Climate Policy

The United Nations provides the international mechanism for addressing climate change through the UNFCCC.

The stated goal is: …*to prevent dangerous human interference in the climate system.*

The benchmark of *dangerous interference* is measured against 3 arenas of impact:

- sustainable development
- agricultural productivity
- ecosystem response

Climate Policy

The convention states that carbon emissions and climate change should be arrested in a time frame that allows ecosystems to:

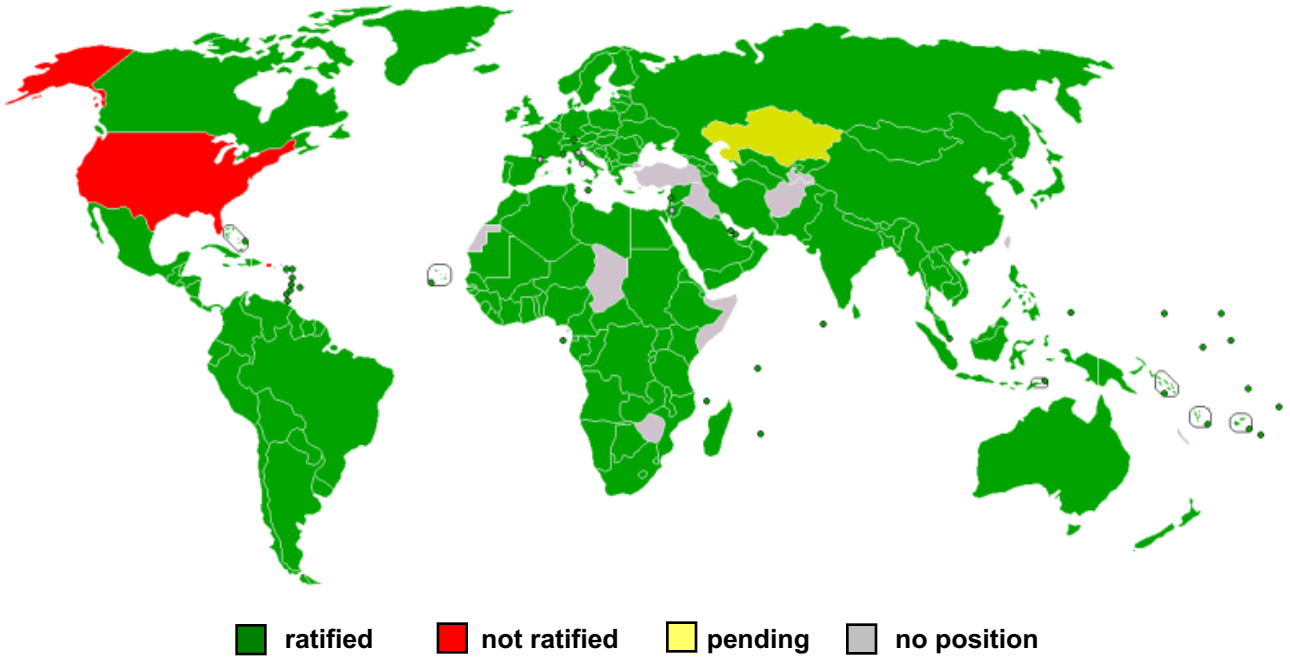
- adapt naturally to climate change
- does not impede sustainable development
- maintains agricultural productivity

Because human-induced change may be different from past changes in both magnitude and speed it may be impossible to set a baseline for *adapt naturally*.

And of course, that is the weasel-word phrase countries are using to avoid action.

Human-induced extinction violates the spirit of adapt naturally so examining extinction risk is key to enforcing compliance.

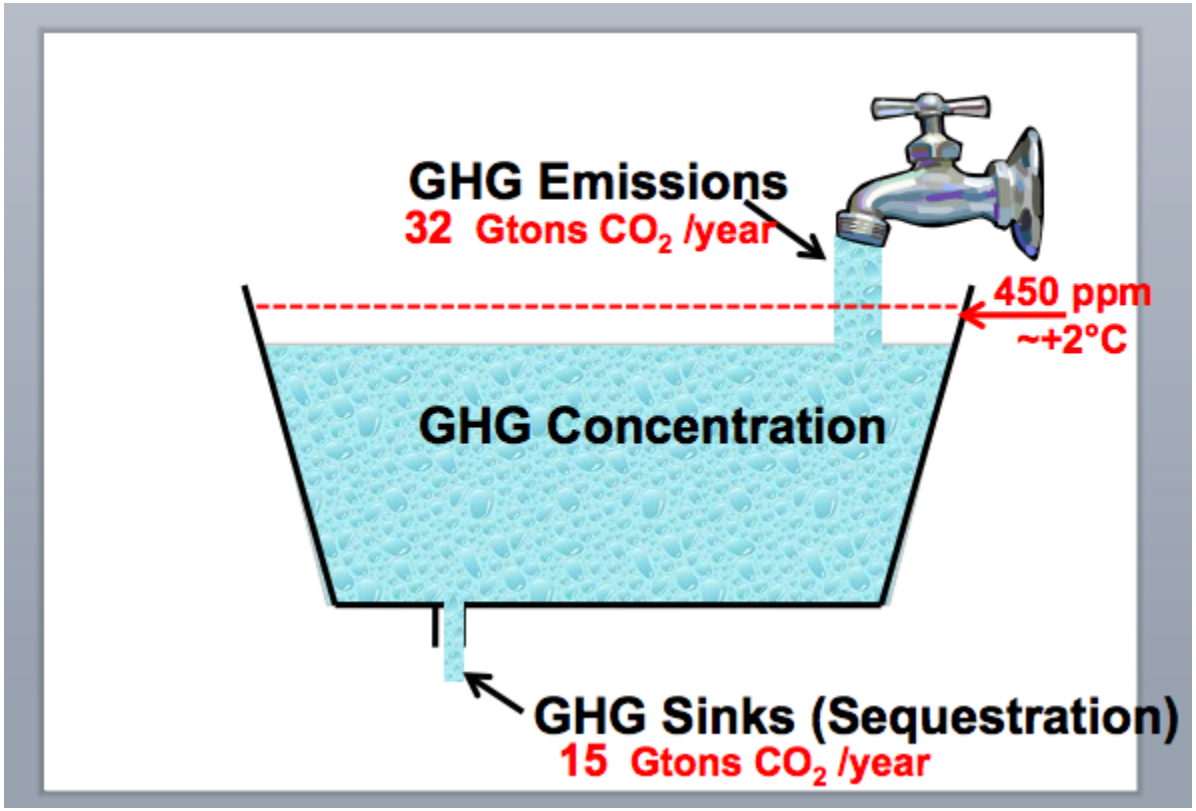
Kyoto Protocol



The Kyoto Protocol was the first set of rules from the UNFCCC and called for 37 industrialized countries (in 2005) to reduce carbon emissions to 10% below their 1990 levels.

