Energy Management Training: Carbon Credits.

Jonathan Churchman-Davies, Industrial Efficiency Team Leader

Contents

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SECTION 1: WHAT ARE CARBON CREDITS?

Credit

- Noun:
  - “A method of paying for goods or services at a later time, usually paying interest as well as the original money”
  - “Money in your bank account”
  - “A unit that represents a successfully finished part of an educational course”
  - “Praise or approval, esp. to recognize achievement”
  - “A credit is also an amount of money you do not have to pay”
- Verb:
  - To believe – sometimes used in the context of highlighting belief in something that seems unlikely to be true……

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Carbon credit

- Appears both side of the balance:
  - A certificate that proves that an entity actively prevented a unit of greenhouse gas being emitted.
  - A certificate that gives permission for an entity to emit a unit of greenhouse gas without it appearing on its carbon inventory.
- An entity that can make an emissions saving can give its carbon credit to another who cannot.
- This covers the “Credit – Debit” balance. Note that this is an indirect link back to the financial nature of the concept.

Types of carbon credit

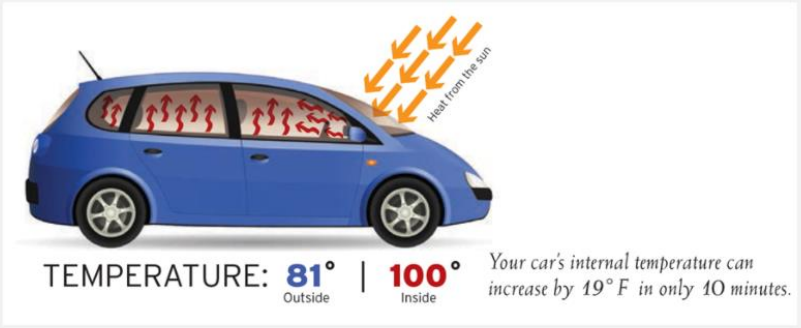
- Voluntary Emissions Reductions – “VERs”
  - Traded over the counter to enable entities to “offset” their emissions. Generated through recognized and policed mechanisms.
- Certified Emissions Reductions – “CERs”
  - Traded over the counter and through regulated markets to enable entities of publicly offset their emissions and to demonstrate regulatory compliance. Generated through a regulated mechanism.

SECTION 2: WHY DO WE NEED TO CUT EMISSIONS?

We all know how greenhouses work!

The Dangers of Hot Cars

Car Seat Safety Team at McKay-Dee Hospital Jul 2, 2015

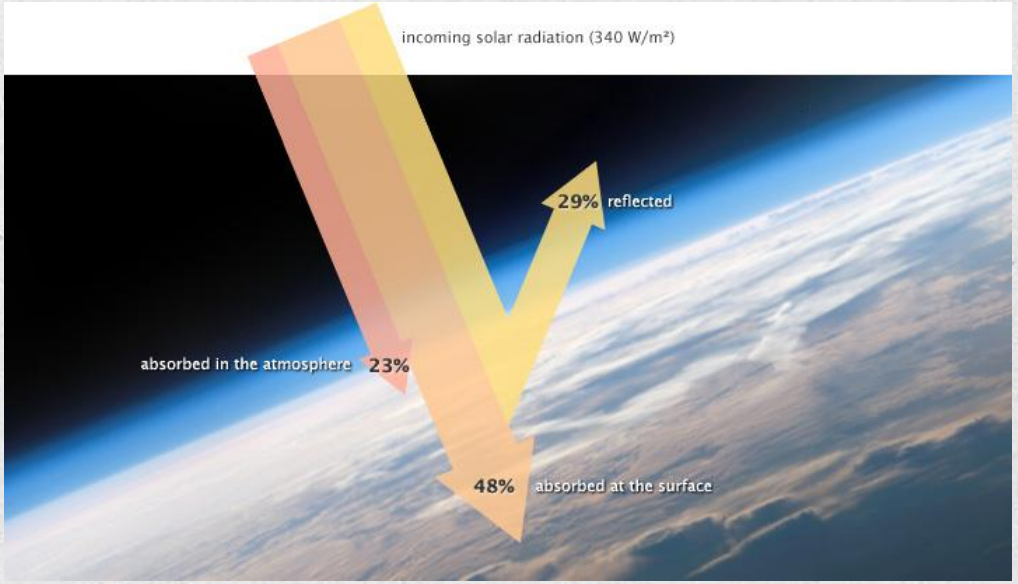


As temperatures climb we need to be aware that temperatures can reach over 130 degrees on an 82 degree day in just a few minutes. As you can see in the video below, the temperature in the parked car increase one degree per minute. This is dangerous to children left in a car.

© Halls Ltd, McKay-Dee Hospital Inc.

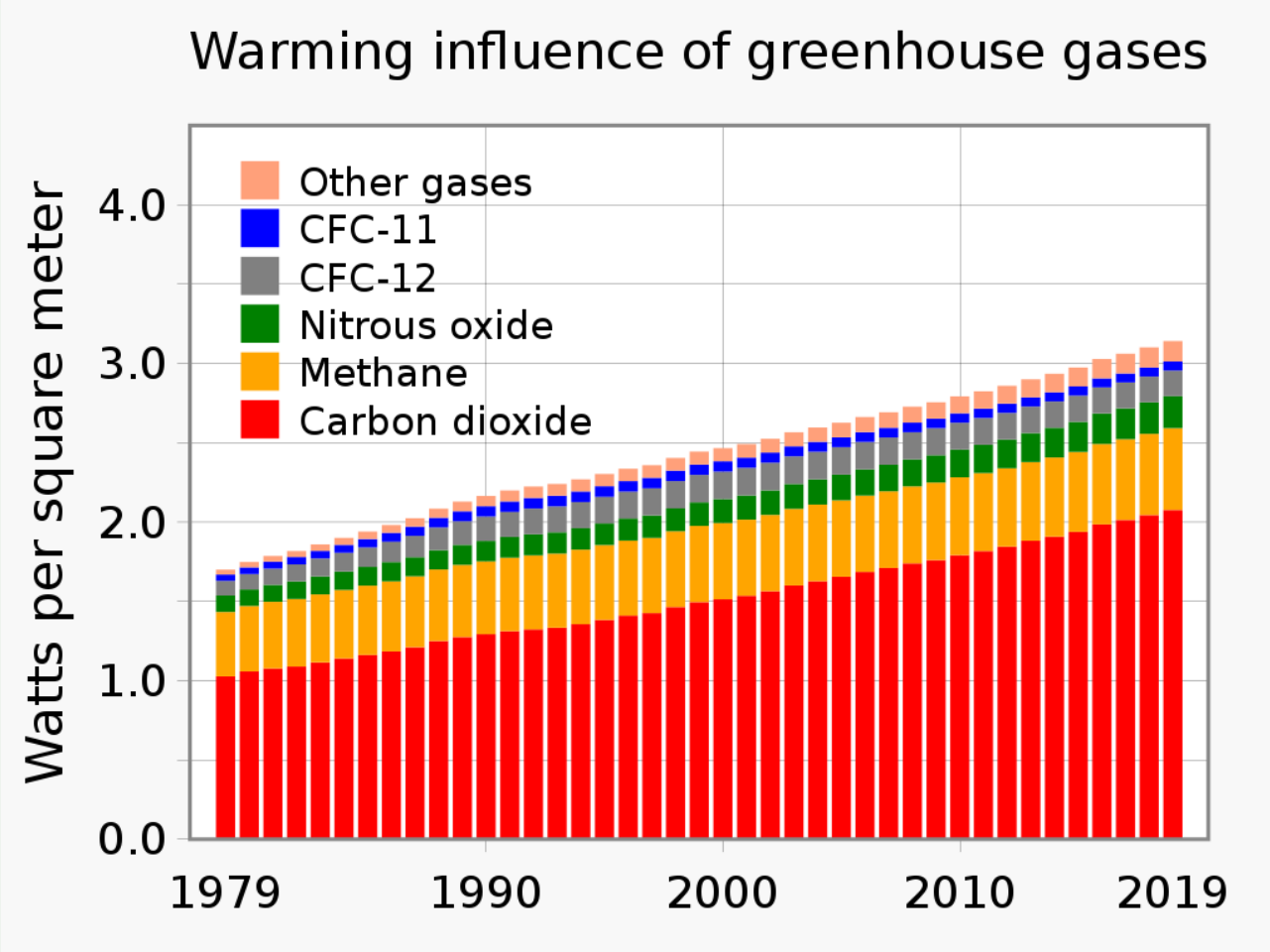
Why worry about GHGs?

