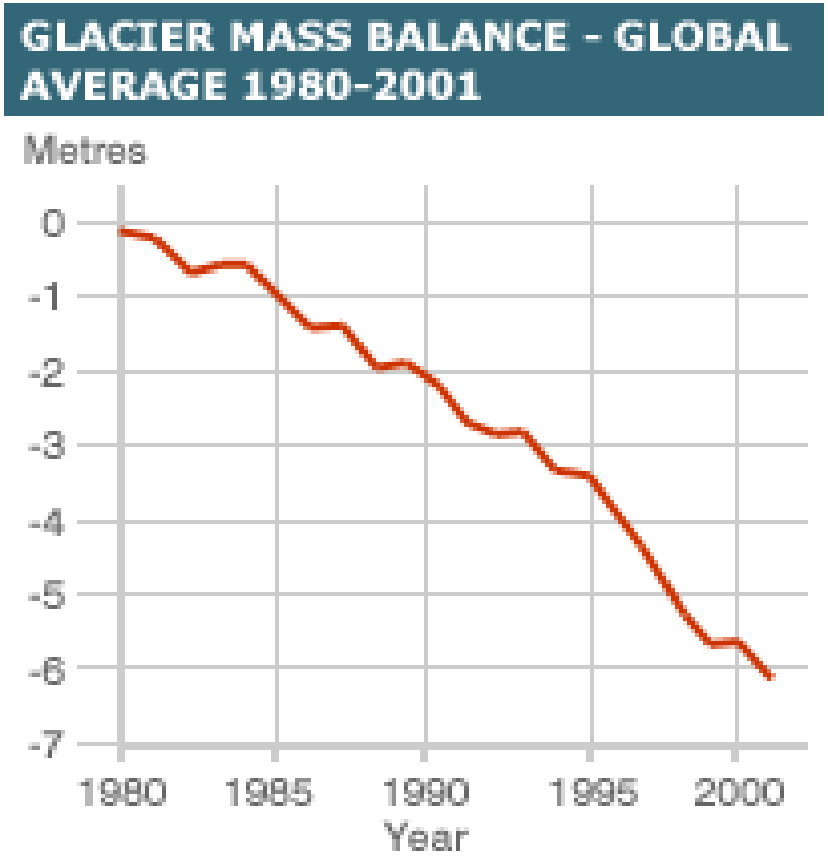
- Seas are predicted to rise by 10-40cm by 2100 (minimum)
- Two-thirds of population live on or near coastline
- Major cities and nuclear power stations at risk