Under the leadership of George W. Bush, the USA did not ratify the protocol since rapidly developing countries like China and India were not defined as “industrialized” and were not required to cut their emissions.

Stabilizing Greenhouse Gas

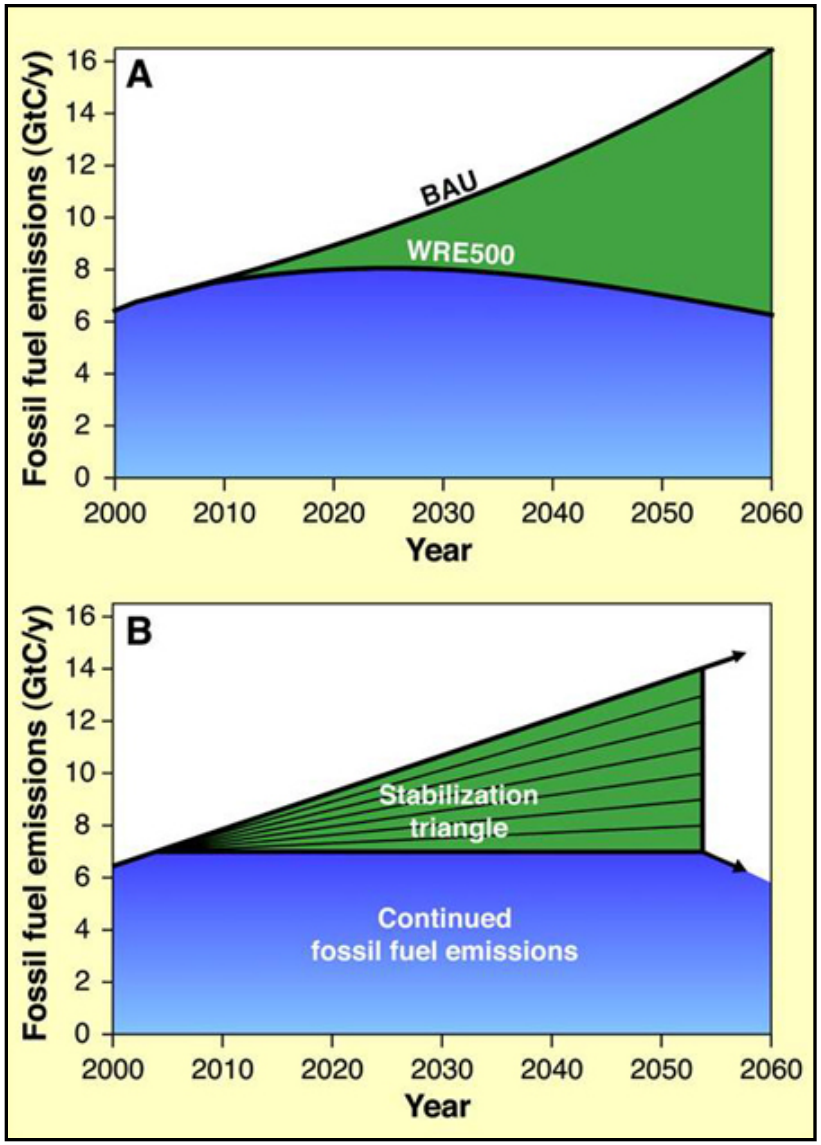


In the absence of more “sinks”, stabilizing the GHG concentration means turning off the tap.

Most policy discussions are aimed at stabilizing GHG concentration at 550 ppm, a level we are rapidly approaching.

The EU has set its target at 450 ppm which is unrealistic since current levels are near 400ppm.

Stabilization Wedges



Business As Usual will drive our carbon footprint up along the BAU line.

The goal of 500 ppm GHG concentration requires we follow the WRE500 curve.

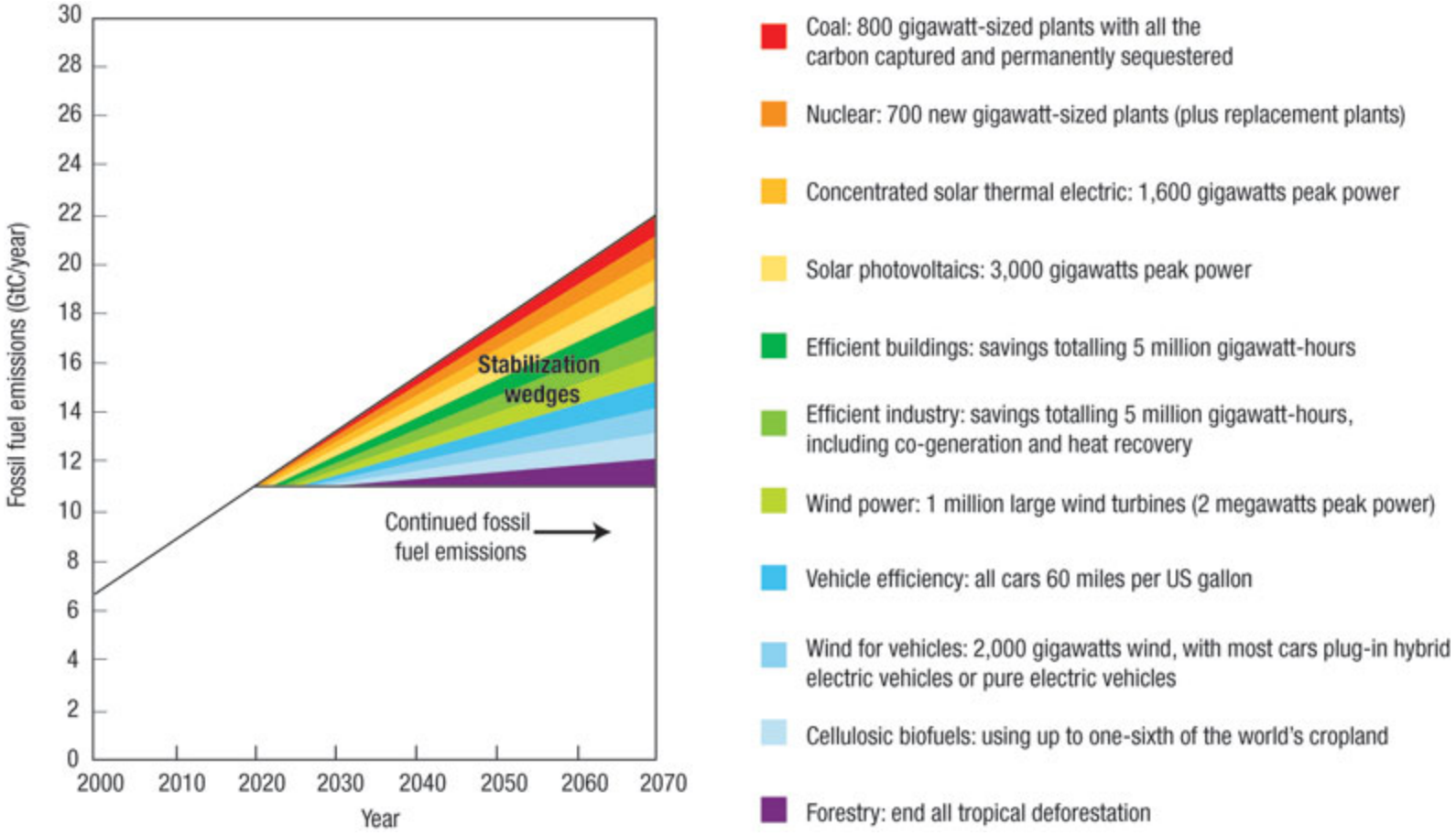
One strategy is to substitute “wedges” that offset the green portion of the upper curve.

