Climate change:
What's in the 2014 IPCC reports

Summary by Eric Eisenhandler, with much help from Jo Lakeland (April 2014)

5 reasons why human interference with the climate system is dangerous:

Note: 'further warming' is relative to the 1986–2005 global average, which is already up by 0.8°C from pre-industrial levels

1. Extreme weather events are already more likely

- **With 1°C further warming, much higher risk of extreme events: heat waves, extreme precipitation, coastal flooding, severe cold…**

2. Unique ecosystems and cultures are already threatened

- **With 2°C further warming, many species and systems at very high risk**

3. Food production is already being affected

- **With 2°C further warming, high risk of water shortages and lower crop yields**
- **Risks are unevenly distributed – and greater for disadvantaged people**

4. Global impacts

- **With 1–2°C further warming, some risks to Earth's biodiversity and the overall global economy**
- **With 3°C further warming, risk of extensive biodiversity loss with associated extinctions, loss of ecosystems, and damage to goods and services**

5. Large-scale, abrupt and irreversible changes ('tipping points') are more likely with warming

- **Changes to coral reef and Arctic ecosystems may already be irreversible**
- **With 1–2°C further warming, risks increase out of all proportion**
- **Above 3°C further warming, risk of large and irreversible sea-level rise from ice sheet melting (e.g. if the Greenland ice sheet melts, sea level could rise by up to 7 metres)**

For more information see our website: www.blewbury.co.uk/energy/warming.htm

Global warming is real

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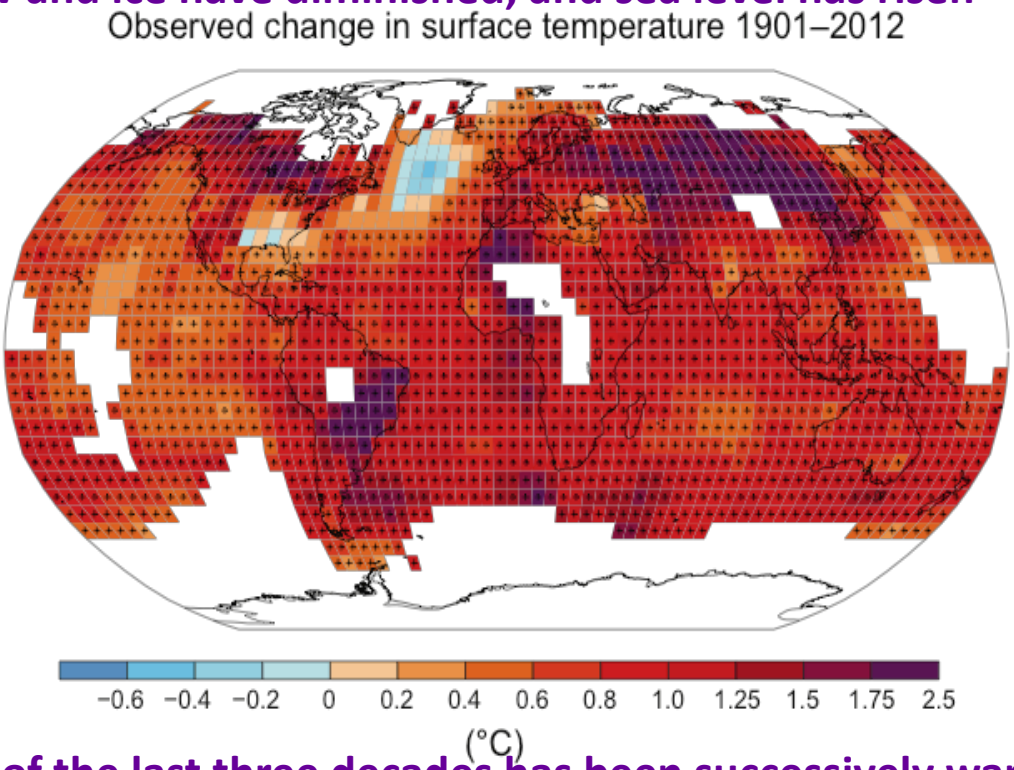
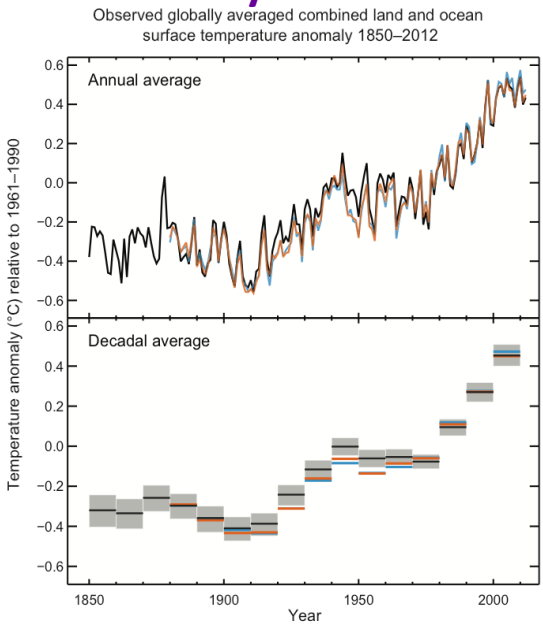
It's a fact: the atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea level has risen