- They prevent heat from leaving the earth's surface into space. We need them, otherwise earth would be much too cold!
- The most impactful at present is water vapour.
- However, many other gases can act to keep warmth in…..



© NASA Earth Observatory

Carbon dioxide + other GHGs



© RCraig09

Differences between potencies of GHGs

- GHGs have different abilities to trap heat and last for different times in the atmosphere.
- To give valid comparisons gases are measured relative to CO2 over a 100 year timespan.
- Impacts beyond the 100 year horizon are not considered for most purposes.

Table 8.7 | GWP and GTP with and without inclusion of climate–carbon feedbacks (cc fb) in response to emissions of the indicated non-CO_2 gases (climate-carbon feedbacks in response to the reference gas CO_2 are always included).

	Lifetime (years)		GWP_{20}	GWP_{100}	GTP_{20}	GTP_{100}
CH_4[b]	12.4[a]	No cc fb	84	28	67	4
		With cc fb	86	34	70	11
HFC-134a	13.4	No cc fb	3710	1300	3050	201
		With cc fb	3790	1550	3170	530
CFC-11	45.0	No cc fb	6900	4660	6890	2340
		With cc fb	7020	5350	7080	3490
N_2O	121.0[a]	No cc fb	264	265	277	234
		With cc fb	268	298	284	297
CF_4	50,000.0	No cc fb	4880	6630	5270	8040
		With cc fb	4950	7350	5400	9560

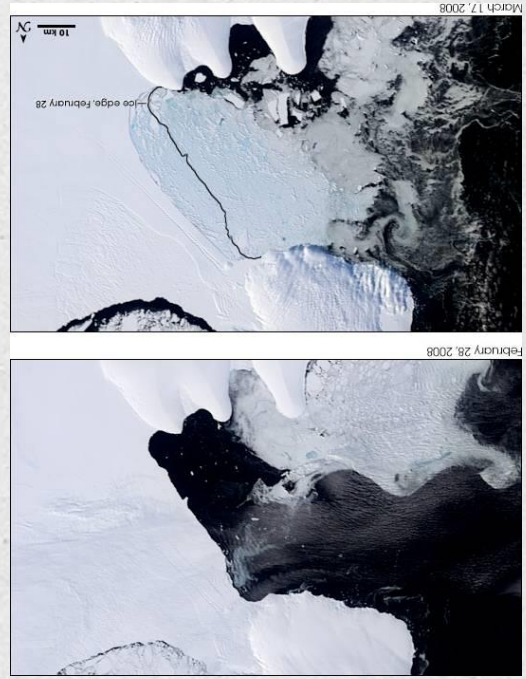
IPCC Fifth Assessment Report, 2014.

Over-arching reasons to worry:

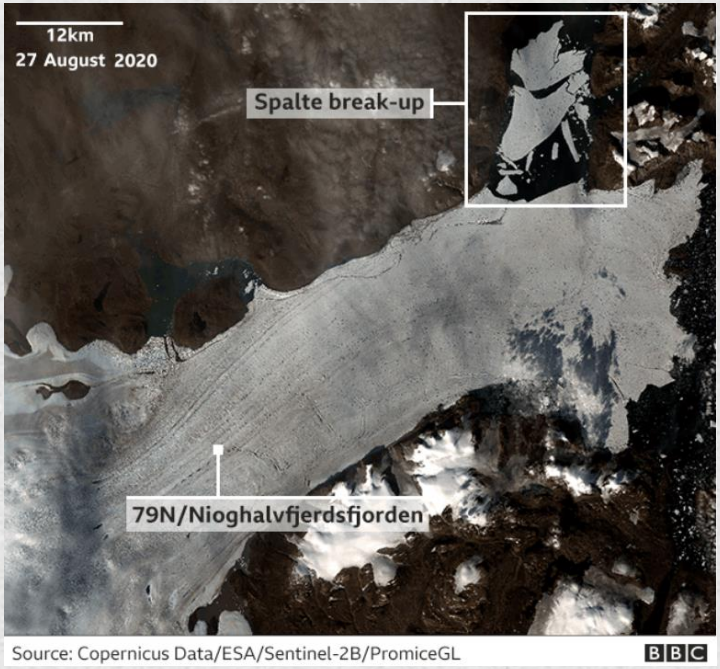
- A rapidly strengthening mass of scientific data and interpretation over the past 40 years has shown us that there is a significant danger posed to humanity from climate change.
- Climate change is driven by excess emissions of greenhouse gases “GHGs” into the atmosphere, combined with damage to existing global storage of GHGs.

Evidence: ice shelves collapsing

Wilkins ice shelf collapse
Feb 2008

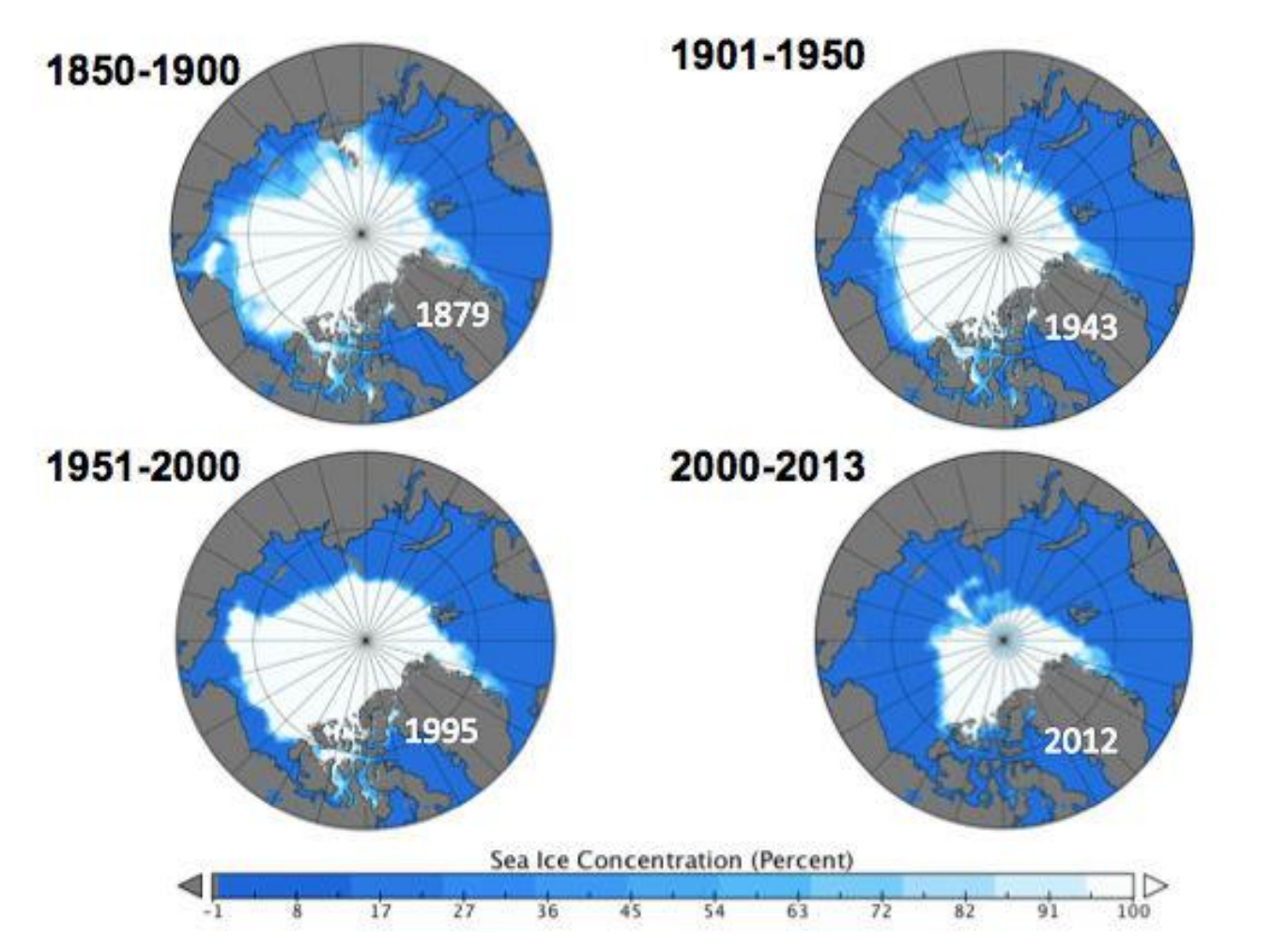


Spalte Glacier, Greenland
Sept 2020



NASA Earth Observatory, 2008
BBC, 2020

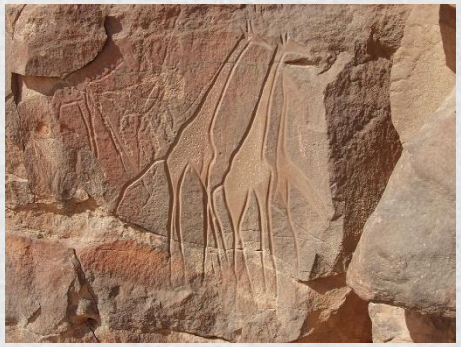
Arctic sea ice history from 1850



https://www.carbonbrief.org/guest-post-piecing-together-arctic-sea-ice-history-1850

Warning signs: climatic history

- Archaeology: Growth and decline of the Indus Valley civilization, 5,300-3,300 BP.



