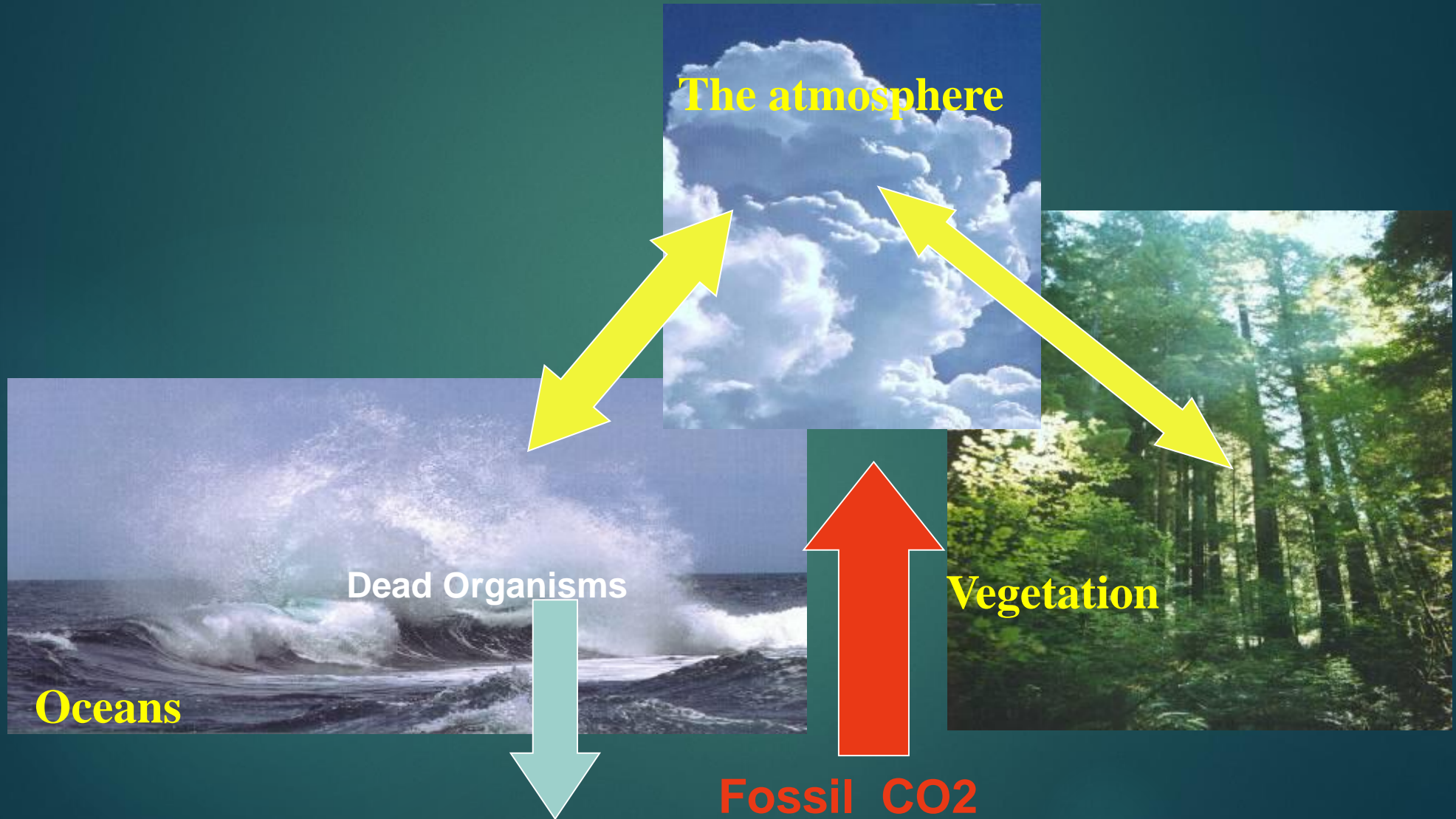




# Climate Change

# The carbon cycle



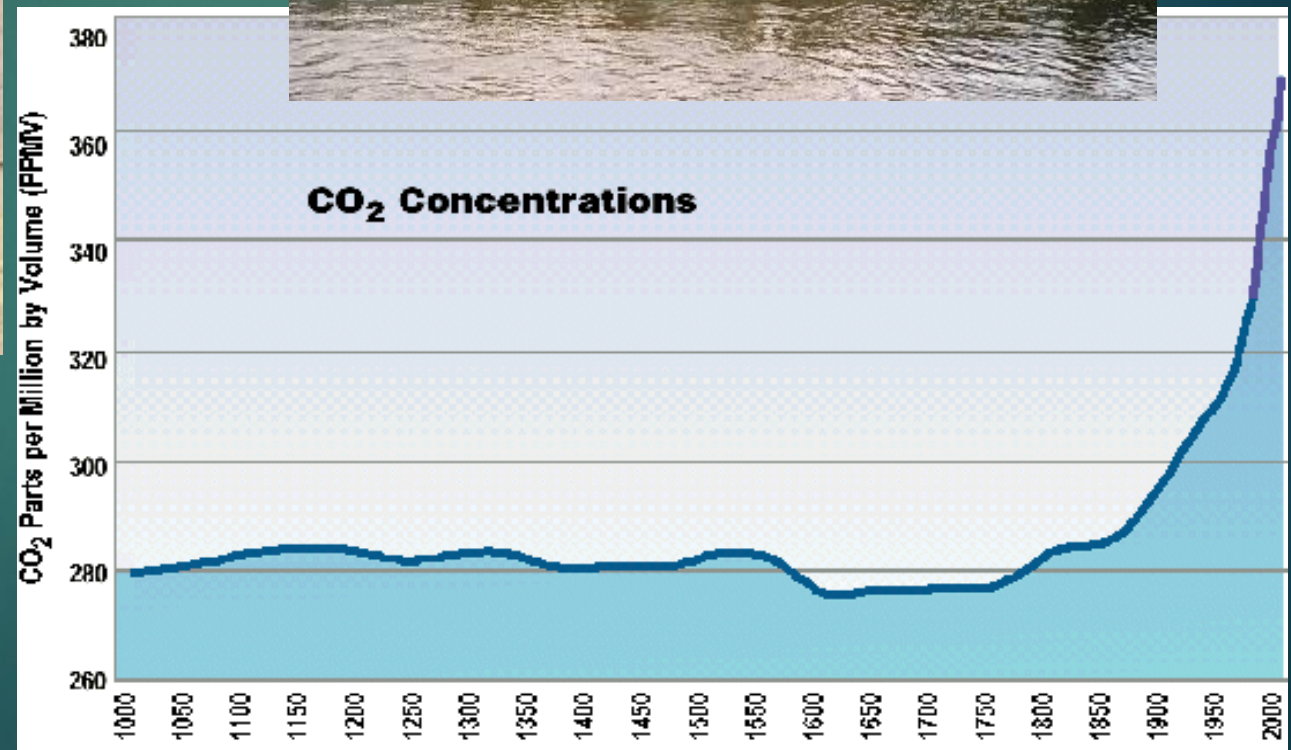
# The active carbon cycle



- The carbon dioxide cycle is a natural one, and one that has been in dynamic balance and undergone many fluctuations and cycles over millions of years.
- There is a balance between the seas and the land and the atmosphere. Carbon was created by ancient sunlight, it is locked up in the seas in plankton and other marine life, and dissolved in the water. Carbon is also locked up in plant matter on the earth (active carbon cycle), and in fossil deposits (inactive carbon cycle) of oil, natural gas, and coal.
- The destabilising factor in the carbon cycle is that we have taken the locked up (inactive) carbon from fossil fuels and put that carbon into the atmosphere. The land and the sea carbon sinks are unable to absorb this excess carbon.