Hurricanes destroy coasts

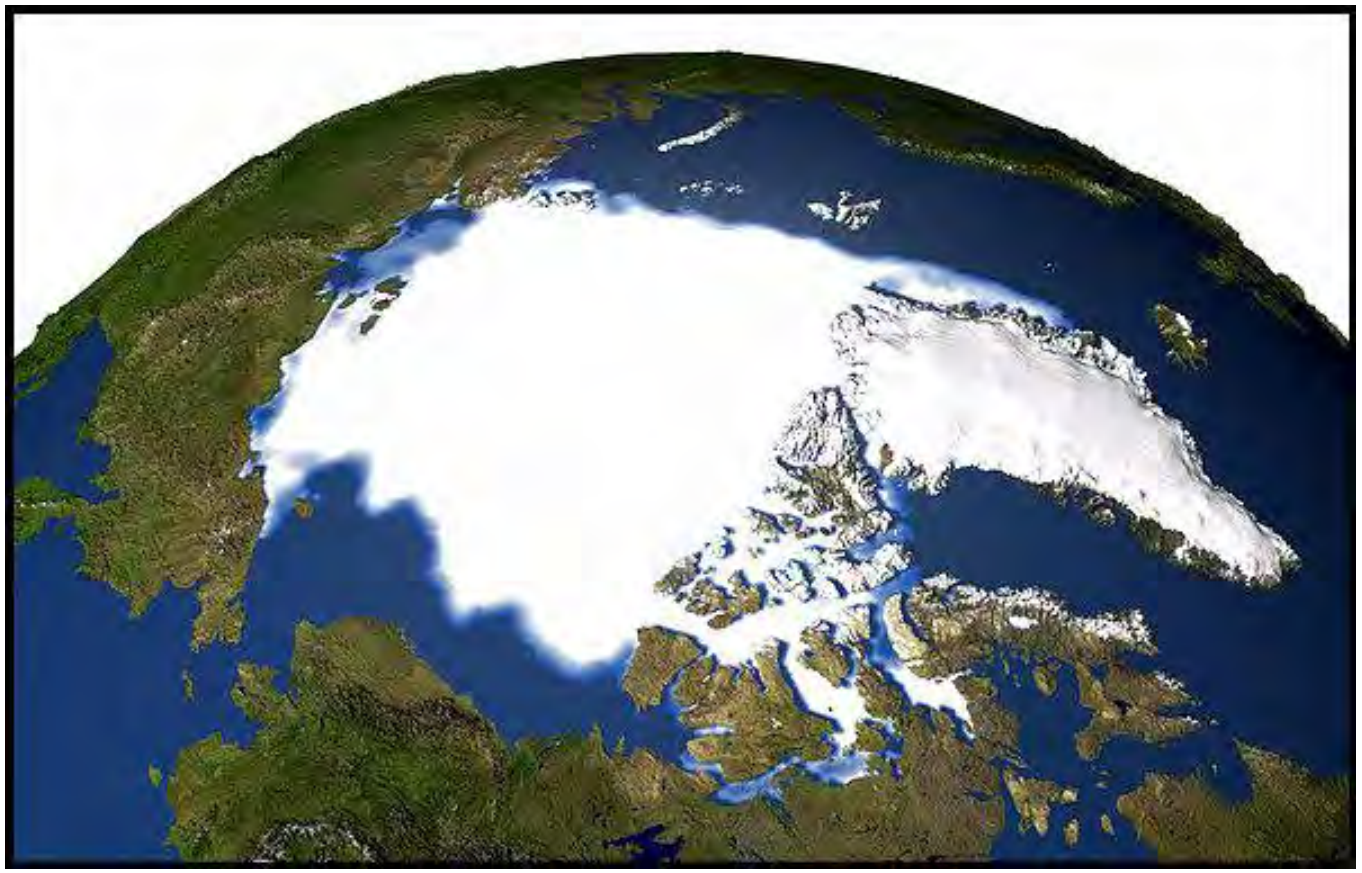
Glaciers melting



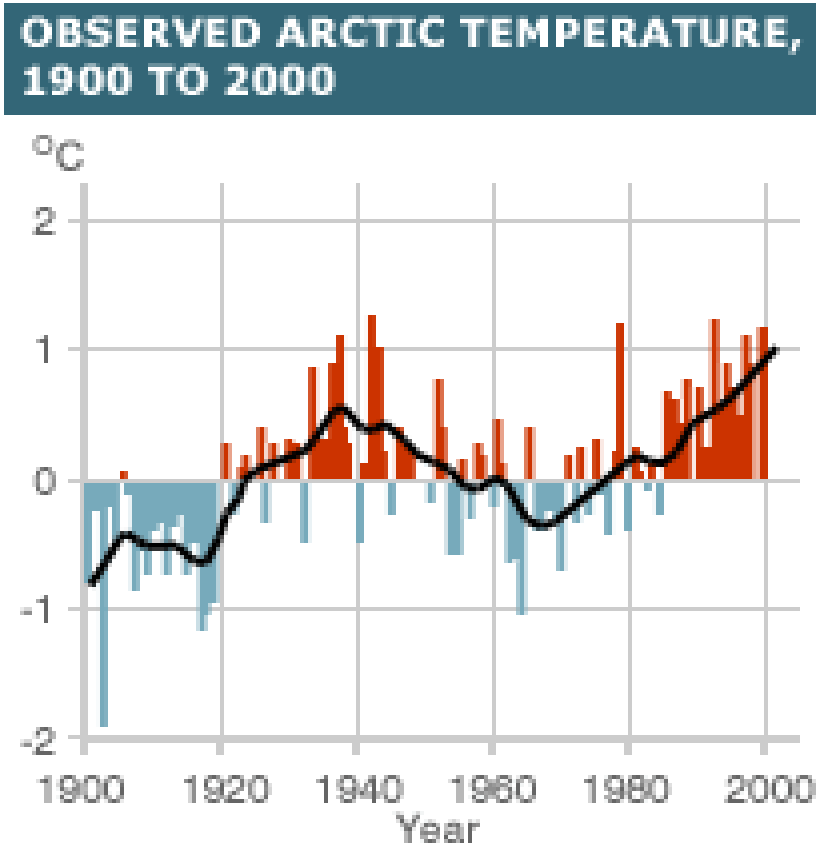
Glaciers - declining



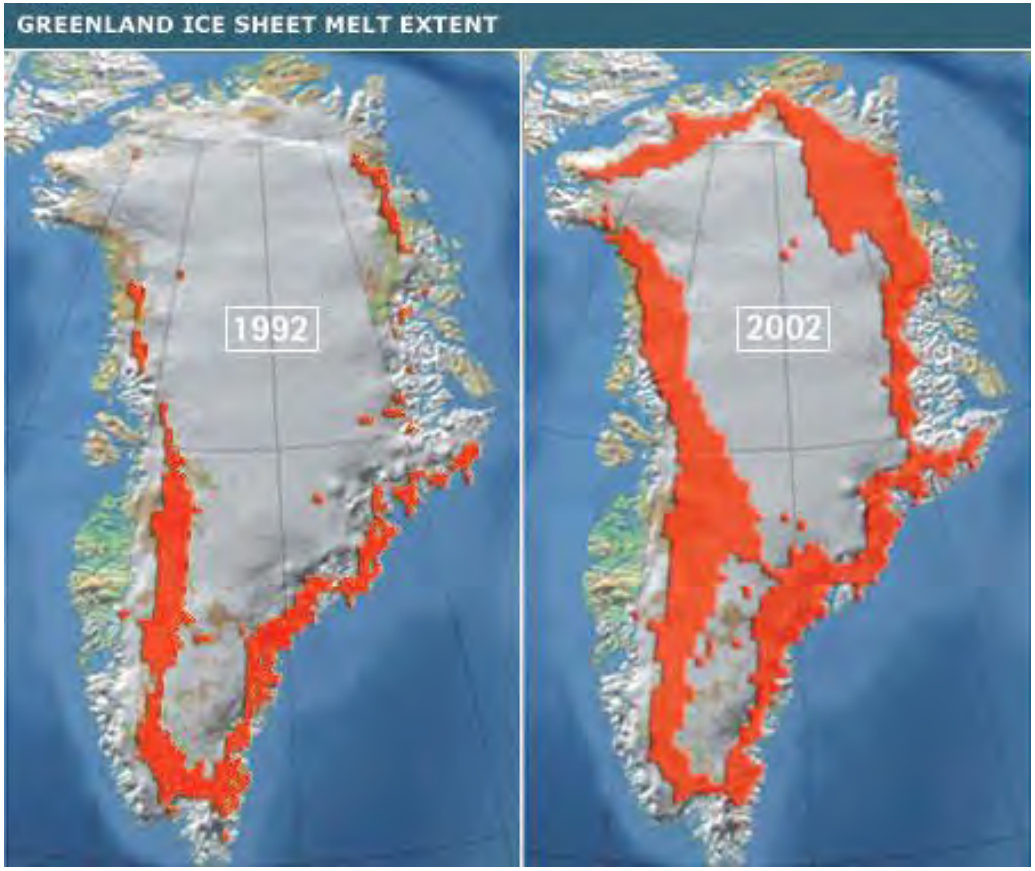
Ice caps melting



The Arctic is Warming



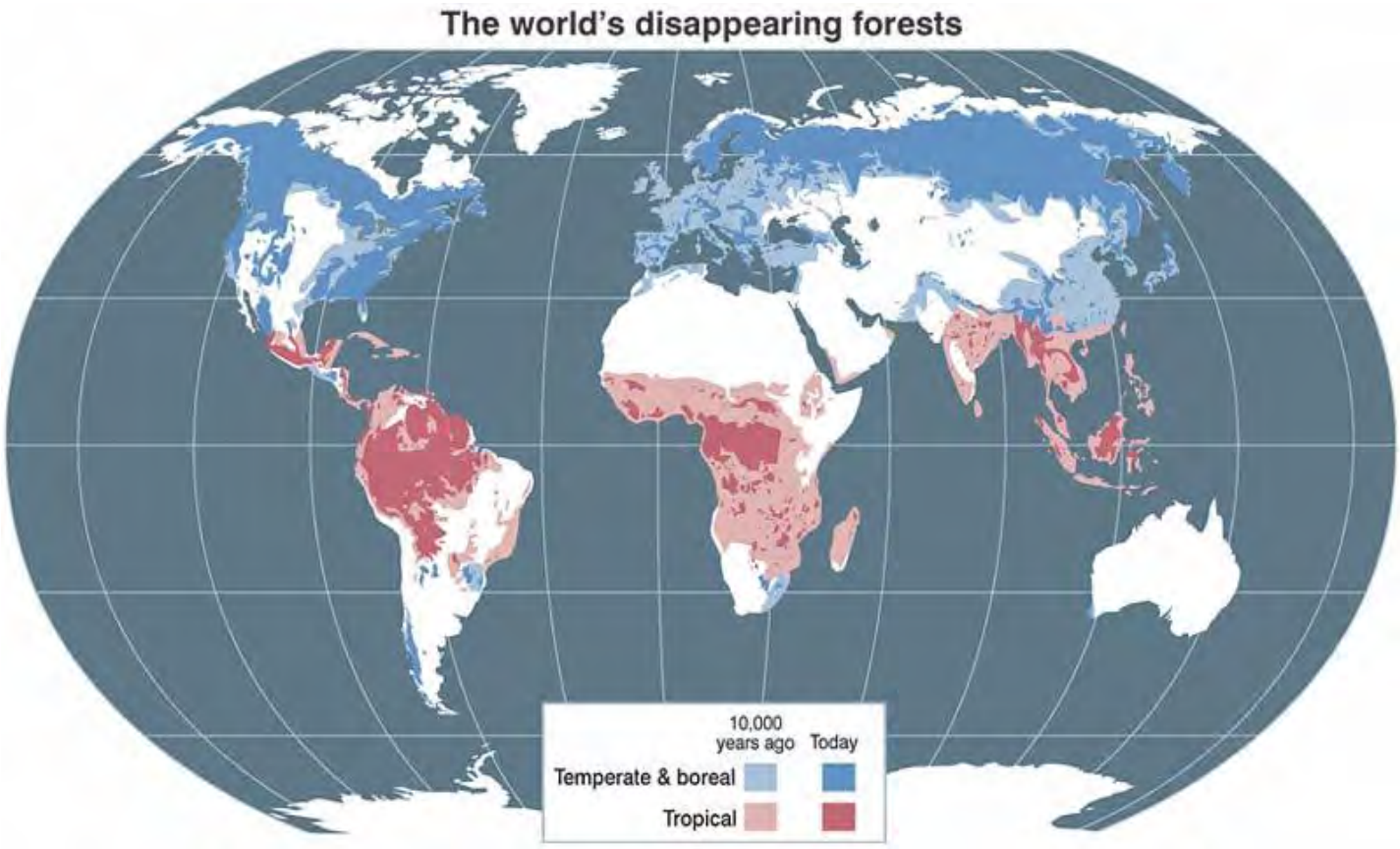
Greenland Ice melting



Greenland Ice sheet

- 10% of world's water
- 2 miles thick ice
- Stable for 800,000 yrs
- If melted would raise global sea-levels by 7m (average)
- If triggered would take 1,000 years
- Process would be unstoppable
- Effect global ocean currents and weather patterns
- 450ppm -dangerous
- 560ppm- critical threshold

Deforestation



Deforestation

- Forests cover 30% land
- Brazil, Congo, Indonesia (rainforests)