These could include shifting portions of energy needs to alternate sources that have no carbon footprint.

Some of the “wedges” could involve deploying technologies that sequester increasing portion of the carbon footprint.

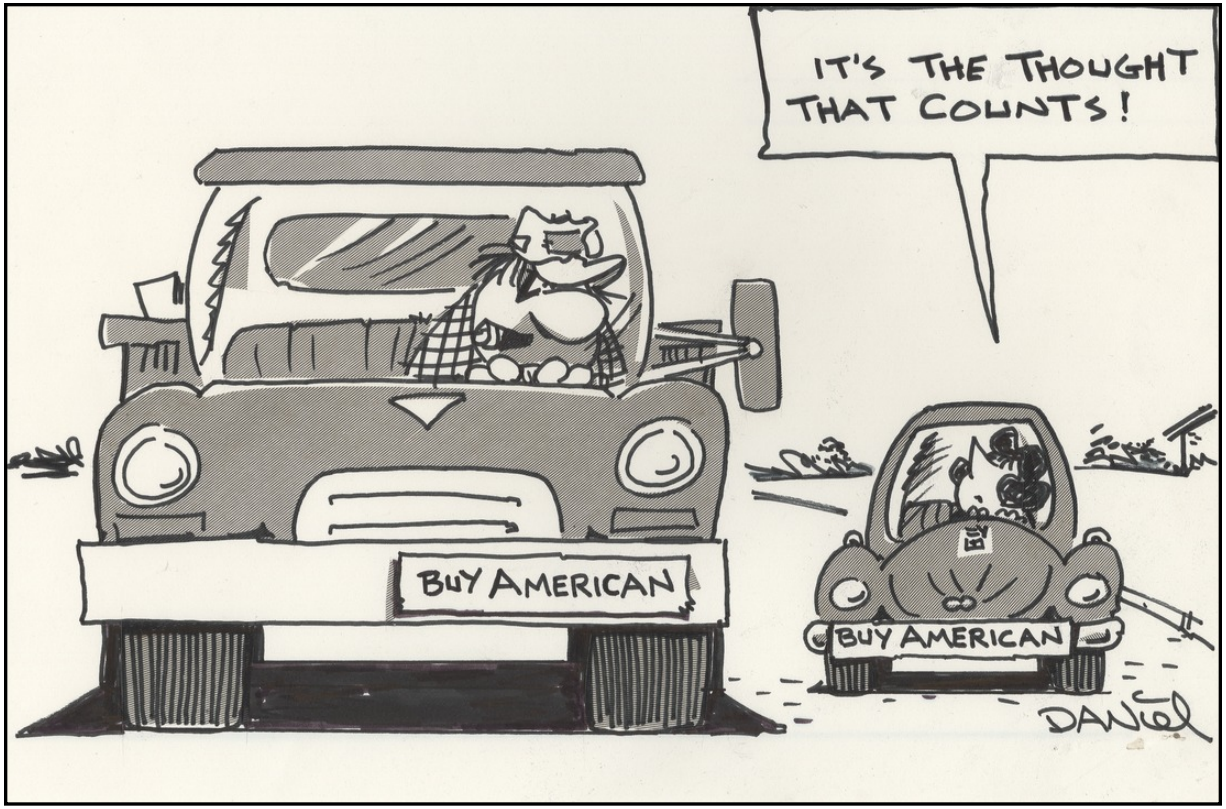
The latter are referred to as carbon offsets.

Stabilization Wedges



The trick is to get industry and governments to work together so these wedges are more profitable than the simple burning of fossil fuel.

Energy Efficiency



While switching sizes and types of cars is an obvious way to improve efficiency, large savings can be obtained by developing and deploying more efficient appliances, windows, heating and cooling systems and endless other of our necessities.