- Archaeology: The Sahara desertification 8,000 to 4,500 BP.

- History: The “Dust Bowl”, American Mid-West, 1930s.

Copyright: Rudolf Baumann, Saqib Qayyum, NOAA

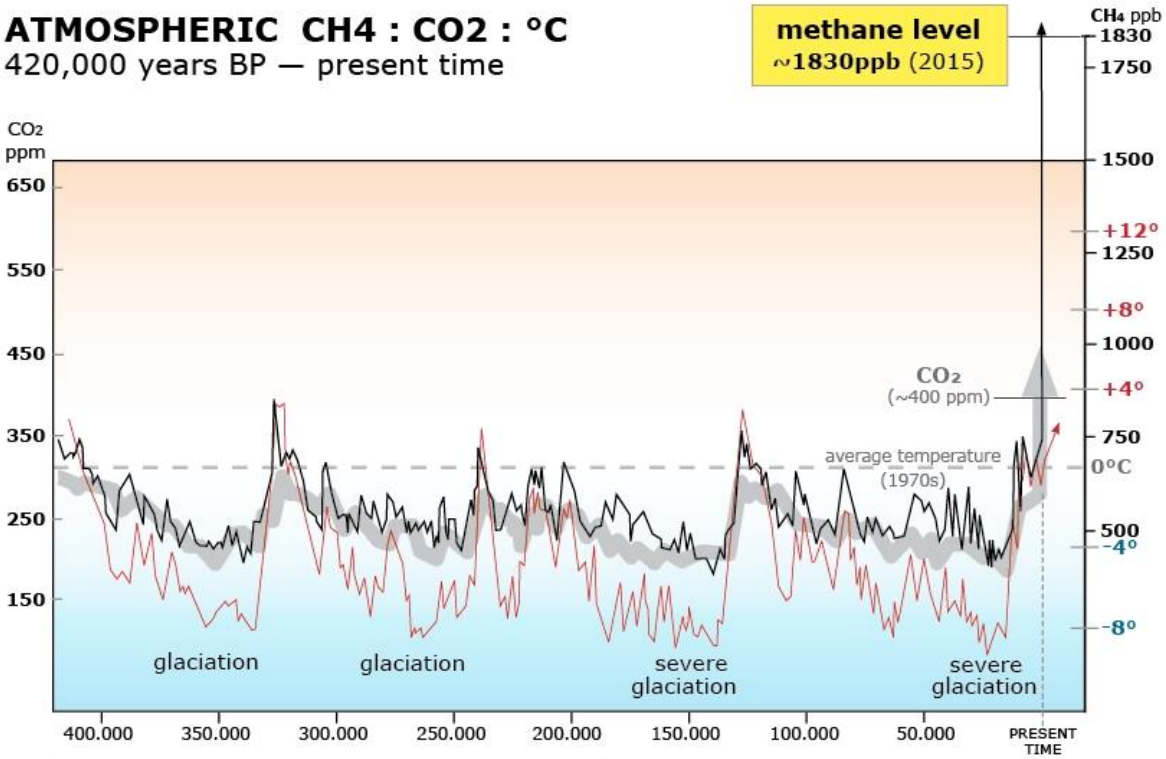
Climate positive feedback mechanisms

- The “clathrate gun”: Methane GHG locked in ice in sea floor sediments and soils by low temperatures and pressures.

- Melting arctic permafrost and destabilized carbonate rocks: 400GT CO_2. stored that might be released. Compare 400GT with humanity’s current emissions of c.50GT per year….

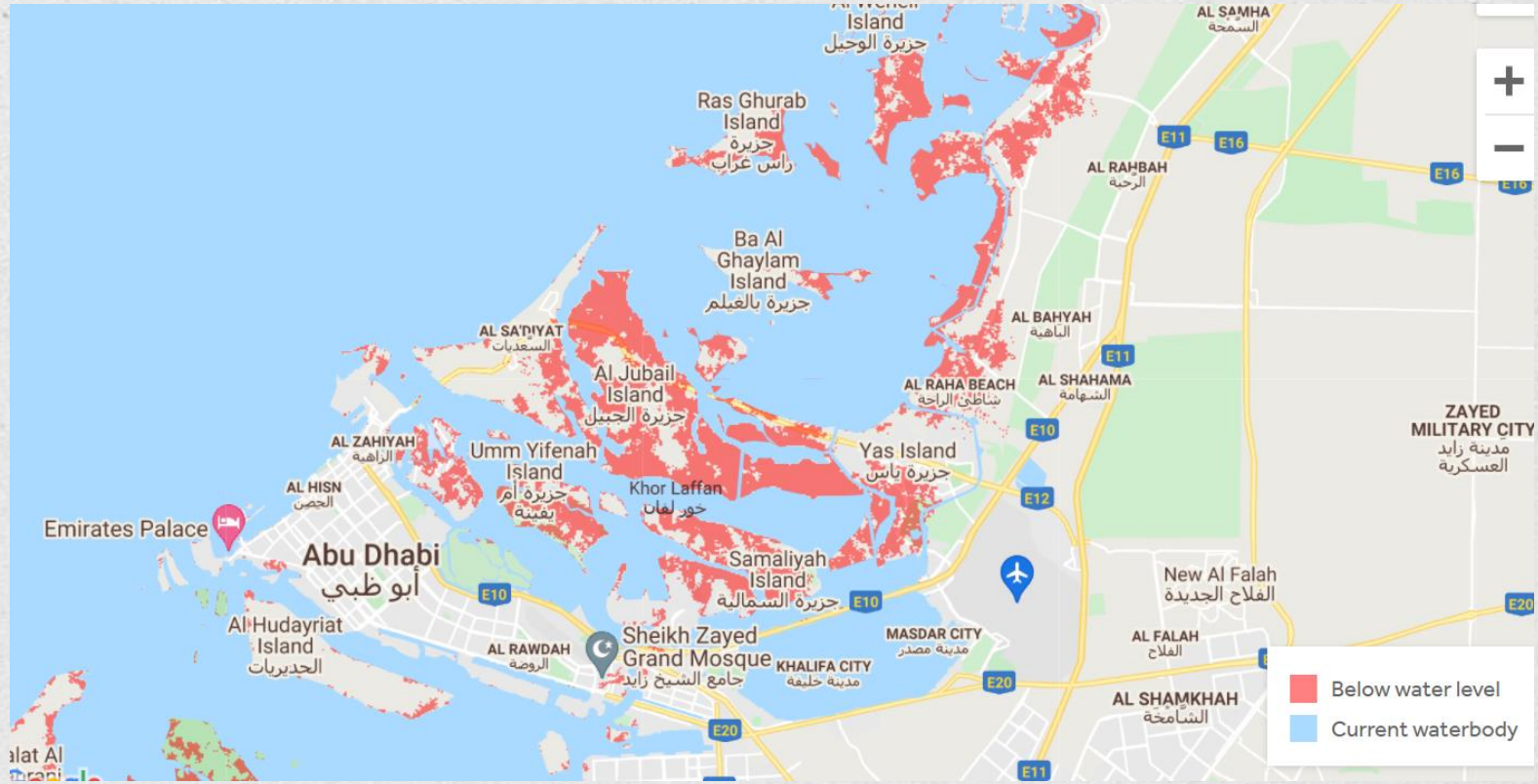
© Michael Robinson Chavez/The Washington Post, Wusel007,

Paleological records of climate change



By 2050 – sea level rise + flooding events

- Assumption: moderate cuts in emissions.