- Russia, USA, Canada, China (boreal forests)
- Size of Wales lost /yr!
- Total carbon in forests is equivalent 283Gt-C

Rainforests

- Deforestation releases 25% of all GHG's
- Rainforests are the main source of oxygen
- Most species (30 million+) live in rainforests
- Amazon will die by 2070 if nothing done

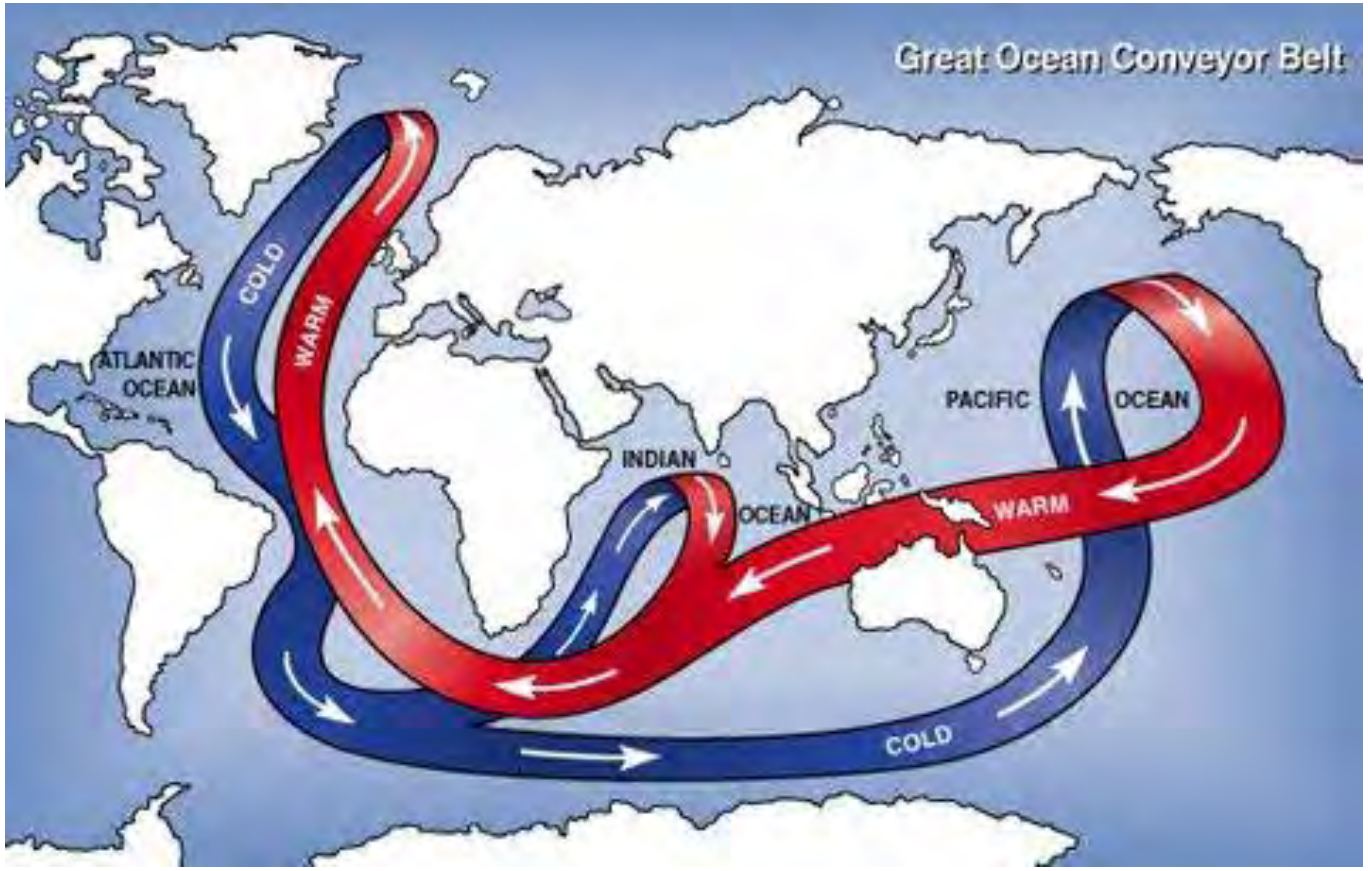
Sinks and Sources

- Vegetation stores carbon in cellulose
- If conditions change (too hot and dry) - forests revert from carbon sinks to carbon sources
- Increased warming is causing bio-feedback

Millions at risk (2080)

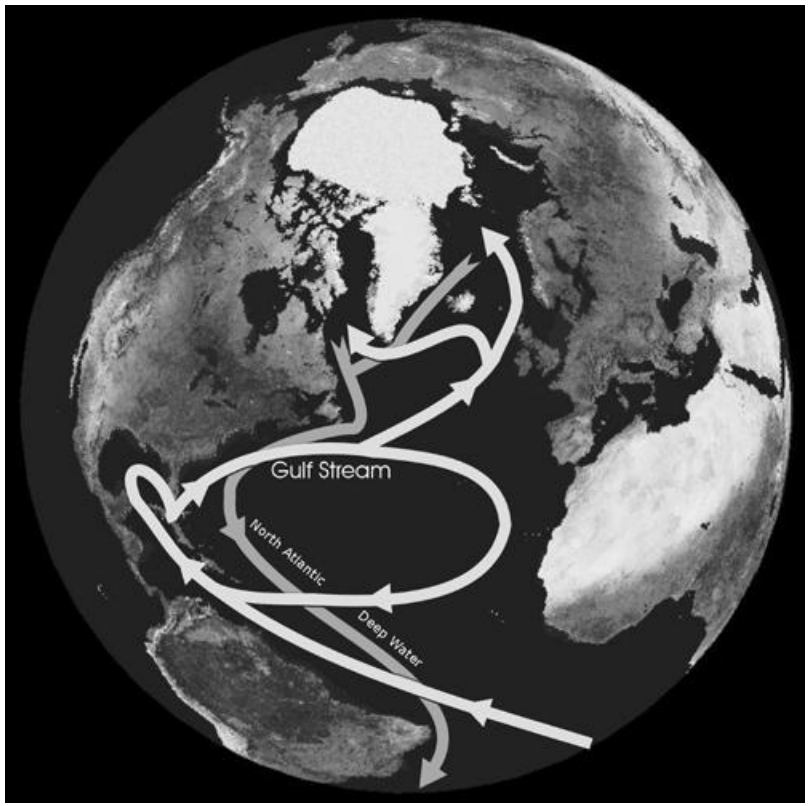
- Water shortage: 1bn - 3.5bn at risk
- Malaria: 2-3bn at risk
- Hunger: 500 million+ at risk
- Coastal flooding: 200million-1 billion at risk