# What is climate change?



# Define Climate Change

- The term "climate change" is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another.
- Natural change in CO<sub>2</sub> parts per million (ppm) over history is 0.0001 per year. Human made rate is 2ppm p/yr.
- Rising human-made CO<sub>2</sub> concentrations in the atmosphere
- A few scientists (mainly sponsored by Energy Companies, and without credentials) are still arguing about two 'cause and effects'. Firstly that CO<sub>2</sub> is the cause of global warming and secondly that humans are causing it through the burning of fossil fuels. The vast majority of climate scientists support these links.
- Peak oil is good for climate change as demand for fossil fuels will be destroyed by high fuel prices. Oil will flow to the rich, not to famers, which effects are worse? Those of demand destruction or climate change ?

# Is it proven?





# Have both 'cause and effects' been 'proven'? Is the earth warming, and are humans causing it?

- Yes, as much as a scientific theory can be proven. It has been confirmed by the International Panel for Climate Change a worldwide group of scientists who have reviewed all available scientific research. Recent controversies over some research doesn't change this.
- The 4<sup>th</sup> IPCC report published in 2007 states, (and subsequent reports concur)
- Warming of the climate system is unequivocal.
- "Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely (confidence level >90%) due to the observed increase in human greenhouse gas concentrations."
- Reduction in volume of end-of-summer sea ice is observed. Polar ice reduction of 100-200 cubic kilometres per year and rate is increasing.
- This United Nations study, which was awarded the 2007 Nobel peace prize, was the most comprehensive study of peer reviewed climate research ever undertaken, and one of the most comprehensive studies of any scientific question ever. Its conclusions are that there is no more debate, the science is clear. The only question is how fast can we act to create real reductions in atmospheric CO<sub>2</sub>.

# What are the main problems with out-of-control Climate Change?





# What are the main problems with out of control CC?

- ▶ Severe 'one in a hundred years' weather events become common
- ▶ Sea level rises, leading to increasing land loss and climate change refugees
- ▶ Species loss
- ▶ No increase in numbers of typhoons but an increase in intensity/ strength of typhoons in SE Asia
- ▶ Climate change is an inter-generational and intra-generational moral issue.