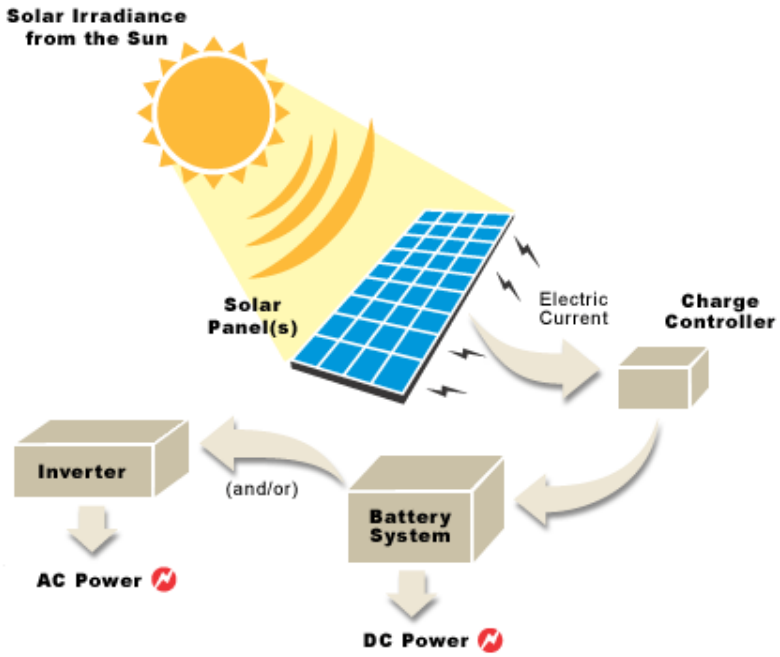
Or perhaps doing without some of them – electric can openers are a particularly annoying.

Renewable Energy Sources

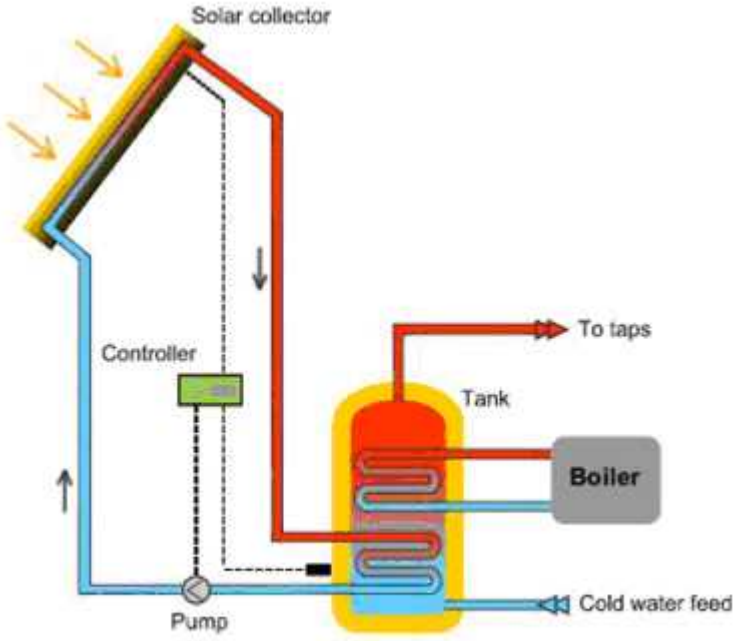
Renewable energy sources do not have a carbon footprint and do not directly contribute to climate change.

Canada meets more than 50% of its electric needs and more than 25% of its total energy needs with hydroelectric power.

Solar Energy



solar voltaic



solar thermal

There are two forms of solar energy that can be used at various scales from home upward.

Solar voltaic systems can be used at a “personal” level to charge every one of your personal electronic devices very efficiently and conveniently.

Solar Energy

Elements of massive solar farms can be mounted and controlled to track the sun to improve efficiency.

Moveable and fixed units can be deployed on existing roof tops so as not to use valuable crop land.

These arrays can drive either voltaic or thermal systems, although the latter are more difficult to install and maintain.

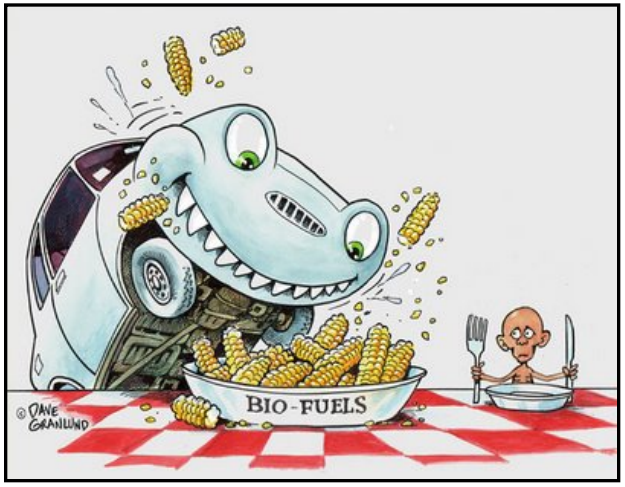
As solar voltaic systems become more efficient and make use of nanotechnology, it is possible that they could provide all residential electricity by the mid 21st century.

That would be a huge *wedge*.

Wind Power

It is possible that wind power may provide as much as 50% of electricity demand by 2050.

Biofuels



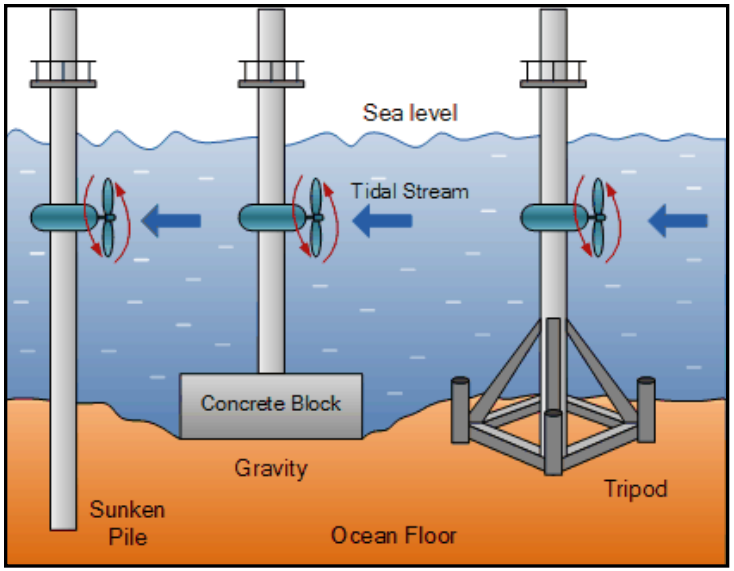
These include both ethanol and biodiesels and clearly there are some political issues that should get covered in the debate.