Atlantic Conveyor



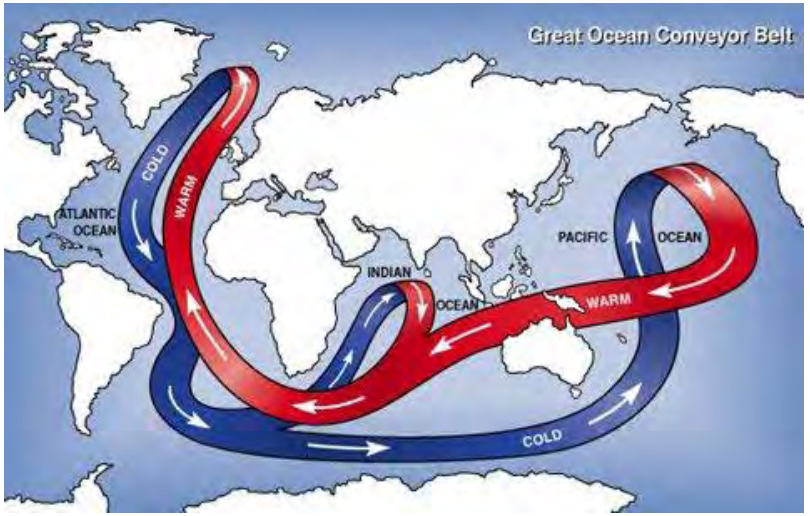
Gulf Stream reduced

- Ice-melt in the Arctic
- Dilution of thermohaline gradient in Atlantic
- 30% of gulf stream has been deflected to W.Africa
- Cooling in Europe ?
- Hurricanes in USA ?



Ocean's are changing

- Seas are warming and acidifying
- Ocean currents are changing
- Fish stocks are moving
- Heat balance of planet is changing
- Last time it took 140,000 yrs to reverse

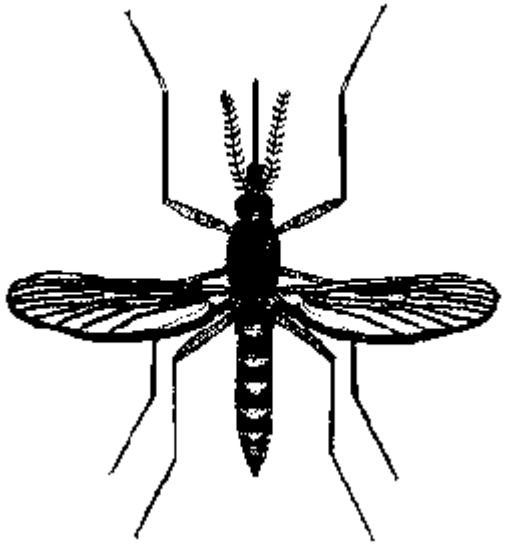


Heatwaves/Fires

- Heatwaves will become more common
- 1 in 50 summer becomes 1 in 3 by 2050
- France (2003)-15,000 died
- Net feedback of carbon to atmosphere

Diseases

- Malaria (2400 million)
- West Nile virus (??)
- Dengue fever (2500million)
- Yellow fever (450million)
- SARS /Avian Flu (150 million)



III. Politics of Climate Change

- IPCC set up in 1990
- UNFCCC set up in 1992
- Kyoto agreed in 1997
- Kyoto ratified in 2005
- Kyoto runs out in 2012
- What happens next?
- Have we got another 20 years to waste?

UNFCCC and Kyoto

UNFCCC

- 184 signatories
- Agreed to “stabilise” global concentrations at a “safe” level
- No enforcement
- Voluntary measures
- USA signed up

Kyoto

- 157 Parties
- Commitment to reduce emissions by 5% by 2012 based on 1990 baseline
- No enforcement
- USA not signed up

UNFCCC- Structure

UNFCCC

- Secretariat
- COP
- SBSTA
- SBI
- GEF
- IPCC

Kyoto

- MOP
- CDM (clean develop mechanism)
- JI (joint-implementation)
- ET (emissions trading)
- SCCF (special climate change fund)
- LDCF (least developed)
- AF (adaptation)
- SOGE (Seminar of Govt experts)

North vs South

North(Annex-1)

- EU (15/25)
- CG-11 (Central Group)
- EIG (Env.Integrity)
- JUSCANNZ
- WEOG (W.EU)
- OBG (Balkans)
- Australia/USA

South (G77+China)

- NIC's (newly industrialised)
- RIDC's (rapidly industrialising developing)
- ODC's (other developing)
- LDC's (least developing)

North vs South (2)

North

- Developed
- Industrialised
- Sources (fossil fuel)
- Voluntary GHG reductions
- Luxury emssions
- Over-Polluters

South

- Developing
- Industrialising
- Sinks (forests etc)
- Mandatory GHG reductions for Annex1
- Survival emissions
- Under-Polluters

UK Emissions

UK

GHG's

- 1990-2004: all ghg's reduced by -14.6%
- "Dash for Gas"

CO2

- 1990-2004: -5.6%
- 2003-2004: +0.5%

- Main sectors of concern are energy and transport
- Ironically hot weather can lead to an increase in emissions from soils and cities
- Car and plane are the big culprits

EU-ghg emissions

MEMBER STATE	Change 1999–2000 (%)	Change 1990–2000 (%)	Targets 2008–12 under Kyoto Protocol and EU "burden sharing" (%)	Distance-to-target indicator (DTI) (index points)	Evaluation of progress in 2000
Austria	0,0 %	2,7 %	-13,0 %	9,2	☹
Belgium	0,5 %	6,3 %	-7,5 %	10,0	☹
Denmark	-6,0 %	-1,7 % (-9,8 %)	-21,0 %	8,8 (0,7)	☹ (☹)
Finland	-2,9 %	-4,1 %	0,0 %	-4,1	☺
France	-1,1 %	-1,7 %	0,0 %	-1,7	☺
Germany	-0,2 %	-19,1 %	-21,0 %	-8,6	☺
Greece	4,8 %	21,2 %	25,0 %	8,7	☹
Ireland	1,5 %	24,0 %	13,0 %	17,5	☹
Italy	0,7 %	3,9 %	-6,5 %	7,2	☹
Luxembourg	-0,6 %	-45,1 %	-28,0 %	-31,1	☺
Netherlands	-0,4 %	2,6 %	-6,0 %	5,6	☹
Portugal	-1,1 %	30,1 %	27,0 %	16,6	☹
Spain	4,1 %	33,7 %	15,0 %	26,2	☹
Sweden	-1,6 %	-1,9 %	4,0 %	-3,9	☺
United Kingdom	0,4 %	-12,6 %	-12,5 %	-6,3	☺
EU-15	0,3 %	-3,5 %	-8,0 %	0,5	☹