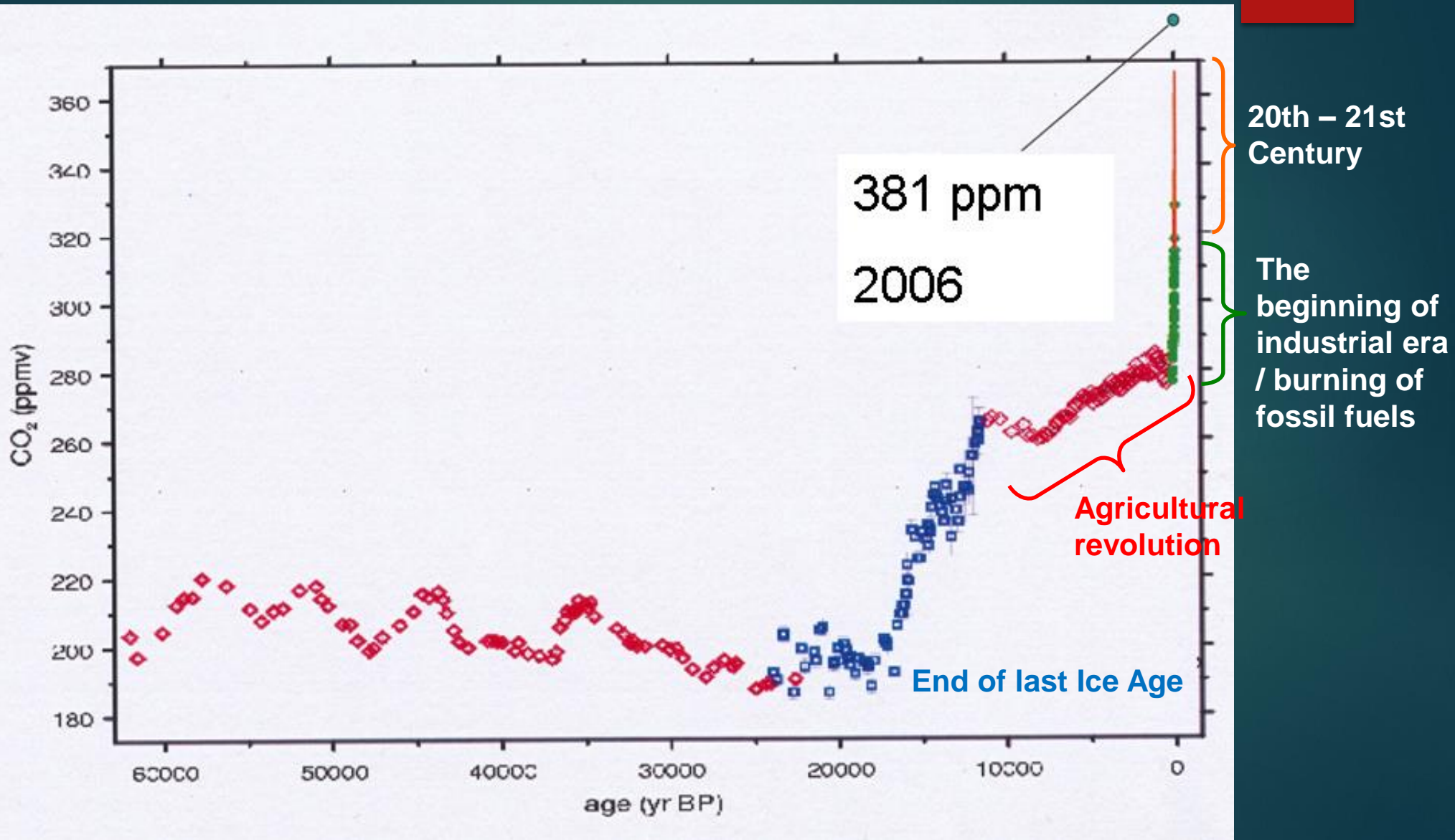
## Additional Points

- ▶ Increased droughts/desertification. This slide is of the Australian Murray River system, which has faced an extreme multi-year drought – it doesn't reach the sea any more. The government has had to take the decision to allocate whatever water there is to the cities rather than allow farmers to irrigate their crops. This has led to a huge decrease in the Australian wheat harvest. This part of Australia was once one of the bread baskets of the world.
- ▶ Increased droughts and floods
- ▶ Acidic seas kill coral reefs that are the rain forests of the seas
- ▶ Atlantic conveyor – the gulf stream stopped for 18 days in 2007. It is the driver of climate in Europe.
- ▶ Species loss and ecosystem loss due to climate zones migrating pole-wards at the rate of 5km/yr. This will accelerate species loss due to habitat loss, as many species of plants and animals will be unable to migrate with the temperature. We face a potential of 50% or more loss of life on earth. Yet we are dependent on the web of life for human survival.
- ▶ Co2 emissions must peak and start to decline by 2020
- ▶ Climate change will bring gradually falling crop yields.
- ▶ +5 degrees = crocodiles and jungle at the North Pole. We are heading for this if things don't change.
- ▶ 450 ppm Co2 = 50% chance of 3 degrees – one more billion people without water

CO<sub>2</sub> levels over the past 60000 years

(ppm = parts per million)

**PPM CO<sub>2</sub> in 2015 = 400**



# The natural carbon cycle and human effects

## Main points

- ▶ The previous slide shows the ice core data measuring atmospheric CO<sub>2</sub> concentrations over the last 60,000 years. As you can see CO<sub>2</sub> levels have risen and fallen.
- ▶ CO<sub>2</sub> level **currently** around **400ppm** without counting the other Green house gases which are Methane, nitrous oxide, CFCs. (with these included it is 470PPM Co<sub>2</sub> E - equivalent). We need to return to 350 CO<sub>2</sub> ppm
- ▶ Methane has a global warming potential (GWP) of 72 (72 x Co<sub>2</sub> over 20 years) and GWP of 25 over 100 years
- ▶ 10 top highest mean temperatures came after 1990
- ▶ Methane is given off in flooded rice paddies and in domestic livestock production – (so we need dry, organic rice paddies and less meat eating.- everywhere).
- ▶ There is a big gap between what scientists know and what the public understands.