Courtesy of Climate Central

Warning signs: climate science

- A wide range of evidence is now accepted to definitely show a link between human CO_2 emissions, atmospheric CO_2 levels and global temperatures.
- The power of measurement to define changes and the power of theory and modelling to explain findings in a self-consistent structure.
- Techniques and data sources:

Ice core records	Ocean sediment cores	Isotopic enrichment analysis
Atmospheric gas measurement	Tree ring records	Paleobotany & paleozoology
Meteorological records	4-D Climate modelling	Soil chemistry
Radiometry	Atmospheric physics	Remote sensing

Where are GHGs emissions from? (1)

LED bulb – 10W, 1600 lumens, 3g CO2/hour

Incandescent Bulb - 100W, 1600 lumens, 30g CO2/hour

Candle – 80W, 13 lumens, 20g CO2/hour

Propane torch – 490g CO2/hour

© Petar Milošević, Wikipedia, Sievert Ltd, Dorno Inc.

Where are GHGs emissions from? (2)

Tesla 3 – 100km/h, 4,700g CO2/hr

Land Cruiser V8 – 100km/h, 32,000g CO2/hour

Gas Turbine – Trent 900 370kN full thrust, 64,300,000g CO2/hour

Coal Fired Power Station – 2,116MW, 1,813,714,286 g/hour

© Tesla Inc, Toyota Motors, Airbus Ltd, Alan Murray-Rust

What else releases GHGs?

Burning of forests	Intensive agriculture	Draining of wetlands
Extraction of peat	Industrial processes	Consumer goods
Gas Pipeline leakages	Coal mining	Sewage treatment
Landfill	Electrical equipment	High temperatures

Specific examples of GHG sources

- CH_4 from rotting organic material in landfills.
- N_2O from high temperature combustion of fuels and decomposition of nitrogen fertilizers in soil.
- SF_6 from high voltage power transmission and distribution switchgear.
- HFC-134a from foam manufacture, asthma inhalers, air conditioners, gas dusters etc.
- CO_2 from volcanos!

Balance

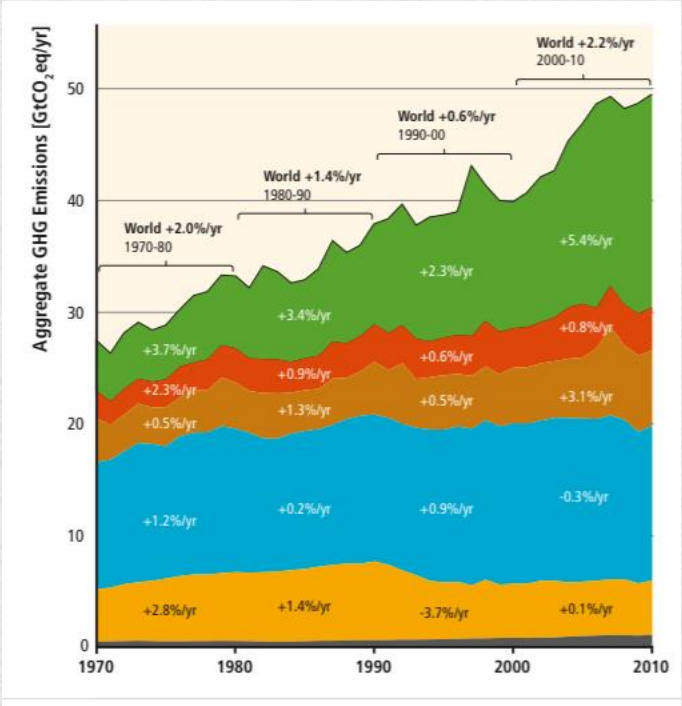
- We have to remember that the earth has always had emissions of GHGs and absorption of GHGs into natural sinks.
  - Forest fires, volcanos, drying out of wetlands, decomposition processes EMIT.
  - Coal and oil formation, soils, sediments and weathering of rocks ABSORB.

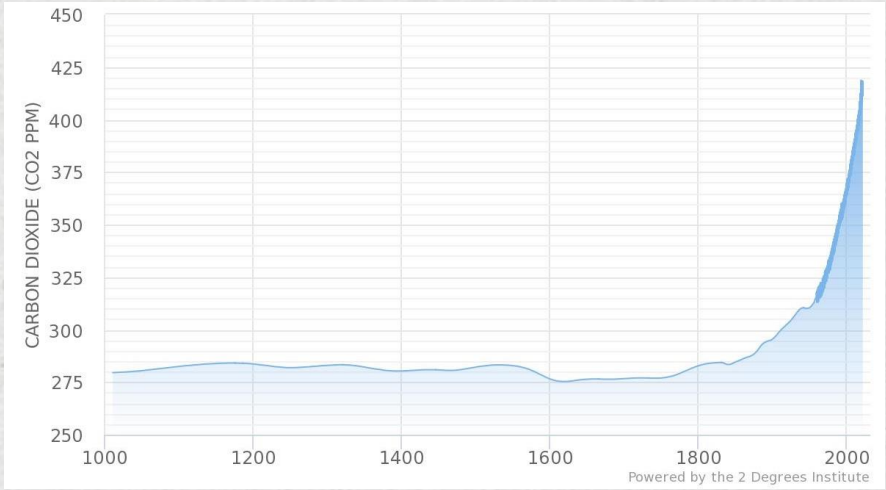
- Our understanding has changed however, and we now see that the balance between the two is actually very delicate.
- A small added excess can tip the climate out of all proportion.

© Telecoms.com

What does it add up to?

- Large increases in human emissions and atmospheric concentrations.





All GHGs, IPCC, CO2 Plot 2 Degrees Institute.

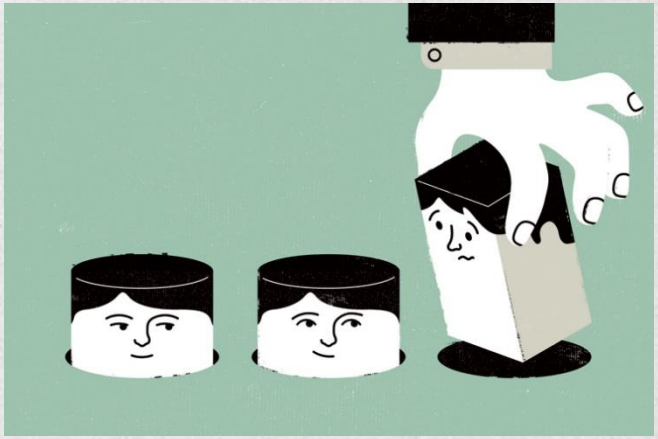
So we have to reduce emissions….

- https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Headline-statements.pdf
- Basically, the higher GHG levels are, the higher the risk of rising global average temperatures.
- The risks of severe impacts on humanity increase sharply with temperature rises above 1.5C compared with pre-industrial levels.

SECTION 3: WHY THE CONCEPT OF A CREDIT?

So what is the problem?

- When it comes to cutting back on emissions, one size does not fit all!
- Opportunities differ between people, societies, industries, nations and geographies.
  - If I already drive a Tesla, I cannot save as much as someone who drives a Land Cruiser.
  - An average paper factory cannot save as much as an average shopping mall.
- An economic solution can help to share the burden between different groups.