EU-CO2 emissions

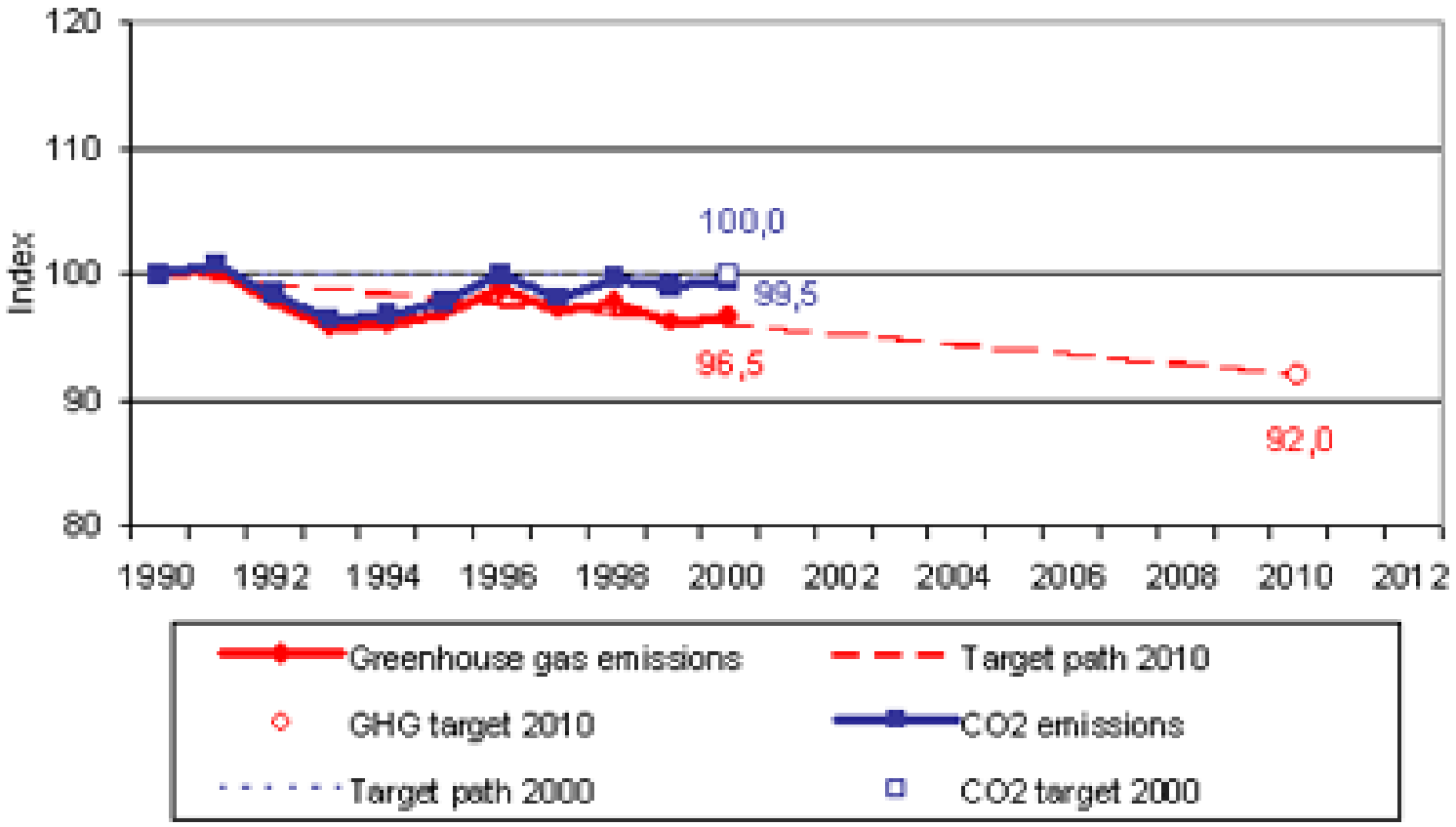
MEMBER STATE	Change 1999–2000 (%)	Change 1990–2000 (%)	UNFCCC and national targets for 2000 (%)	Target reached in 2000 [1]
Austria	0,1 %	6,1 %	0,0 %	☹
Belgium	1,1 %	7,7 %	-5,0 %	☹
Denmark [2]	-7,7 %	0,4 (-10,3 %)	-5,0 %	☹ (☺)
Finland	-2,8 %	-0,3 %	No target	No target
France	-1,2 %	2,0 %	No target	No target
Germany	-0,2 %	-15,4 %	No target	No target
Greece	5,2 %	23,0 %	15,0 %	☹
Ireland	4,8 %	39,1 %	20,0 %	☹
Italy	0,6 %	4,7 %	0,0 %	☹
Luxembourg	-0,6 %	-46,8 %	0,0 %	☺
Netherlands	0,9 %	8,7 %	-3,0 %	☹
Portugal	-1,4 %	43,2 %	No target	No target
Spain	3,9 %	34,9 %	12,0 %	☹
Sweden	-1,1 %	-0,4 %	0,0 %	☺
United Kingdom	1,2 %	-7,0 %	0,0 %	☺
EU-15	0,5%	-0,5%	0,0%	☹

[1] In this table the following rating is used:

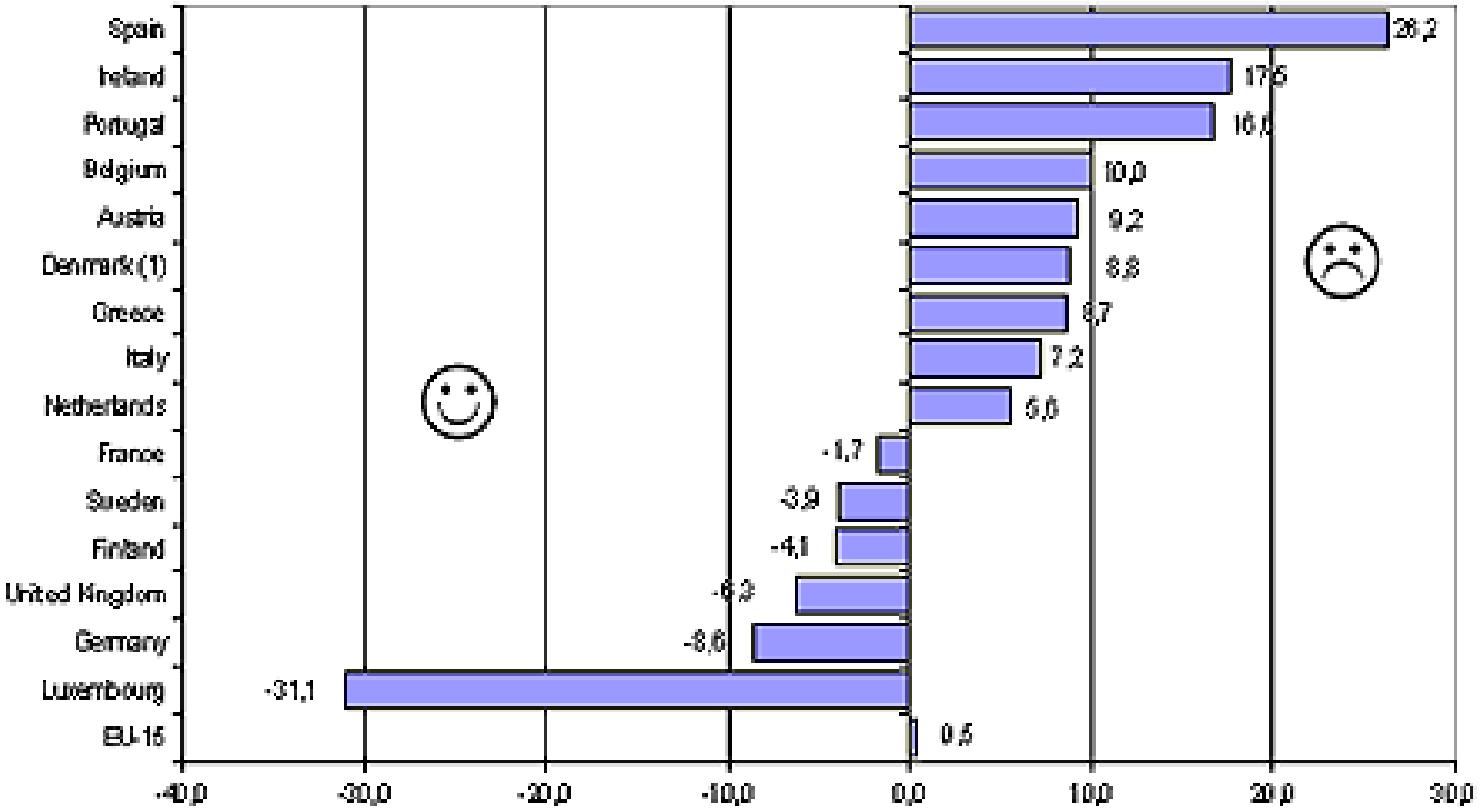
☺ CO_2 emission target 2000 reached
☹ CO_2 emission target 2000 not reached

[2] See note 2 in Table 1.

EU-Emissions in relation to Kyoto target



Winners and Losers



USA not for Kyoto ?

Adopters of GHG cuts

- California
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- New Mexico
- New York
- Rhode Island
- Vermont

Probables

- New Jersey
- Oregon
- Washington

Possibles

- 25 US municipalities

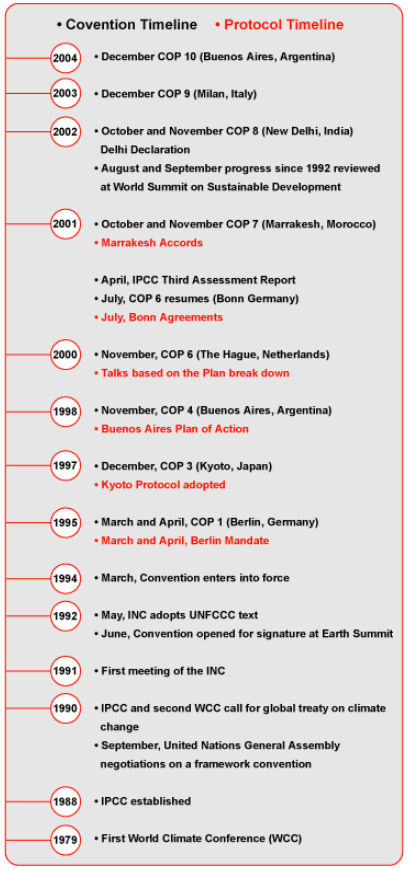
COP-11 at Montreal

- Kyoto rule-book
- Post-Kyoto (2012) "talks for talks"
- Pew Centre (44 models for post-kyoto)
- "Save the Forests coalition" (Papua New Guinea)
- OPEC - oil compensation call

COP's and more COP's

- COP1: Berlin Mandate
- COP2:Geneva Accord
- COP3:Kyoto Protocol
- COP4:Buenos Aires Accord
- COP5: Bonn Agreement
- COP6: Hague Accord
- COP6 (bis): Hague Accord
- COP7: Marrakesh Accord
- COP8: Delhi Accord
- COP9: Milan Agreement
- COP10:Buenos Aires Work Programme

UNFCCC rolls on and on!



OLD vs NEW

Kyoto

- Political fix
- 38 parties only
- Fixed term (2012)
- Regional (EU/EIT)
- Too Complex
- No penalties/bonuses
- Not working

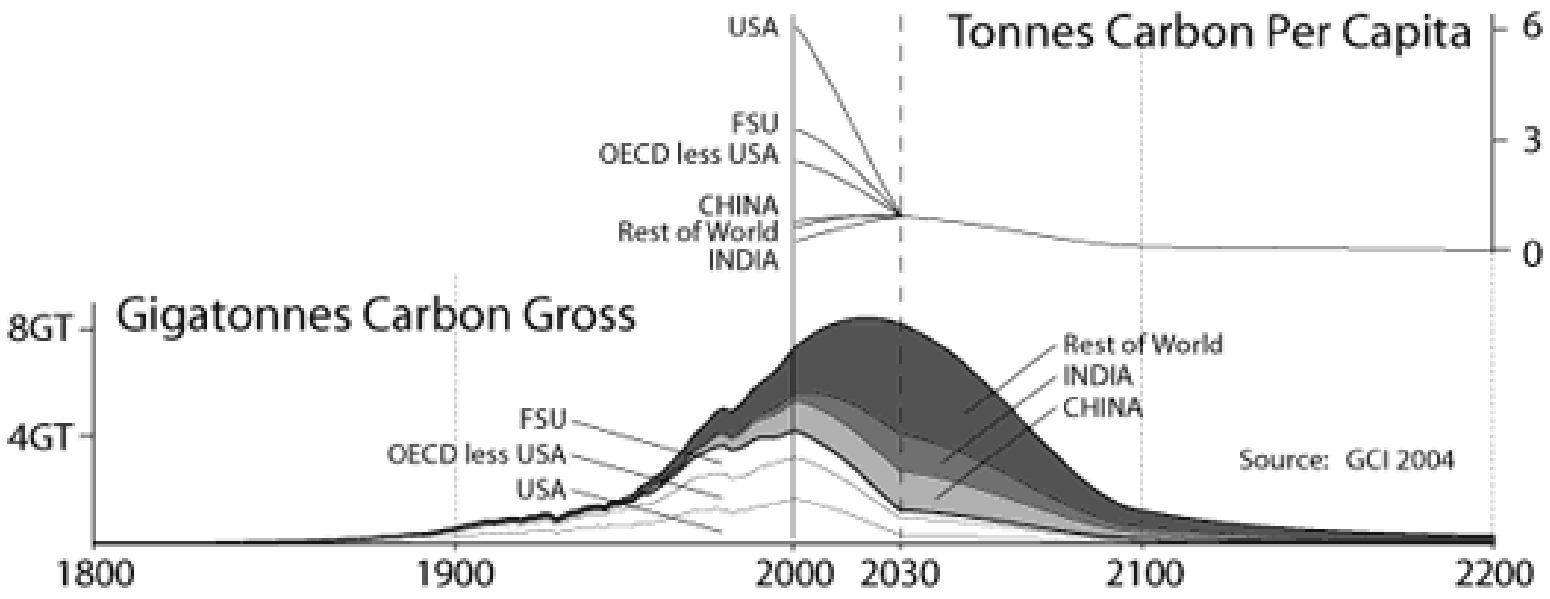
"C+C"

- Science based (equity)
- Inclusive (189 parties)
- Long-term (2050)
- Global
- Simple
- Incentived (trading)
- Would work

“Contraction and Convergence”

- Contract Global Carbon budget (2Gt-c/yr)
- Converge all parties by 2050
- Equity based (6 billion people/6Gt-C)
- Comprehensive (all countries in UNFCCC)
- Transparent process
- Allows for emissions trading
- Promotes Renewables

C+C in reality



This example shows rates of C&C negotiated as regions.
This example is for a 450ppmv Contraction Budget, Converging by 2030.