- Each of the last three decades has been successively warmer
- The 10 warmest years on record have all been since 1998, and 13 of the 14 warmest years have been in the 21st century



Human influence on the climate is clear

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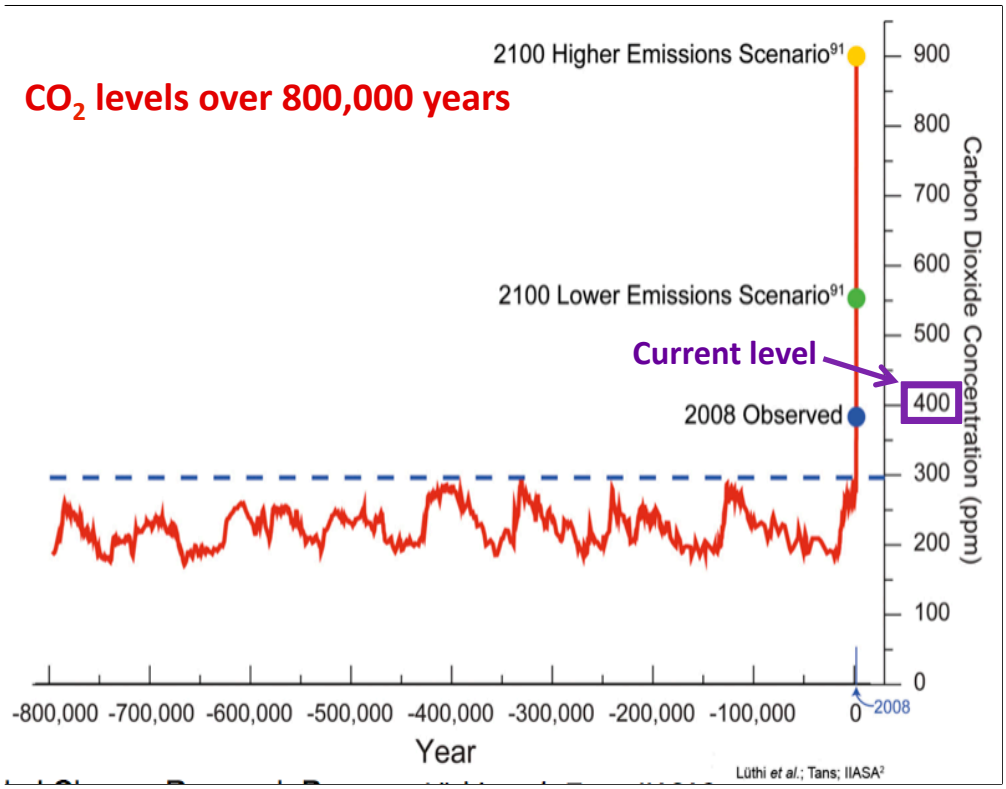
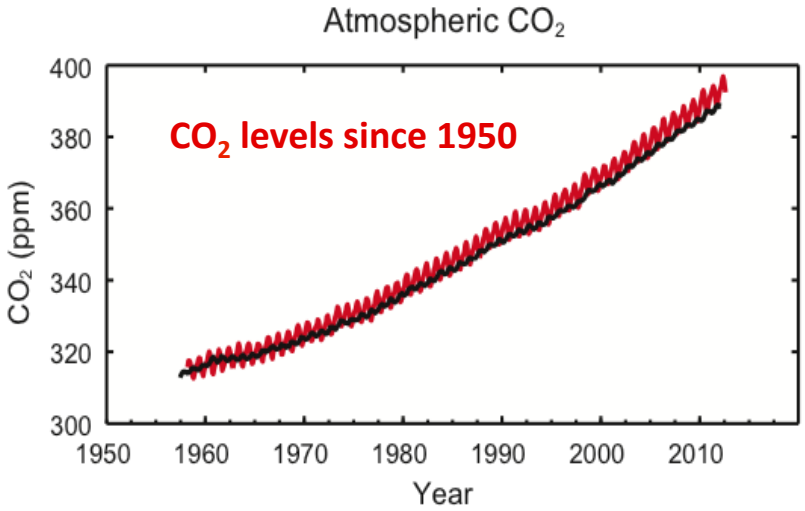
The cause:
Greenhouse gases