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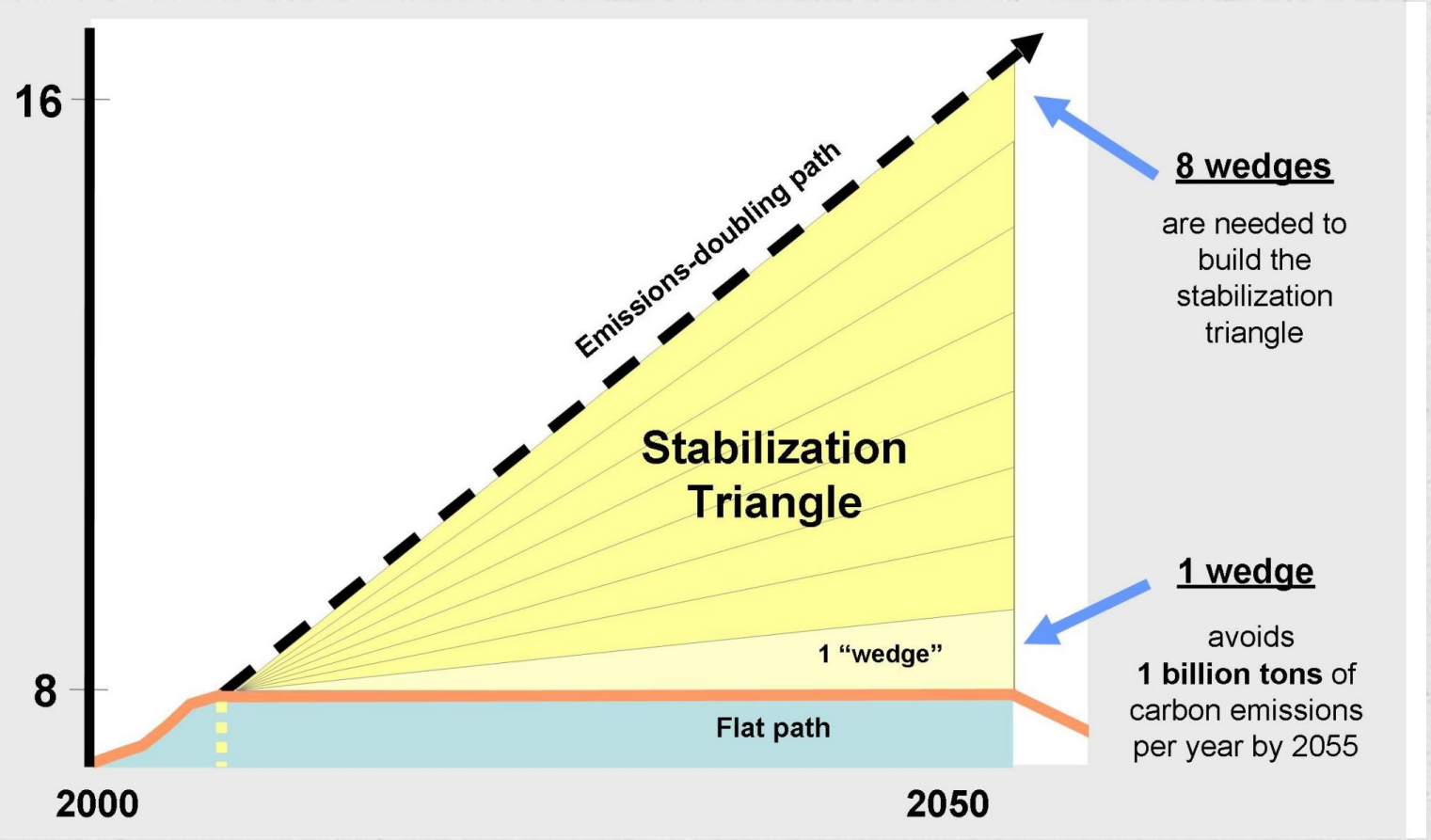
Emissions credits

- Emissions credits mean that if one person finds it easy to make savings and can prove that they are real, they can sell those savings to someone else who finds it harder to actually make savings.
- The transfer helps to unlock the emissions saving project for the saver, while the purchaser can buy the emissions “saving” for less than they would have spent on doing the project themselves.
- The use of emissions credits offers economic efficiency.

Climate Change: Reduction "Wedges"

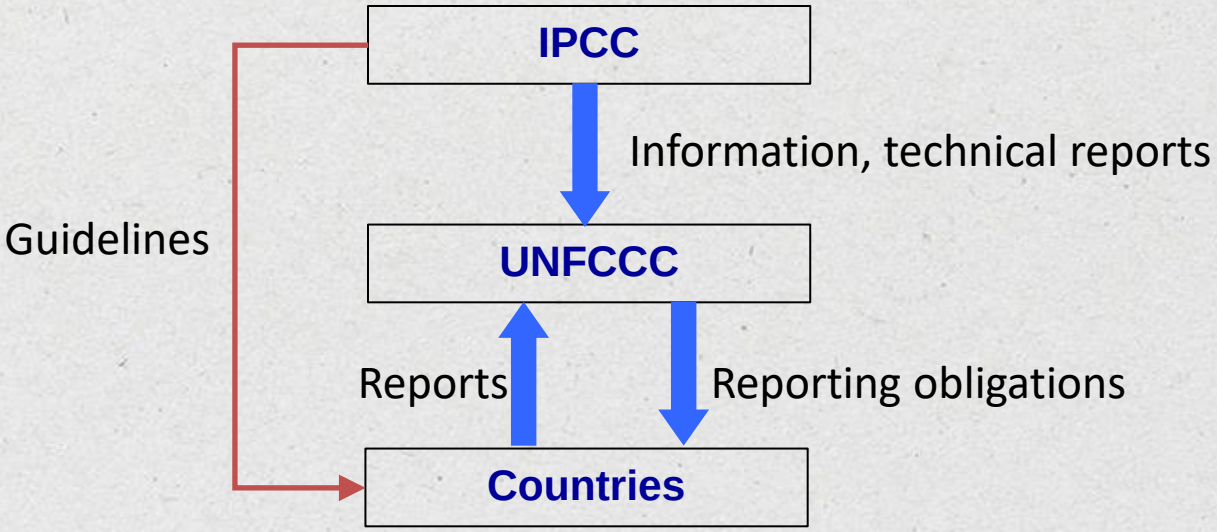


Pacala and Socolow, Science 305(5686), P968-72, September 2004

SECTION 4: CARBON TREATIES AND COMPLIANCE

United Nations: IPCC & UNFCCC

- Intergovernmental Panel on Climate Change.
- United Nations Framework Convention on Climate Change.



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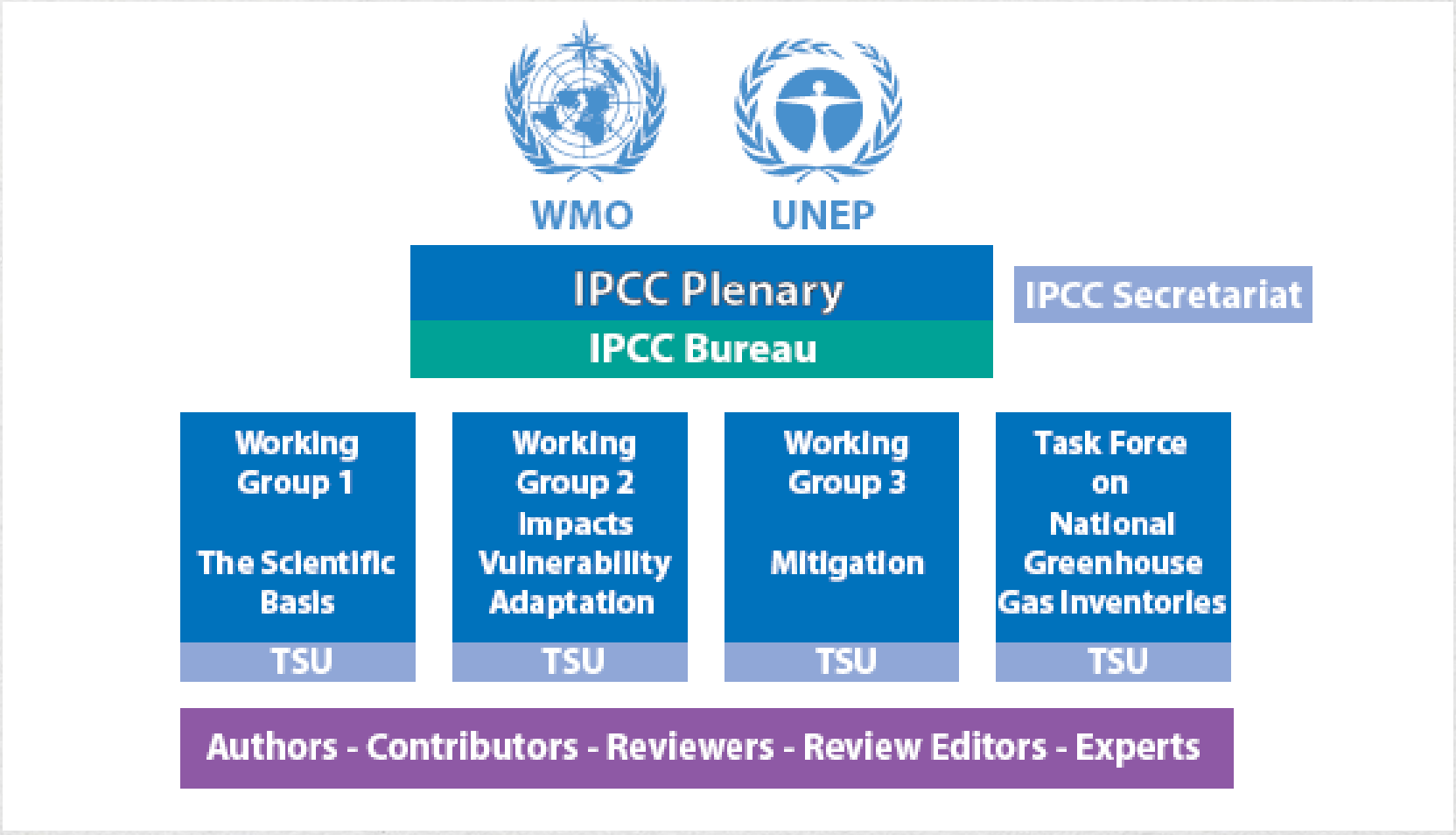
Intergovernmental Panel on Climate Change



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IPCC emissions limits

- The IPCC has defined a limit of 1.5-2C average global warming over pre-industrial levels as being a safe limit, defined as being 550ppm of CO_2 in the atmosphere.
- Beyond this there are significant concerns of runaway greenhouse effect, with activation of positive feedback mechanisms in the global climate system.