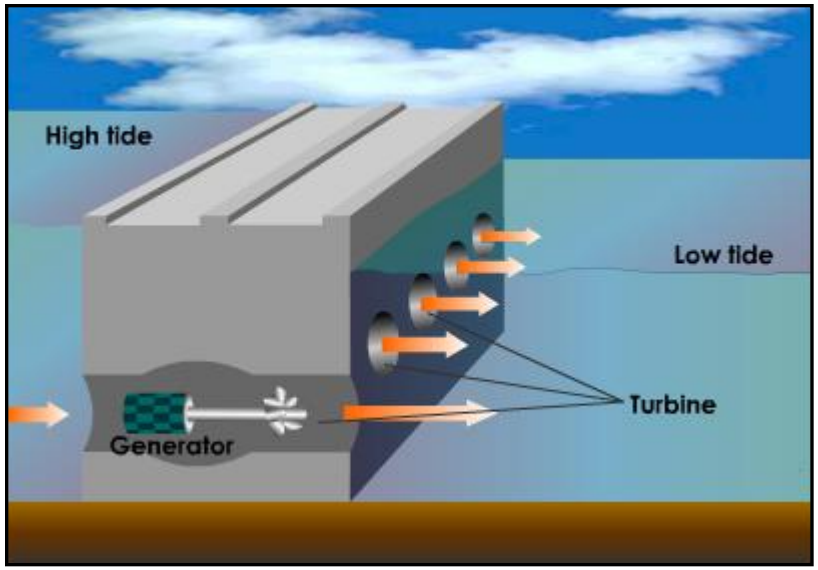
Biodiesels can be made from crops but also from the recycling of waste cooking oil.

The debate will hopefully reveal that while lowering our dependency on oil, biofuels add GHG during their production so are not truly renewable.

On a personal note, biodiesel made from cooking oil burns with an odor and has attracted polar bears to houses and vehicles using it in Churchill, Manitoba.

Tidal Power





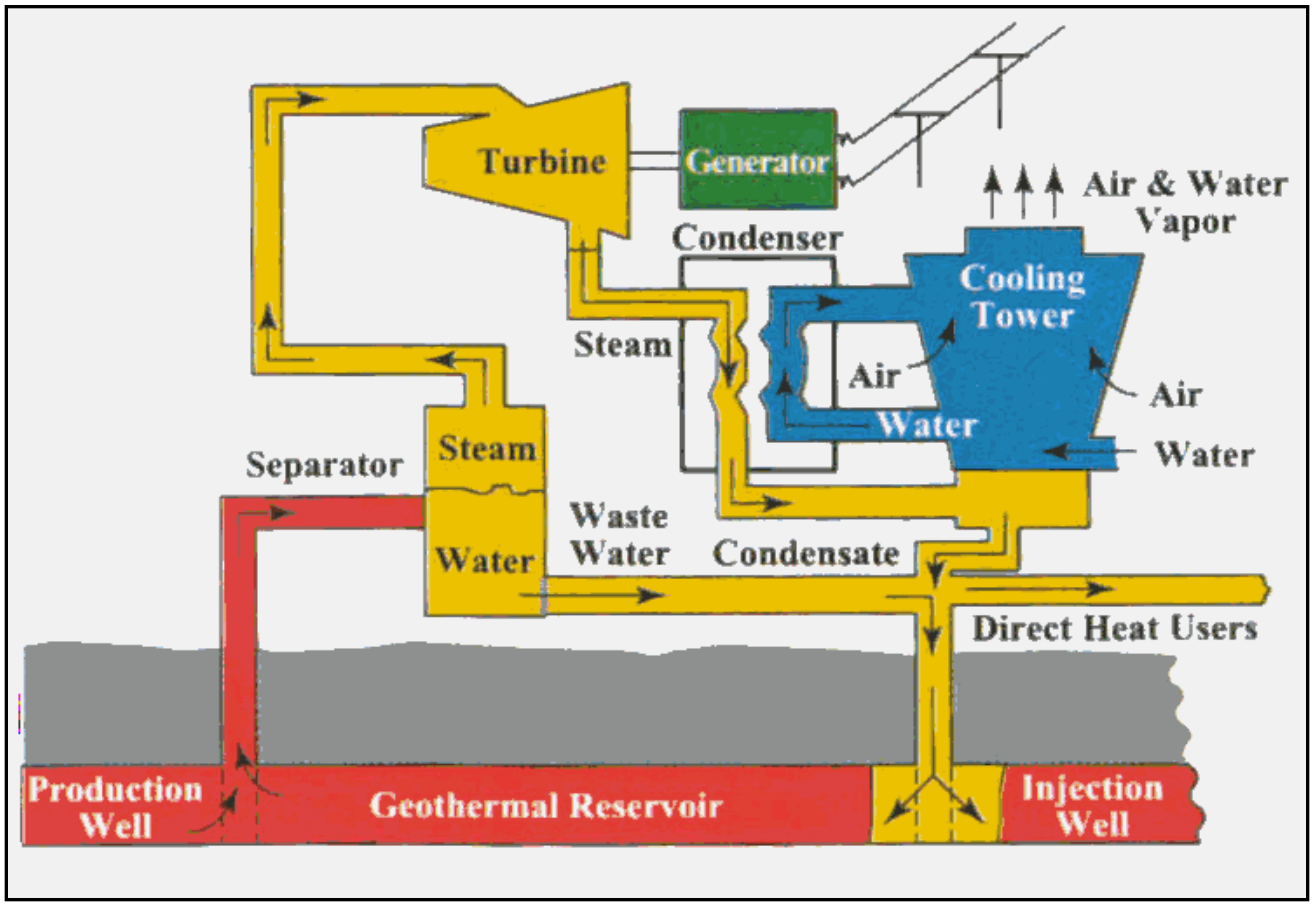
There are two basic types of tidal generation systems in development.

Free standing systems have bidirectional propellers that are kept below the low tide level and generate on in- and out-bound tides.

The second and more common system is associated with a barrier across a tidal river where turbines spin on the inbound tide.