Atmospheric carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions

- **Greenhouse gases – carbon dioxide, methane and nitrous oxide – are now at levels unprecedented for at least 800,000 years**



Annual carbon emissions are *continuing to rise* and even *accelerating* due to economic growth and population increase – this has to change



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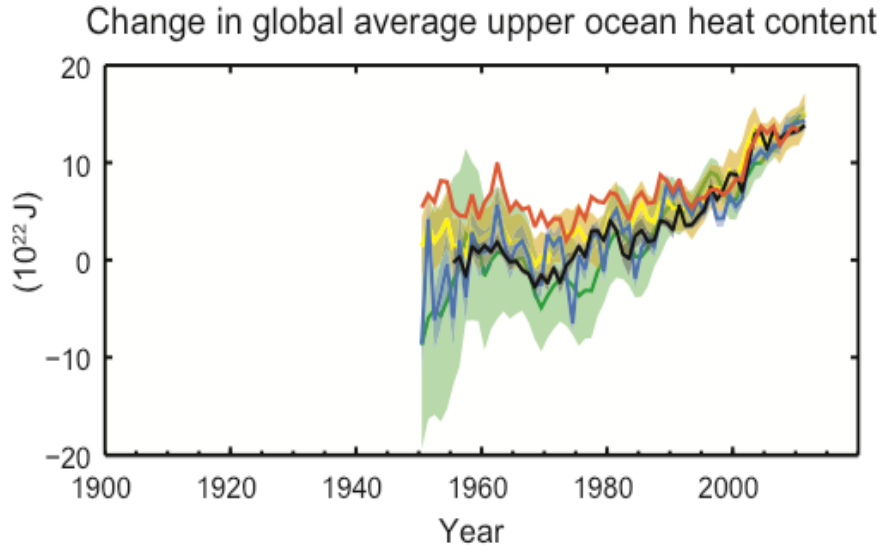
The effects:
Oceans

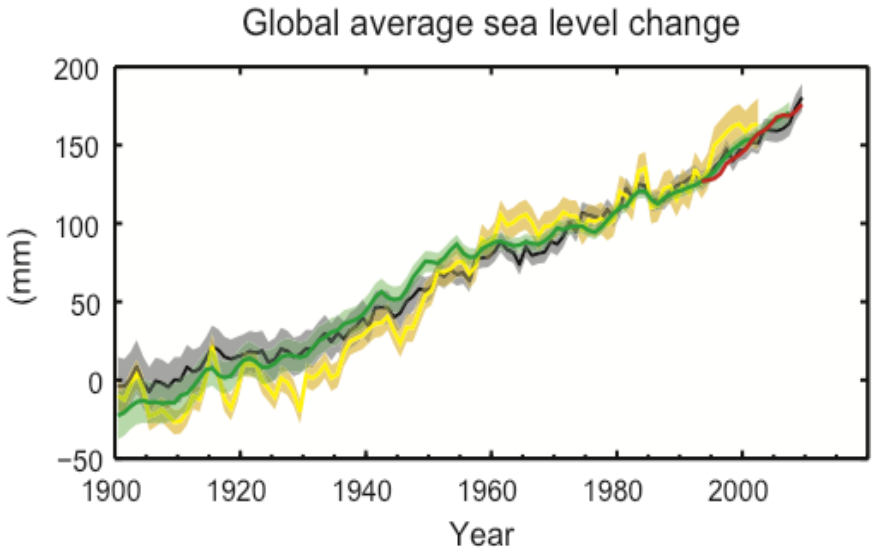
Ocean warming accounts for more than 90% of the energy accumulated in the climate system from 1971 to 2010