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United Nations Framework Convention on Climate Change

- The UNFCCC is the 1994 agreement between 197 Nations to prevent “dangerous” human interference with the climate system.
- It set up the general framework that determines how the problem should be approached, and how equity should be managed between wealthy and developing nations.
- It led on to the signature of an international treaty, the Kyoto Protocol in 1997.

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1997 Kyoto Protocol

- The treaty Split nations into Annex I, Annex II and Non-Annex I categories.
- Annex I are members of OECD in 1992 and Economies In Transition (EITs – mostly former Eastern Bloc Nations).
- Annex II nations are members of the OECD only, and are assigned targets under the protocol, plus obligations to assist EITS and Non-Annex I nations.
- Kyoto Annex II Nations are:
  - Australia , Austria, Belgium, Bulgaria, Canada (withdrew), Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, United States (did not ratify).

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The 2015 Paris Agreement

- Paris Agreement (2015) is not a treaty, but may lead on to the development of a new one.
- It gives further general principles and states a specific target to keep global warming below 2°C. The involved countries in the agreement are obliged to state their own emissions reduction targets, and every five years, a follow-up review is to take place to enhance and empower climate change mitigation strategies.

https://www.myclimate.org/information/faq/faq-detail/what-are-the-kyoto-protocol-and-the-paris-agreement/

The Kyoto Protocol and carbon credits

- Developed the concept of Assigned Amount Units – "AAUs"
  - The right of a nation or bloc of nations to emit one tonne of CO_2 and to trade any surplus.
  - Establishes the framework within which meaningful reductions from a nation's national inventory can be measured and traded.
- Three types:
  - Certified Emissions Reductions: "CERs".
  - Emission Reduction Units: "ERUs".
  - Removal Units: "RMUs".
  - Reductions in Deforestation and Degradation: "REDDs"

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Certified Emission Reductions (CER)

- The most important means for trading AAUs is currently using carbon credits issued under the UN's Clean Development Mechanism ("CDM").
- These credits are known as Certified Emissions Reductions, or "CERs", emissions units developed by projects certified as being compliant with the requirements of Clean Development Mechanism.
- CDM projects can only be generated within countries that are not listed in Annex 1 of the Kyoto Protocol.
- A CER gives the right within the Kyoto framework to claim a tonne of CO_2e reduction.
- Being based on improvements in Developing Nations means that the reputational benefit linked to CERs is HIGH.

https://www.fairclimatefund.nl/en/news/from-30-eurocents-to-25-euros-the-price-of-a-tonne-of-co

https://en.wikipedia.org/wiki/Certified_Emission_Reduct

Emission Reduction Units (ERUs)

- Where two nations in Annex 1 of the Kyoto Protocol agree that projects in one can reduce emissions more cheaply than the other.
- The reduction projects are managed under the “Joint Implementation” mechanism.
- The ERUs are issued out of the reducing nation’s allocation of Assigned Amount Units.
- Because both nations are within Annex 1 of the protocol, they will have good measurement systems in place, so certainty will be high.
- However reputational benefits from ERUs are LOW.

Removal Units (RMUs)

- Where an Annex 1 nation certifies that a tonne of CO_2 is removed from the atmosphere into a carbon sink.
- The carbon sinks concerned are biological in nature.
- Generated by projects including:
  - Land use.
  - Land use change.
  - Forestry.
- They build up carbon in stored biomass, such as trees, organic materials in soils and sediments in peat bogs.

https://www.fairclimatefund.nl/en/news/from-30-eurocents-to-25-euros-the-price-of-a-tonne-of-co

https://en.wikipedia.org/wiki/Certified_Emission_Reduct

Reductions in Deforestation & Degradation (REDD)

- Where a project in a non-Annex 1 nation certifies that a tonne of CO_2 is prevented from entering the atmosphere because it remains in an existing carbon sink or through restoration or enhancement of past or existing sinks.
- Prevention of deforestation.
- They build up carbon in stored biomass, such as trees, organic materials in soils and sediments in peat bogs.
- Because REDD credits are linked to the protection of nature and biodiversity, their reputational benefits are HIGH.

https://www.fairclimatefund.nl/en/news/from-30-eurocents-to-25-euros-the-price-of-a-tonne-of-co

https://en.wikipedia.org/wiki/Certified_Emission_Reduct

Example of REDD+ Project

- Kariba REDD+ project in Zimbabwe, covers 7,850km^2 of forest and aims to generate 52 million tonnes of emissions reductions over 30 years. Helps famers to move from slash-and-burn agriculture by training them in how to look after the soil and maintain fertility.

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Sometimes credits are not claimed…

- Jubail Mangrove Park, Abu Dhabi, UAE.

- Skerne Wetlands, Yorkshire, UK.

© Government of Abu Dhabi, Yorkshire Wildlife Trust

SECTION 5: QUALITY AND ADDITIONALITY

Quality of credits is paramount

- Carbon credits are COUNTERFACTUAL.
- They represent something that did not happen!
- This means that proving them is much more difficult than for tangible goods or services.
- Apart from accurate and repeatable measurement of quantities, the key issue is **additionality**.

Additionality

- Additionality refers to whether or not an emission saving would have happened anyway.
- If it would have happened anyway then it has no value.
- A key aspect of certifying emissions reductions is proving additionality.
- A simple test is whether the value paid for the carbon credit had a significant impact on the economics of the project that made the savings.
- However if carbon prices are low, this means that projects are not viable and emissions cannot be saved.
- Chicken and egg!

Quality again!

- A key element of the value of a credit is how attractive it is.
- What are the qualitative aspects that might make stakeholders value a project more?
- CERs intrinsically more attractive because they are accurately measured according to approved methodologies and come from developing nations where carbon project income can make a real difference.
- Within this category there are also projects that are:
  - Industrial in nature – less attractive, and;
  - Projects that are strongly social in nature – more attractive.

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High attractiveness projects

- Cook stoves. Replacing open wood fires for household cooking with engineered wood stoves:
  - Deliver savings by improving efficiency and reducing deforestation.
  - Reduce lung damage from indoor air pollution.
  - Greatly reduce time needed to gather firewood.
  - Especially beneficial to women.
- Solar lamps. Replacing expensive kerosene lamps or electric lights driven from diesel generators with solar battery-powered LEDs:
  - Free up household income to purchase other goods and services, especially education.
  - Allows children to study after sunset, assisting in educational development.

SECTION 6: CREATING A DEMAND FOR CREDITS

What creates a demand for credits?

- Mandatory arrangements, such “Cap and Trade” schemes, where nations require that certain organisations offset their emissions:
  - EU, UK, California, Shanghai, Korea.
- Voluntary schemes and commitments, where companies decide to offset for reputational reasons:
  - To gain access to capital.
  - To maintain or grow consumer commitment.
- Innovative product offerings, where companies offer products that appeal to the moral values of consumers:
  - Flight offsets.
- Personal offsetting, where individuals decide to measure their own emissions (approximately) and to purchase and “retire” carbon credits to cancel them out.