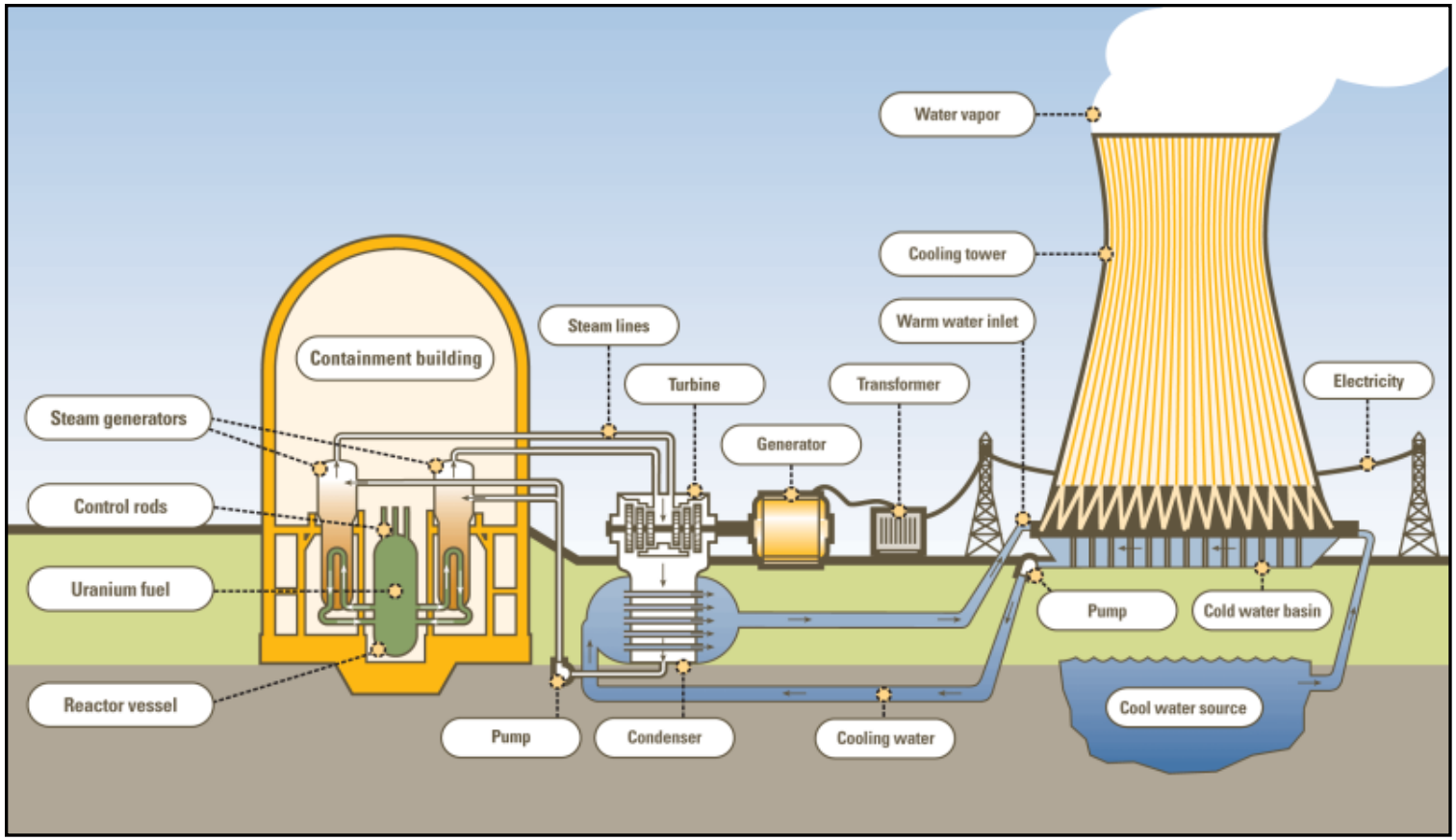
The addition of sluice gates and bidirectional turbines allows the high tide water to be trapped and released as in traditional hydroelectric systems.

Geothermal Power



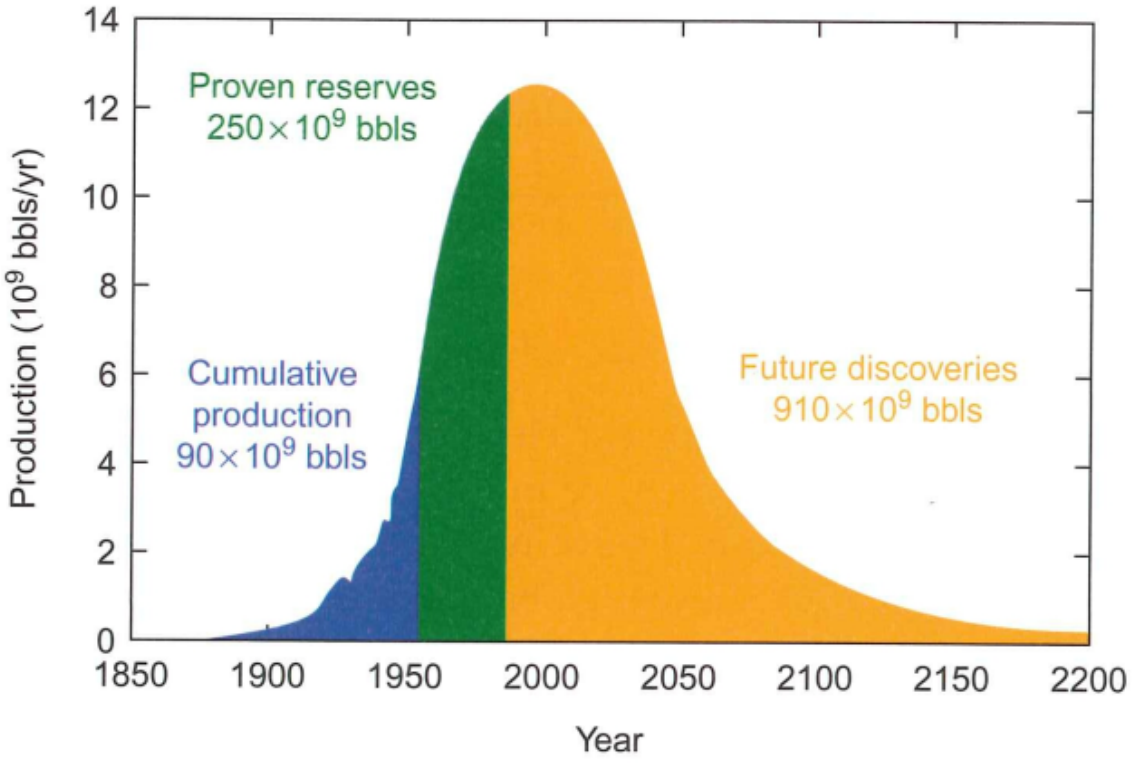
In regions like Iceland where geothermal reservoirs are close to the surface these systems are used for producing both electricity and heat for home use.

Nuclear Power



Nuclear power is not renewable but it produces no GHG and if waste can be safely stored and there are no meltdowns it is a safe source of electric power.