- **It is virtually certain that the upper ocean (0–700 m deep) warmed from 1971 to 2010**



The rate of sea-level rise since the mid-19th century has been larger than during the previous 2000 years

- **From 1901 to 2010, global mean sea level rose by 190 mm**



The ocean has absorbed about 30% of man-made carbon dioxide emissions – this has made the oceans more acidic

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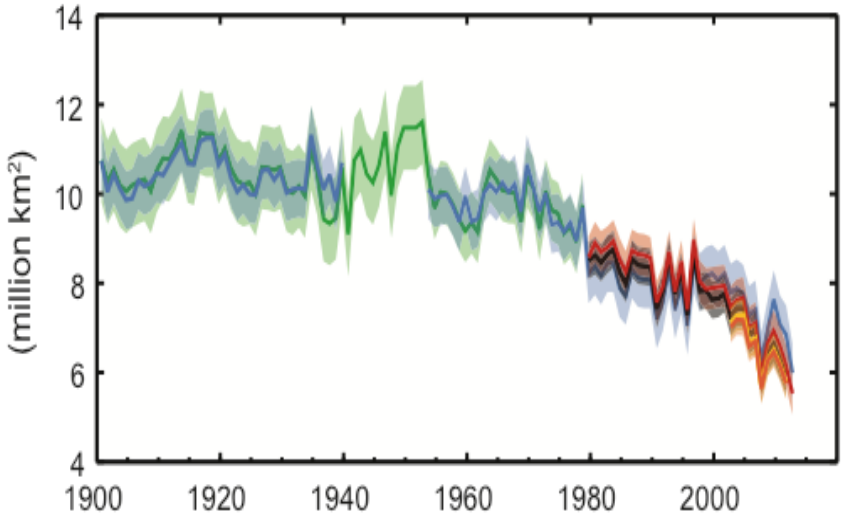
The effects:
Ice

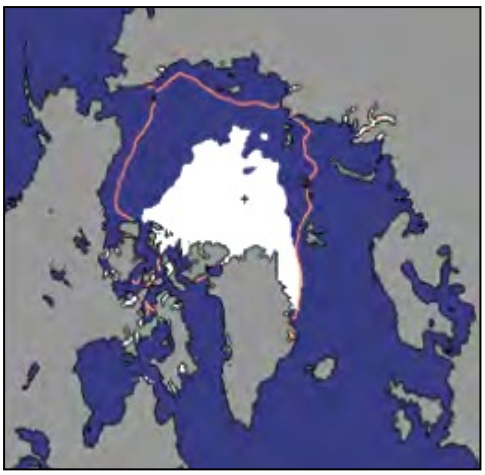
Over the last two decades:

- **The Greenland and Antarctic ice sheets have been losing mass**
- **Almost all glaciers worldwide have continued to shrink**
- **Arctic sea-ice has continued to decrease – the summers with the lowest minimum sea-ice extents have *all* been in the past 7 years**

Arctic summer sea ice extent: 1900–2012



Arctic summer sea-ice extent:
- 2012 (white area)
- 1979–2000 average (red line)



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Predictions:
Global warming

Continued emissions of greenhouse gases will cause further warming, changing all components of the climate system

Limiting climate change requires substantial and sustained reductions of greenhouse gas emissions

There are four scenarios in the IPCC report:

(1) Very optimistic – huge and rapid reduction in CO_2 emissions

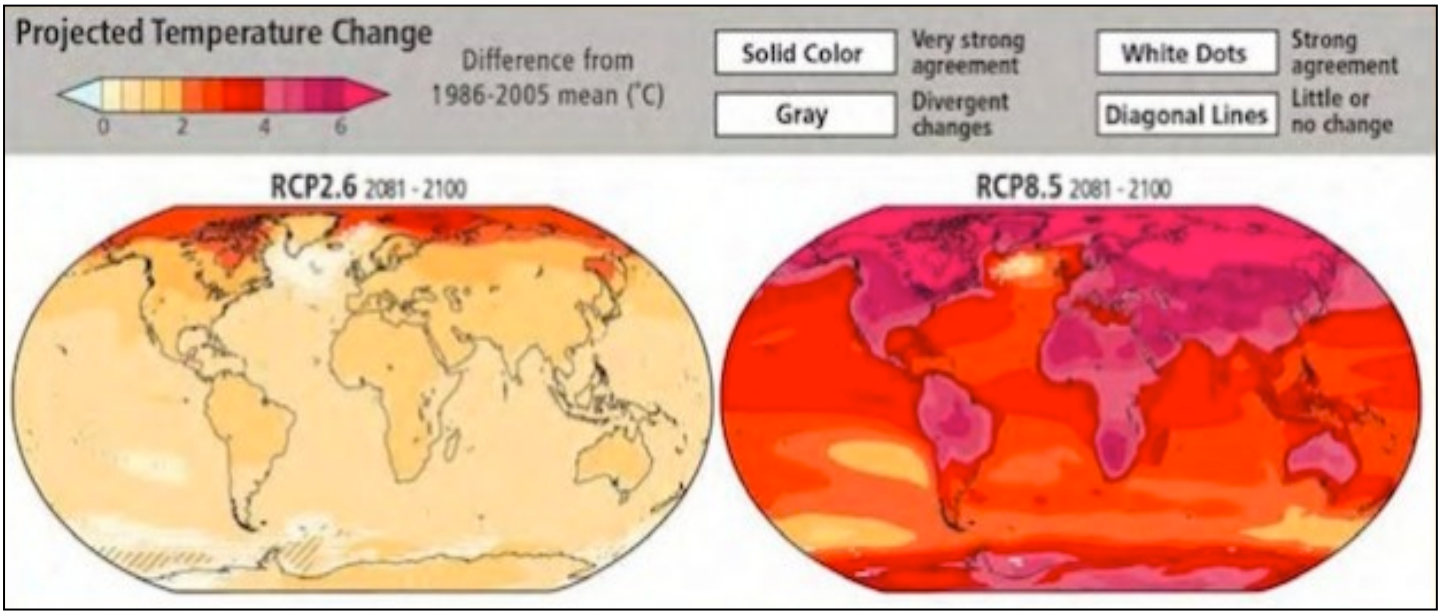
(2) Optimistic – serious reduction in CO_2 emissions

(3) Realistic – some reduction in CO_2 emissions

(4) Business as usual – we do nothing

Only scenario (1) is likely to keep the temperature rise below 2°C and to end warming by 2100

In scenario (4) the temperature rise by 2100 is predicted to be 3.7–4.8°C, but might even be as high as 7.8°C



Scenario (1) in 2100 ***Scenario (4) in 2100***

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Predictions: Climate change

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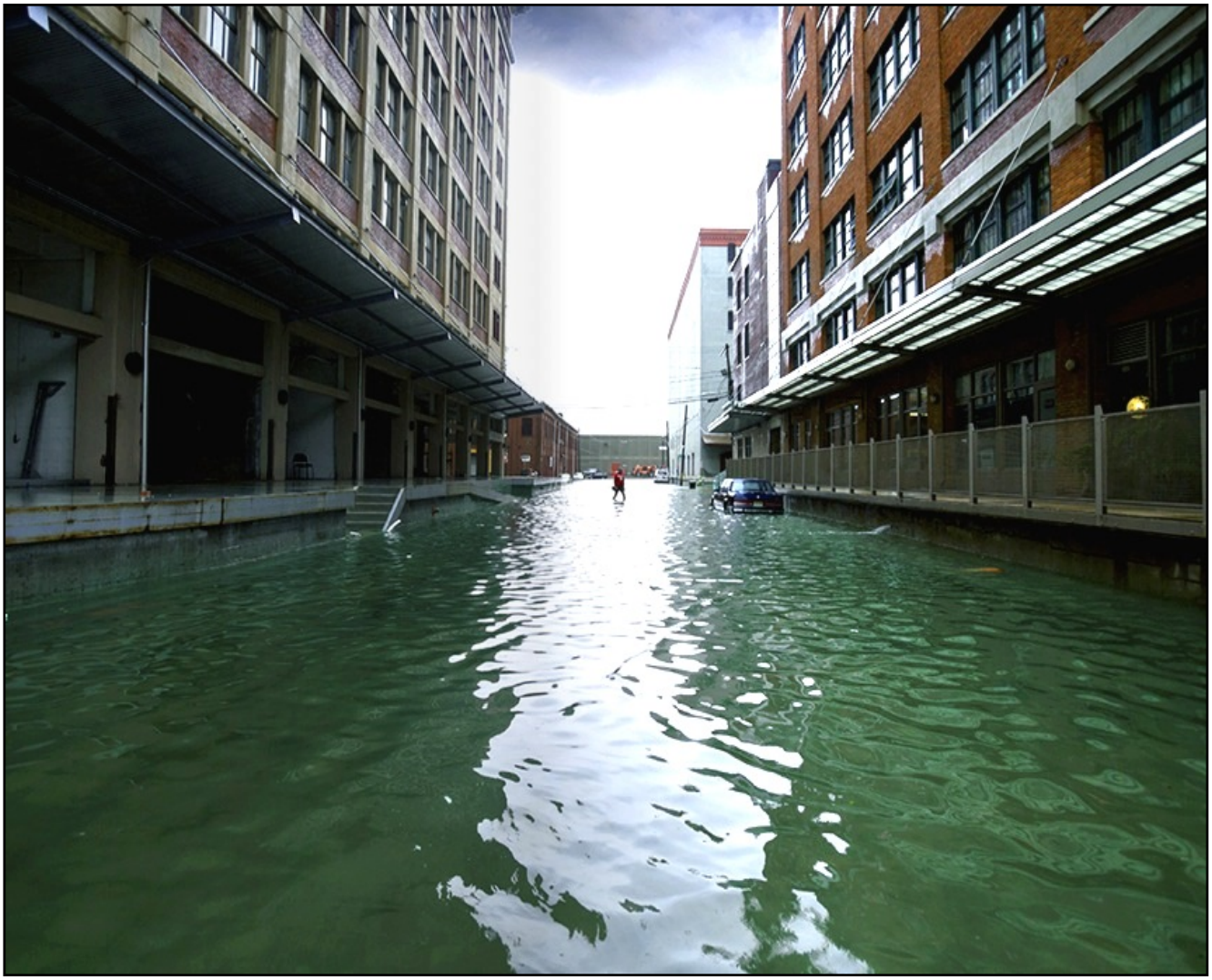
Changes in the global water cycle due to warming during the 21st century will not be uniform