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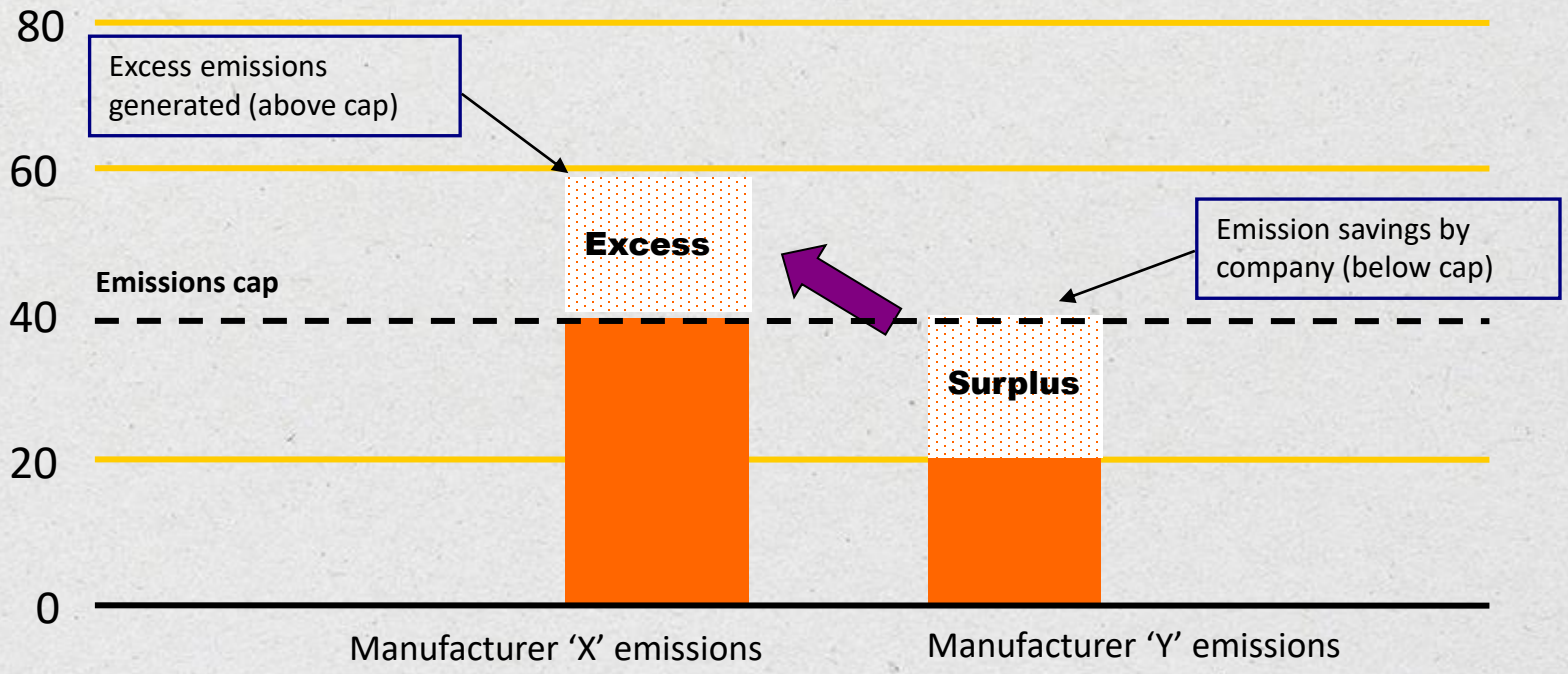
How do cap and trade schemes work?

- They sit within a nation or a region and consider the AAUs that have been assigned to that area.
- The “permits to emit” are then shared out between the obligated entities – usually industries and the power sector.
- During the sharing process, the government identifies how much of a reduction it wants to drive, and shares out permits to industries that emit CO_2 in such as way that each site has a cap on emissions that is less than its expected emissions.
- The obligated entities must then not exceed the cap, either through:
  - Reductions in actual emissions.
  - Buying surplus permits from other obligated entities in the scheme.
  - Buying credits that are allowed under the scheme – usually CERS.

The workings of a “cap and trade” scheme

Where one company reduces emissions below the cap, they may sell their ‘excess’ credits to companies who have exceeded their own emissions cap



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European Emission Allowances (EUAs)

Demand for compliance credits…

- The compliance market is the largest market for carbon credits.
- It also offers the highest prices because entities are legally obliged to comply.
- Demand for compliance credits has swung back and forth very sharply.
- This is because these markets are very new and demand is strongly dependent on how mechanisms have been set up.
- If initial understanding of mechanisms is poor, then demand and supply will be out of balance.
- It takes time for such markets to evolve and for compliance limits to be set so that sensible market prices and smooth growth can ensue.

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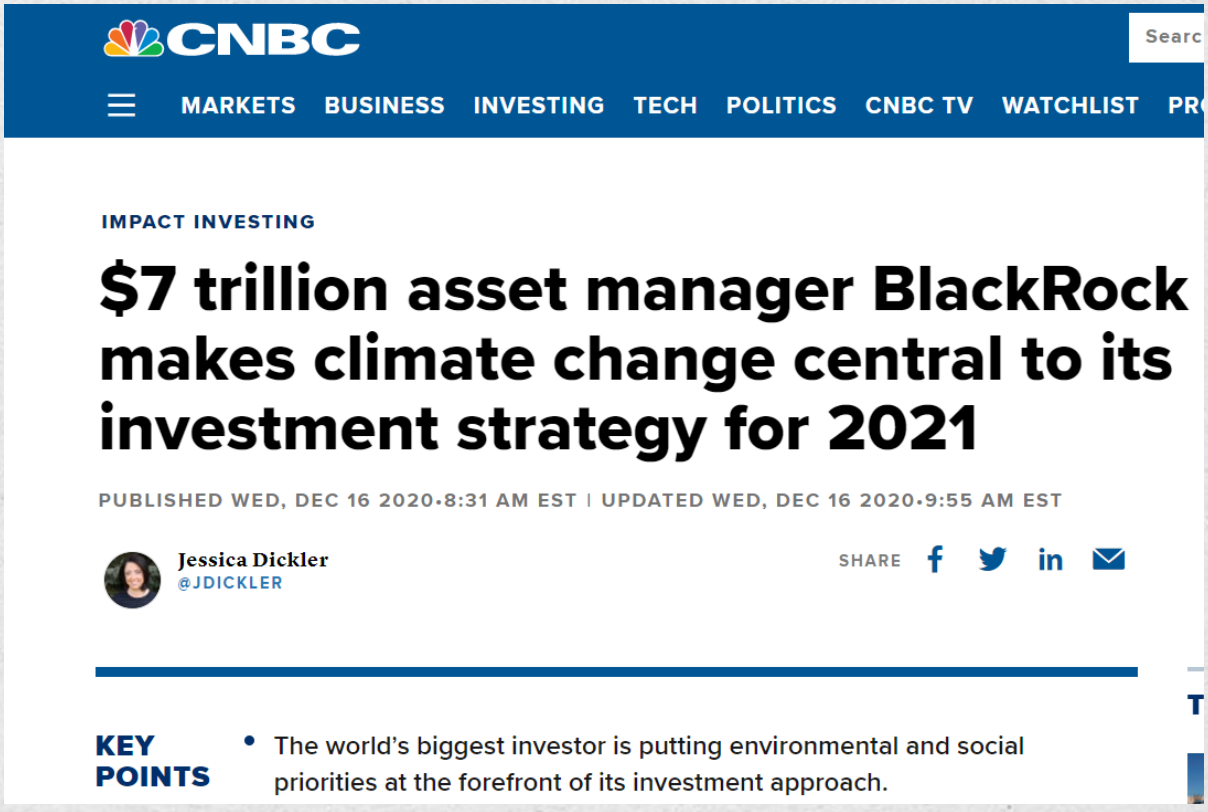
Voluntary credit consumption – customer outreach

- Companies who want to show that they care – so consumers will favor their products……

Voluntary credit consumption – investor activisim

- Investors who wish to attract funds from ethical investors…..