## Additional Points about the slide

- ▶ The last ice age ended 20,000 years ago and lead to a rise in CO<sub>2</sub>, and if we went back a few 100,000 years we would see this pattern of rise and fall. What happens next (in red) shows the result of a new agricultural system, and human population increase, and then the green shows the beginning of the industrial era and the burning of fossil fuels. The orange is the 20<sup>th</sup> & 21<sup>st</sup> century.
- ▶ There is a big time lag in IPCC data, 3 – 7 years out of date.
- ▶ Cumulatively USA has 10 times the emissions of China, though now China is higher than USA on a day-to-day or year to year basis.



# The need for an urgent response



# The need for an urgent response

- Global Ave. temp is now less than 1 degree above pre-industrial level but effects (ice cap loss, glaciers and drought) are worse than predicted.
- Once global temperatures rise to 1.7 degrees + pre-ind. level positive feedback loops will cause further releases of greenhouse gases, leading to runaway climate change.
- For example if the arctic tundra melts it will emit so much methane, that it will dwarf human CO2 emissions.
- Governments now say and negotiate on how to slow down growth in emissions in a way that is acceptable to big business.
- Rate of CO2 emissions has increased after Kyoto 1.5% pa to 2.5% pa.
- After Copenhagen 2010 we had the highest emissions ever. 2015 is the hottest year on record
- 350 -400ppm = + 2 to 2.4 degrees above pre-industrial.
- 450 ppm = a 50% chance of + 3 degrees
- 500 ppm = + 3.5 degrees – up to 70% extinction of animals and plants

## CARBON Maths PROBLEM (Giga/ Billion TonnesCO<sub>2</sub>)

**Carbon budget 2011 to 2050                      565** (the limit of CO<sub>2</sub> we can release from burning fossil fuels to stay under 2 degrees above pre-industrial levels)

**But,** Listed in Government and Company Assets

Global Govt. fossil fuel reserves:                      nearly 3,000

Listed company reserves (top 200)                      nearly 800

Listed company “current budgets”                      149

**Total Listed**                      **3,849**



# Energy Asset Bubble

Governments have committed (some, like UK, making legally binding pledges) to limit CO2 emissions. The budget to keep Climate Change within reasonable safe limits is to emit, globally 565 billion tonnes of CO2 between 2011 and 2050.

However Governments and oil companies have assets on their balance sheets, propping up the value of their treasuries and businesses, supposedly ready and available to burn, that cannot be burned.

These countries and companies are therefore grossly over-valued. The listed fossil fuel assets are nearly 7 times the allowable emissions budget; overstated by 3,284 billion tonnes of CO2.

These 'assets' need to stay in the ground to be used slowly and mindfully on key activities by future generations

When this financial reality unravels it will most likely lead to economic collapse. However the Boards of Banks and the financial regulators turn a blind eye to this as to allow for it is bad for short-term business results.

# The need for urgent response



# The need for an urgent response

- 0.5 degree increase on pre-industrial temperature levels was the maximum to keep the earth stable - we are already way past this target.
- Serious, deadly effects are being felt now, so urgent actions are needed now.
- We are at 0.8 with 0.6 in the pipeline – So + 1.4 degrees is unavoidable
- We may have passed arctic sea ice melt tipping point – This is being studied.
- On the best evidence we need to keep temperature rises to less than 2 degrees C above pre-industrial levels.
- So we are perilously close to reaching this even if we reduce emissions dramatically now.
- Cost of correction is low. 1% of GDP – kill inefficient products and behaviours by law.