- **There will be *bigger differences* in precipitation between wet and dry *regions*, and between wet and dry *seasons***
- **Extreme precipitation events over mid-latitude land masses and wet tropical regions will become *more severe* and *more frequent* by 2100**



Feedbacks: climate change will *itself* worsen the increase of greenhouse gases in the atmosphere, e.g. due to methane emitted by melting permafrost in areas like Siberia

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Predictions:
Oceans

The oceans will continue to warm during the 21st century

- **Heat will penetrate from the surface to the deep ocean and affect ocean circulation**

Sea level will continue to rise

- **Under all scenarios, the sea level is very likely to rise faster than 1971 to 2010, due to increased ocean warming and increased loss of mass from glaciers and ice sheets**

Uptake of carbon by the ocean will increase ocean acidity even further, damaging and destroying ocean ecosystems

For more information see our website: www.blewbury.co.uk/energy/warming.htm

Predictions:
Ice

Arctic sea-ice will continue to shrink and thin

Northern hemisphere spring snow cover will decrease

Global glacier volume will continue to shrink

- **Many rivers that formerly supplied water in summer will be dry**

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Predictions:
Society (1)

Those suffering inequalities are most vulnerable

People who are poor or otherwise marginalised are especially vulnerable to climate change, due to inequalities in social status and/or income, as well as being more exposed to climate-related problems

The poorest are *already* most affected

Climate-related hazards affect poor people's lives through impacts on livelihoods, reductions in crop yields, or destruction of homes, as well as increasing food prices and causing food shortages

Extreme weather and poverty

Impacts from climate extremes, such as heat waves, extreme cold, droughts, floods, cyclones and wildfires, are worse for those lacking essential infrastructure and services or living in poor-quality housing and/or in exposed areas

Future food security

Climate change has *already* reduced wheat and maize yields for many regions. Further climate change brings risk of food insecurity and the breakdown of food production linked to warming, drought, flooding, and variable and extreme precipitation – particularly for poorer populations in both urban and rural settings

Risks for rural communities

Further climate change risks loss of rural livelihoods due to water shortages and reduced agricultural productivity or crop failures – particularly for poor farmers in semi-arid regions

For more information see our website: www.blewbury.co.uk/energy/warming.htm

Predictions:
Society (2)

Fishing communities

Climate change risks loss of marine and coastal ecosystems, biodiversity, and what these provide for fishing communities in the tropics and Arctic