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MARKETS BUSINESS INVESTING TECH POLITICS CNBC TV WATCHLIST PR

IMPACT INVESTING

$7 trillion asset manager BlackRock makes climate change central to its investment strategy for 2021

PUBLISHED WED, DEC 16 2020•8:31 AM EST | UPDATED WED, DEC 16 2020•9:55 AM EST

Jessica Dickler
@JDICKLER

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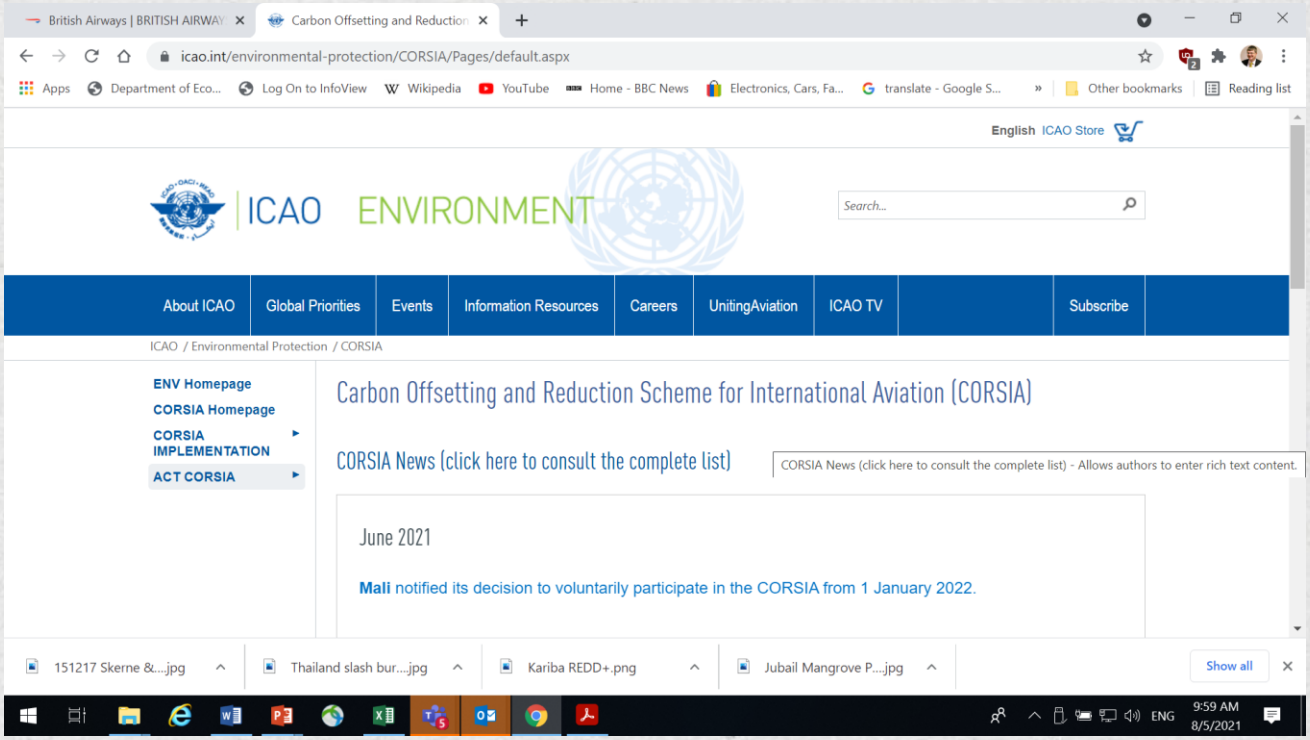
KEY POINTS

- The world's biggest investor is putting environmental and social priorities at the forefront of its investment approach.

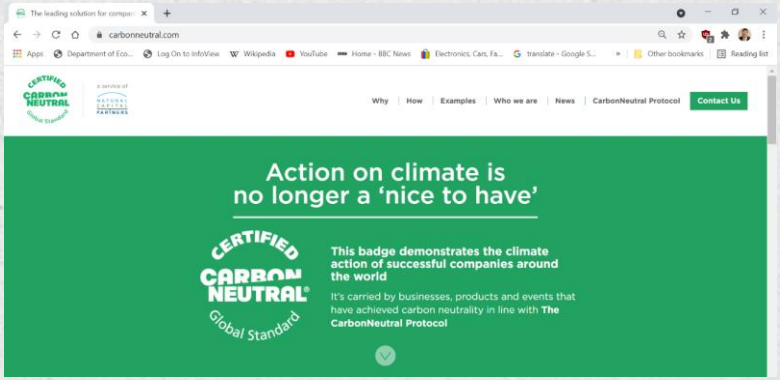
Voluntary credit consumption – industry schemes

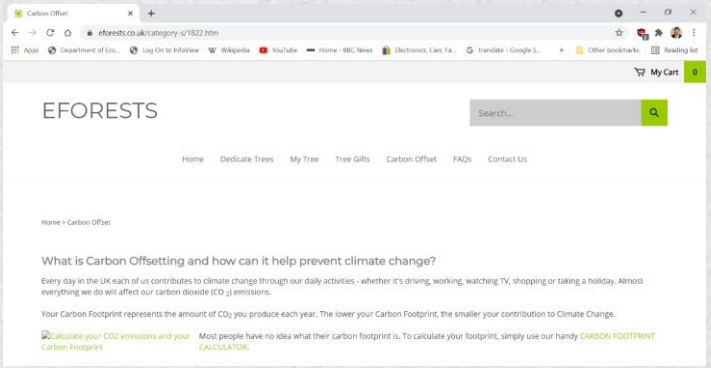
- Industries coordinating amongst companies so as to avoid governments applying mandatory schemes to them.
- The air transport sector is the most prominent…..

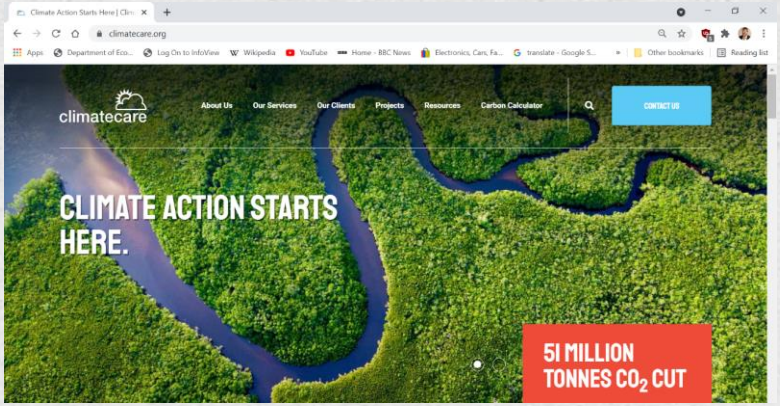


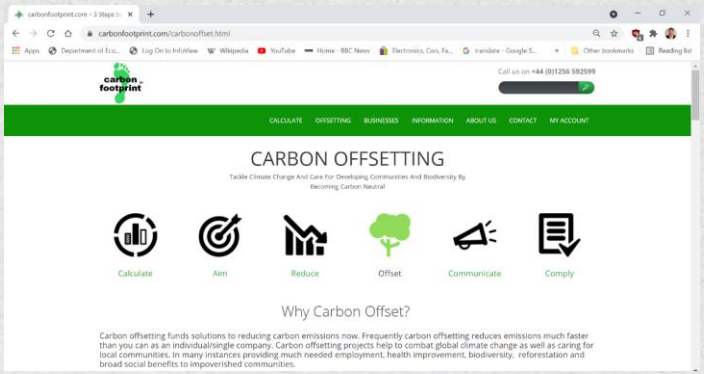
Voluntary credit consumption – individuals

- People just getting out there and offsetting their own emissions using service providers.









8–9 Bn Tonnes CO_2 worth $227 Bn is Traded Annually…..

Type	Emission allowance	Carbon credit	
Utilization	The right to emit 1 tonne of CO_2	Rightful claim to 1 tonne CO_2e reduction realized within the Kyoto Protocol	Verified claim on 1 tonne CO_2e reduction realized for voluntary compensation
Examples and prices	EU ETS - ***European Union Allowance (EUA)*: €25** Korea ETS - ***Korean Allowance Unit (KAU)*: €25** California Cap and Trade Program - ***California Carbon Allowance (CCA)*: €14** Shanghai Pilot ETS - ***Shanghai Emissions Allowances (SHEA)*: €5** * Rounded prices in May 2019	Clean Development Mechanism (CDM) projects - ***Certified Emission Reduction (CER)*: €0,23 *** Joint Implementation (JI) projects - ***Emission Reduction Unit (ERU)*** Land Use, Land Use Change and forestry (LULUCF) - ***Removal Unit (RMU)*** * Foward CER December 2019 price	Credits of projects with a voluntary standard: ***Verified Emission Reduction (VER)*** - ***Gold Standard*: €4*** - ***VCS*: €2*** - ***CDM*: €3,50*** - ***REDD+*: €4** - ***Fairtrade minimumprijs*: €8,10 - €13,00** * Average prices - Ecosystems Marketplace - State of the Voluntary Carbon Markets 2017

https://www.fairclimatefund.nl/en/news/from-30-eurocents-to-25-euros-the-price-of-a-tonne-of-CO_2

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