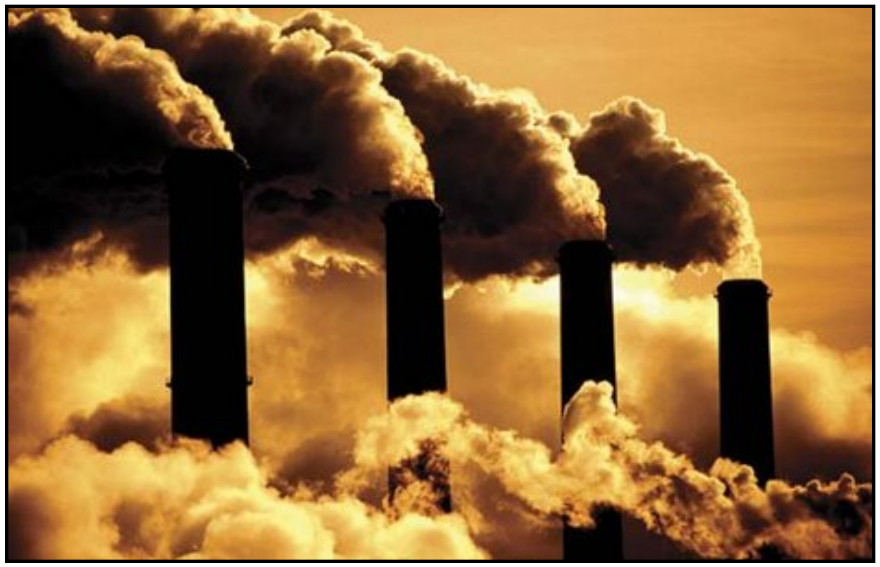
End of Oil



While we may find some more deposits, there is only so much oil and when it is gone if is gone.

If this happens before we convert to renewable energy sources, the scramble may result in using even worse non-renewable options such as coal.

Coal



World coal reserves are 4 to 5 times the size of oil reserves and 28% of them are in the USA.

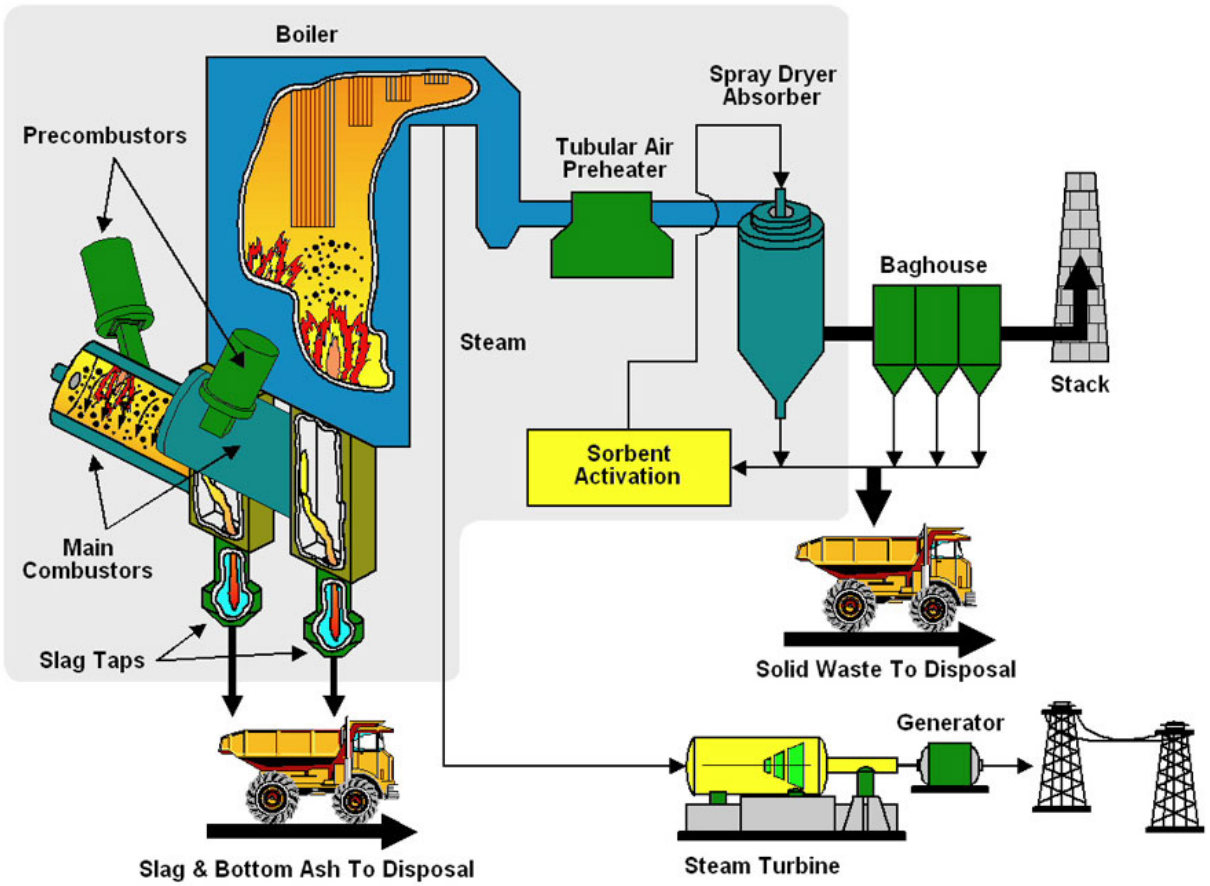
Emissions from coal do not just include high levels of CO_2 but also include particulate carbon (soot) that is related to asthma.

Other inclusions are: NO_2 and SO_2 (that combine with water to form nitric and sulfuric acid), mercury and cadmium.