Sea-level rise

Risk of death, injury, ill-health, or disrupted livelihoods in low-lying coastal zones and small-islands, due to storm surges, coastal flooding, and overall sea-level rise

Extreme heat

Risk of increased illness and death during extended periods of extreme heat – particularly for vulnerable urban populations and for those working outdoors

Reduction of poverty

Climate change will slow economic growth, make poverty reduction more difficult, erode food security, and prolong existing and create new poverty traps – particularly in urban areas and hotspots of hunger

Violent conflict

Climate change can increase risks of violent conflicts in the form of civil war and inter-group violence by amplifying poverty and economic shocks

For more information see our website: www.blewbury.co.uk/energy/warming.htm

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Predictions:
Long-term future

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Climate change will continue for centuries – even if emissions of CO_2 are stopped completely

- **To keep the warming to less than 2°C, we need to limit our cumulative man-made carbon emissions to about 800 billion tons – *but we've already emitted about 550 billion tons!***
- **If we don't make major changes – e.g. *by leaving most fossil-fuel reserves in the ground* – we will use up our 'carbon budget' within just two to three decades**

We have created a substantial multi-century climate change problem, which will continue because of our past, present and future emissions of CO_2 – unless we act *now*, before it is too late

For more information see our website: www.blewbury.co.uk/energy/warming.htm

What we must do:
Reduce emissions

Present measures to reduce CO_2 emissions (e.g. Cancún pledges) are unlikely to keep the temperature rise by 2100 below 2°C

- **Delaying decarbonisation will make it more difficult and more expensive to achieve lower emissions, and make it even less likely that we can keep the temperature rise below 2°C**
- **Limiting CO_2 to 450–500 ppm by 2100 can also achieve better air quality and benefit human health, ecosystems, sufficiency of resources, and energy security and resilience**

- **To limit CO_2 to 450–500 ppm by 2100 we must improve energy efficiency and change our behaviour, in order to reduce energy demand without compromising development**
- **Lifestyle changes can substantially reduce energy use and associated emissions, by: changes in consumption (e.g. use and mode of transport, energy use in households, choice of longer-lasting products); changes in what we eat; and reducing food waste**

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What we must do:
Energy supply

Decarbonising electricity generation is key to achieving low emissions, and it can happen faster than in industry, buildings and transport

- ***But*** **decarbonisation could devalue fossil fuel assets and reduce fossil fuel revenues, causing financial problems**
- **Many renewable energy technologies now perform better and cost less – globally, over *half* of new electricity-generating capacity added in 2012 was renewable, led by wind, hydro and solar power**
- **However, other renewable energy technologies still need support and development if their usage is to be increased**

Nuclear energy usage has declined – it could make a low-carbon contribution

- ***But*** **there are concerns: high cost, safety, uranium mining, waste management and nuclear weapon proliferation**

Carbon emissions can be reduced by replacing coal-fired plants with natural gas ones – *if* methane emissions from extraction are kept low

- **Natural-gas power generation without carbon capture and storage can act as a *temporary* bridge technology**
- **Carbon capture and storage technologies could reduce the carbon emissions of fossil-fuel power plants**

For more information see our website: www.blewbury.co.uk/energy/warming.htm

What we must do:
Transport, buildings & industry

Transport: Energy usage could be reduced by about 40% in 2050 – by low-carbon transport of all kinds, changes in behaviour and new infrastructure

- *But* at present, transport improvements are limited by lack of good energy storage and the poor energy density of low-carbon fuels

Buildings: Advances in technology provide opportunities to reduce global energy use of buildings

Industry: Could reduce carbon emissions by:

- Upgrading, replacement and use of the best available technologies
- More efficient use of materials, and recycling and re-use of materials and products
- Overall reductions in product demand (e.g. through more intensive use of products) and service demand

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What we must do:
Land use, biofuels and cities

Agriculture, forestry and other land use plays a central role in food security and sustainable development

- In **agriculture**, the most effective options are improved cropland and grazing land management, and restoration of organic soils
- In **forestry**, the most effective measures are planting new forests, sustainable forest management and reducing deforestation
- **Biofuels** could play a critical role in decarbonisation – *but* there are serious issues, such as their sustainability and overall efficiency

Urbanisation is a global trend associated with increases in income – but higher urban incomes lead to higher consumption of energy and carbon emissions

For more information see our website: www.blewbury.co.uk/energy/warming.htm