Post Kyoto

Approach

- countries to limit emissions at 1% below BAU for 10 years
- moderate absolute target (incentives)
- absolute target using low per capita levels

Timetable

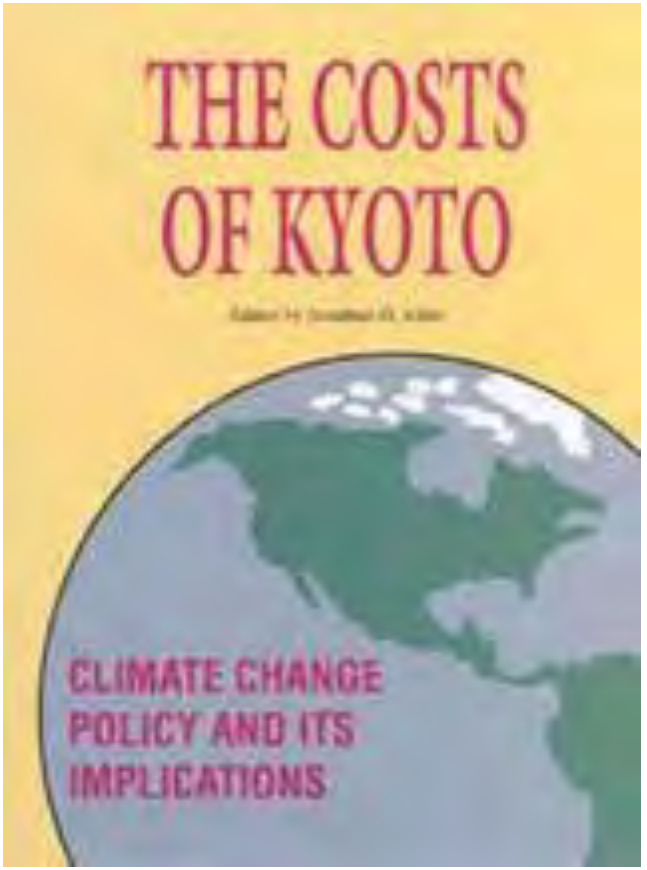
2006 CDM amended and long-tern emission target (2C)

2008 outline post-Kyoto framework (2012)

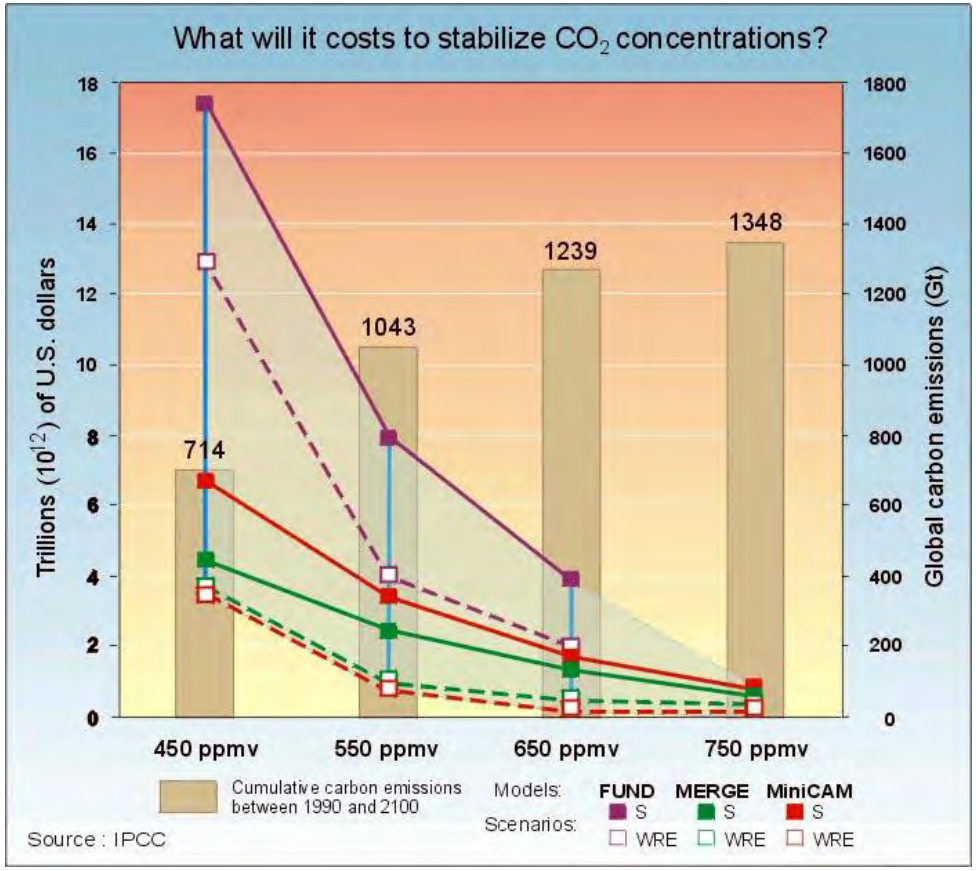
2009 detailed framework for 2013-2024 period

IV. Costs of Climate Change

- Varied estimates
- $300bn-$600bn/yr to fix climate related damage (UN)
- Depends on stabilisation level (450ppm or 750ppm)
- $4-17 trillion at (450ppm) stabilisation



Cost of CO2 stabilisation



Natural Disasters - Losses ($bn) (Lloyd's/Industry)

Hurricanes

- Ivan (0.98) / $11bn
- Frances (0.49)/$5bn
- Charley (0.49)/$8bn
- Jeanne (0.35)/$4bn
- Georges (0.2)/$4.1bn
- Andrew (?)/$19bn
- Katrina (???)/$100bn

- Huge increase in losses in 1990's
- Coinciding with increased temps
- Global in nature
- Cannot be sustained as projected into warmer world-bankrupt by 2065!

$ Trillion Bill

- One event in New Orleans costs $100bn
- 10 years of similar/worse damage
- Trillion Dollar Damage Fund needed
- Who pays?
- How is it raised?