# Human thinking about risk in the Triple Crunch

	Financial crisis	Climate crisis	Oil crisis
Comforting narrative	<ul style="list-style-type: none"> <li>• Risk has been removed from complex derivatives</li> <li>• massive assets in mortgage-backed securities</li> </ul>	<ul style="list-style-type: none"> <li>• uncertainty means absence of threat</li> <li>• climate scientists are conspiring to scaremonger</li> </ul>	<ul style="list-style-type: none"> <li>• 40 years of reserves left; fracking</li> <li>• trillions of barrels in resources</li> <li>• price mechanism</li> </ul>
Uncomfortable narrative	<ul style="list-style-type: none"> <li>• mortgage-backed securities can be toxic</li> <li>• resulting panic can stall or crash other markets</li> </ul>	<ul style="list-style-type: none"> <li>• scientific evidence for massive risk is overwhelming</li> <li>• we are all to blame, to some degree</li> </ul>	<ul style="list-style-type: none"> <li>• its about flow rates, not barrels</li> <li>• underinvestment</li> <li>• a new Saudi Arabia every two years is needed to replace depletion</li> </ul>
Stakes include	<ul style="list-style-type: none"> <li>• recession or depression</li> <li>• massive unemployment</li> </ul>	<ul style="list-style-type: none"> <li>• environmental ruin</li> <li>• economic ruin</li> <li>• threat to civilisation</li> </ul>	<ul style="list-style-type: none"> <li>• energy crisis</li> <li>• recession or depression</li> <li>• energy famine</li> </ul>



## The Triple Crunch:

### 1. The Financial Crisis 2. The Climate Crisis 3. The Energy Crisis

In the early years people rejected the possibility of the Financial Crisis and Climate Crisis. People like to comfort themselves by denying the risks. The Financial Crisis obviously happened. The uncomfortable narrative is accepted for Climate Change but is seen as long-term. The comfortable narrative is still accepted for the Energy Crisis – ie that there are adequate reserves; there will be many major discoveries; that renewables will come fast enough and in high enough volume.

- ▶ The International Energy Agency's World Energy Outlook 2013—current energy consumption trends will increase emissions by 20% by 2035 putting the world on course for an increase in average temperatures of 3.6°C, far in excess of the 2°C the international community is aiming for. To have any hope of meeting the 2°C, **we need to leave two thirds of current fossil fuel reserves underground**, the IEA says (Dec 2013)

# Responses to Peak Oil & Climate Change

## PEAK OIL ONLY

- **Burn everything!**
  - relax drilling regulations
  - biofuels
  - tar sands and non-conventional oils
- **Resource nationalism**
- **Resource Wars**

*Not a solution*

**P O + C C =**

## **Systems Re-think**

- **Planned Re-localisation**
- **Local Economy**
- **Energy Descent Pathways**
- **Local Resilience**
- **Leave the oil in the ground**
- **Organic Farming – put the carbon in the ground**
- **Stop emissions – personal zero emissions target**

## CLIMATE CHANGE ONLY

- **Climate engineering**
- **Carbon capture and storage**
- **International emissions trading**
- **Climate adaptation**
- **Nuclear power**

*Not a solution*



# Response to Peak Oil and Climate Change - TRANSITION

- ▶ Looking at peak oil alone you look for replacements for conventional oil - tar sands, remote fields such as the Arctic and Antarctic, deep sea drilling, bio fuels, coal to liquids; burning dirtier forms of fossil fuels. But these have environmental problems and lead to accelerated climate change.
- ▶ Looking at climate change alone you may look for energy-intensive solutions to mitigate climate change, including nuclear.
  - Although it is a likely short term measure nuclear has safety problems, waste disposal problems, if you take the entire life cycle of a nuclear plant it is likely that the plants take as much energy to build, operate and keep safe as the total energy they produce in their production lifetime. And **Peak Uranium** will come soon – driving the price up.