Costs In Perspective

Climate/disasters

Andrew: $20bn

Katrina: $100bn

Kobe: $100bn

Asian Tsunami: $250bn

Tokyo: $1-2 trillion

Climate change: $4-20 trillion

War

WW1: $196.5bn (1990)

WW2: $2.1trillion(1990)

Iraq: $200bn-$2trillion

Conclusion

CLIMATE = WAR

Insurance Models

Old model

- Premiums are based on past claims
- Assuming world does not change much -OK
- If world warms claims will spiral faster than premiums- GO BUST!

New Model

- Premiums based on future claims
- Assume world warms to at least IPCC temps
- Invest premiums in green companies- reduces carbon output and climate damage

Insurance and Climate Change

- *"Any insurance company that is not focussing on climate change is not being realistic in looking at their future profitability"*

Richard Moore

Carolina State Treasurer

Investments

- Need to de-carbonise
- SELL Carbon stocks
- Need Renewables
- BUY Green stocks
- Send signal to markets and governments
- Create Climate Fund
- Carbon Trading

AIM

- Renewable/alternative energy sector
- 20 listed companies
- £1.3bn market cap
- Big interest after announcement of Govt Energy Review
- Massive growth potential
- Clipper Windpower
- Ocean Waves Technology
- Solar Integrated Technology
- Polyfuel
- Novera Energy
- D1 Oils

V. Technology

Fossil

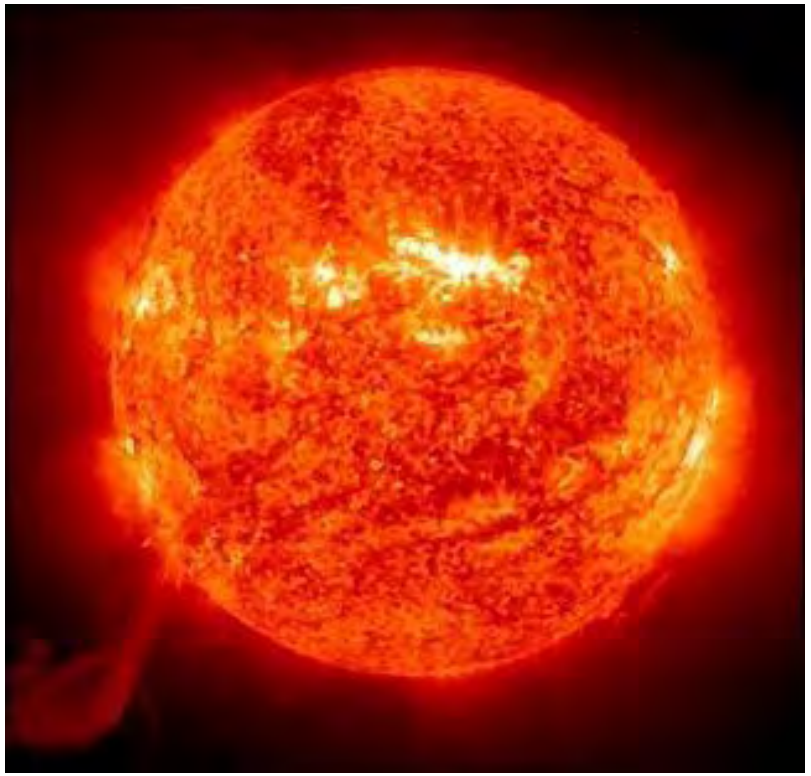
- Clean Coal technology
- Coal Gasification
- Oxycombustion
- Methane hydrates
- Fuel cells
- Hydrogen
- Carbon sequestration

Non-Fossil

- Solar (thermal and pv)
- Wind (on/off-shore)
- Tidal
- Geothermal
- Biomass
- Nuclear (fusion)/He-3
- ZPE

Solar

- EU has 2008 target of 35 million m2 solar thermal installations and1,500MW photovoltaic installations
- USA has 1 million solar roofs target
- Big Potential in Middle East, Africa



Wind

- EU has a 2008 target of 15,000MW of wind turbines
- USA has identified 13,000MW of wind turbine sites
- Global wind market is up to 47,300MW
- Top-5 USA, Germany, Denmark, Spain, India

Biomass

- Bio-ethanol and Bio-diesel big in USA, Brazil, Ukraine
- Brazil meets 25% of its gasoline supply from ethanol derived from sugarcane
- USA following
- EU acting slowly

Ocean Energy

- Ocean energy has same potential as wind energy
- Tidal energy (Severn)
- Wave Energy (Salter's ducks)
- Ocean Thermal Energy-massive! (e.g.Gulf Stream)

Geothermal Energy

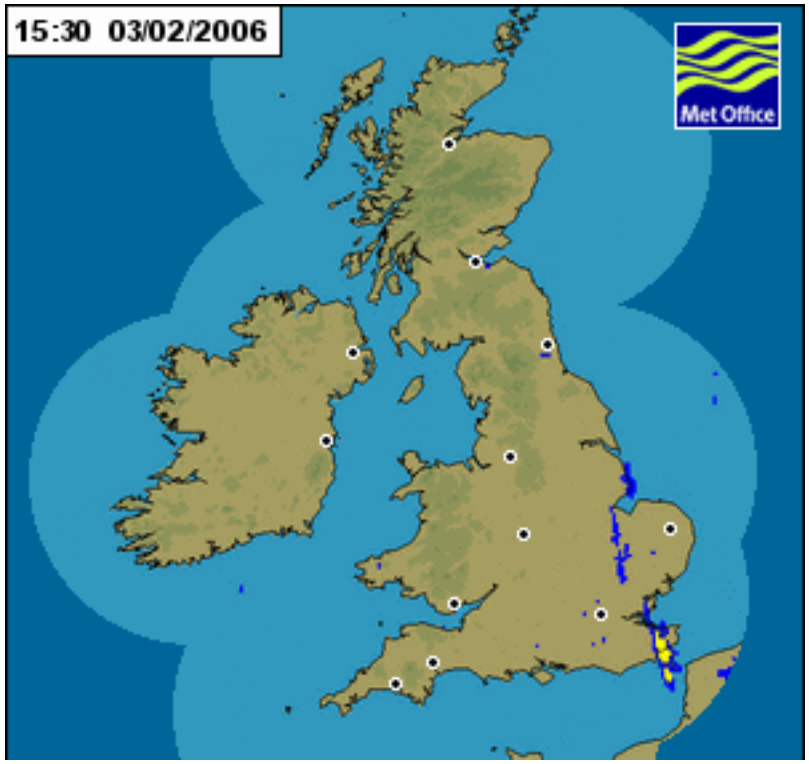
- High temperatures (150C) deep below ground
- Greatest potential of all renewables
- All regions of Earth can tap into this source
- Local house heating

Helium-3

- Special isoptope of He
- Found only on Moon
- 500m tonnes
- Energy for Earth-1,000yrs
- Russian - Moonbase 2015/2020
- Next fuel ??

UK Met Office

- *"The biggest obstacles to the take up of technologies such as renewable sources of energy and clean coal lie in vested interests, cultural barriers to change and simple lack of awareness"*



VI. Solutions

PESTEL

- Political (post-Kyoto deal)
- Environmental (de-carbonised world)
- Social (global awareness)
- Technology (non-fossil energy forms)
- Economic (true-cost of climate change)
- Legal (penalties for non-compliance)

Global Plan

- Marshall Plan for Renewable Energy Resources
- Global Energy Grid
- Global Climate Action Plan
- Population Control Plan
- Reformed United Nations

Time is Running out!!