Coal

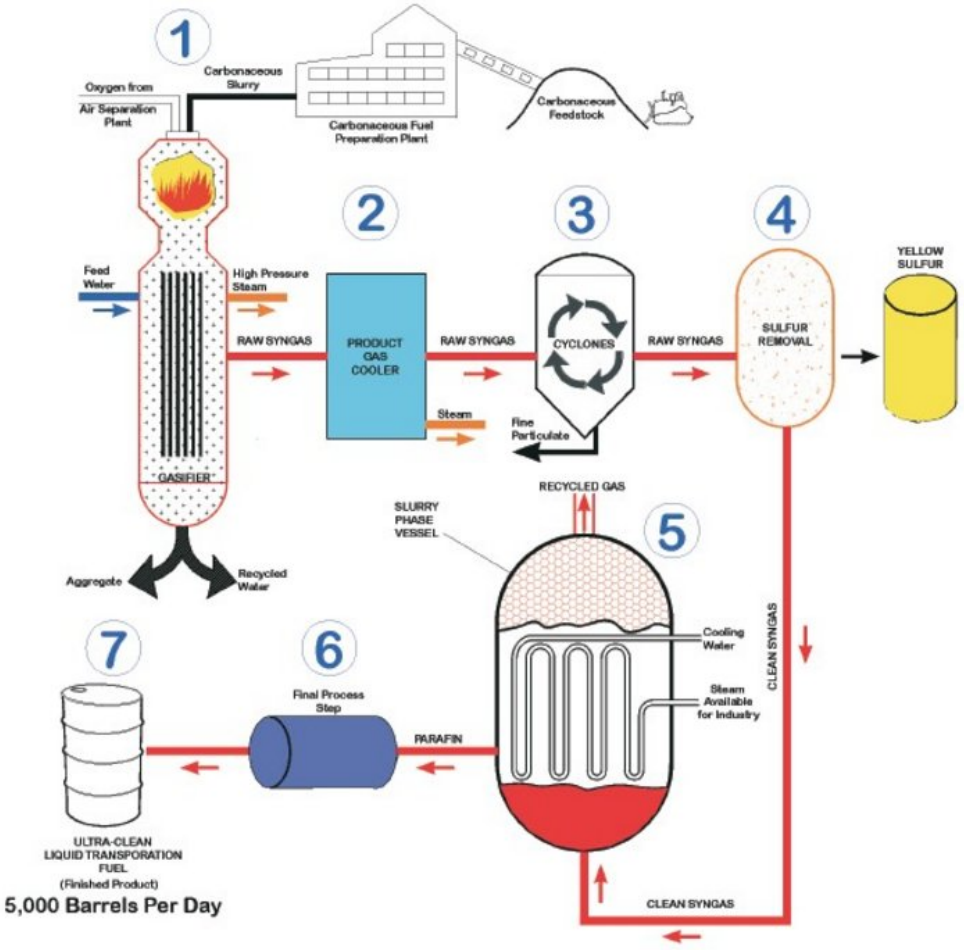
So is it possible to clean coal and make it safe?

Coal Scrubbing



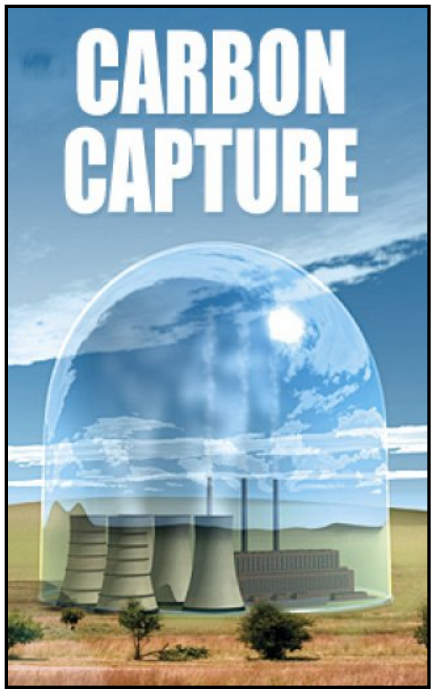
One approach is to clean up the combustion but there are issues of toxic solid waste and the cost of installing “scrubbers” is extreme.

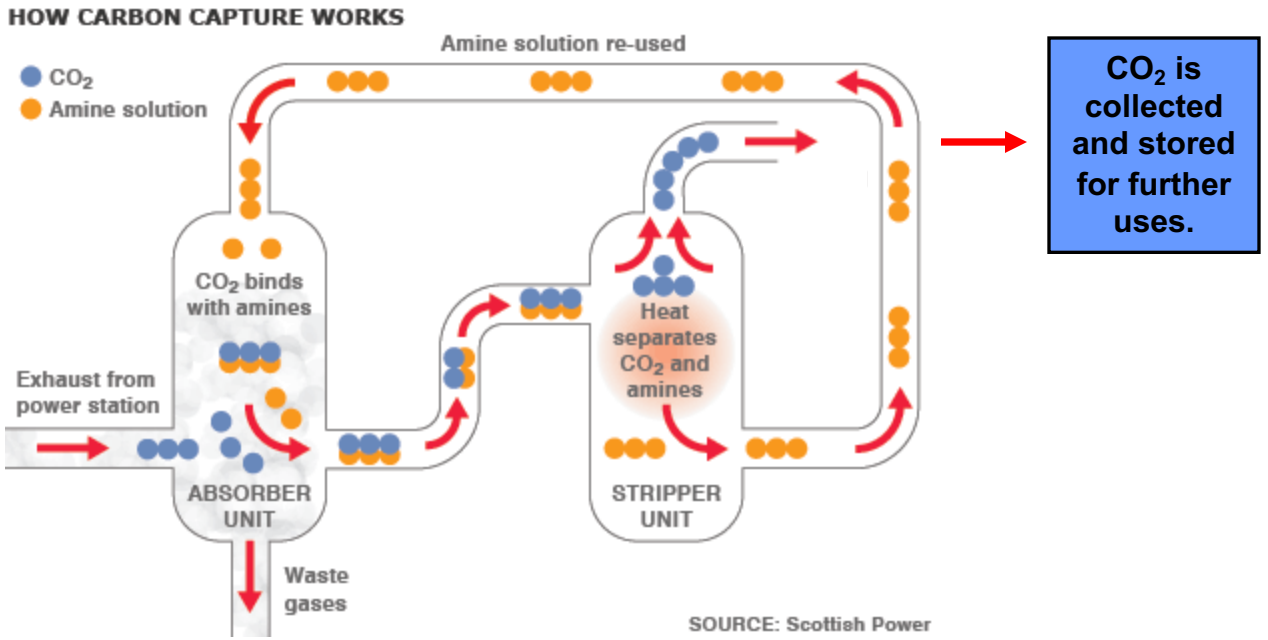
Coal Liquefaction



Another approach is to “liquefy” the coal, removing the most harmful compounds chemically during processing.

Capture and Sequestration of CO_2

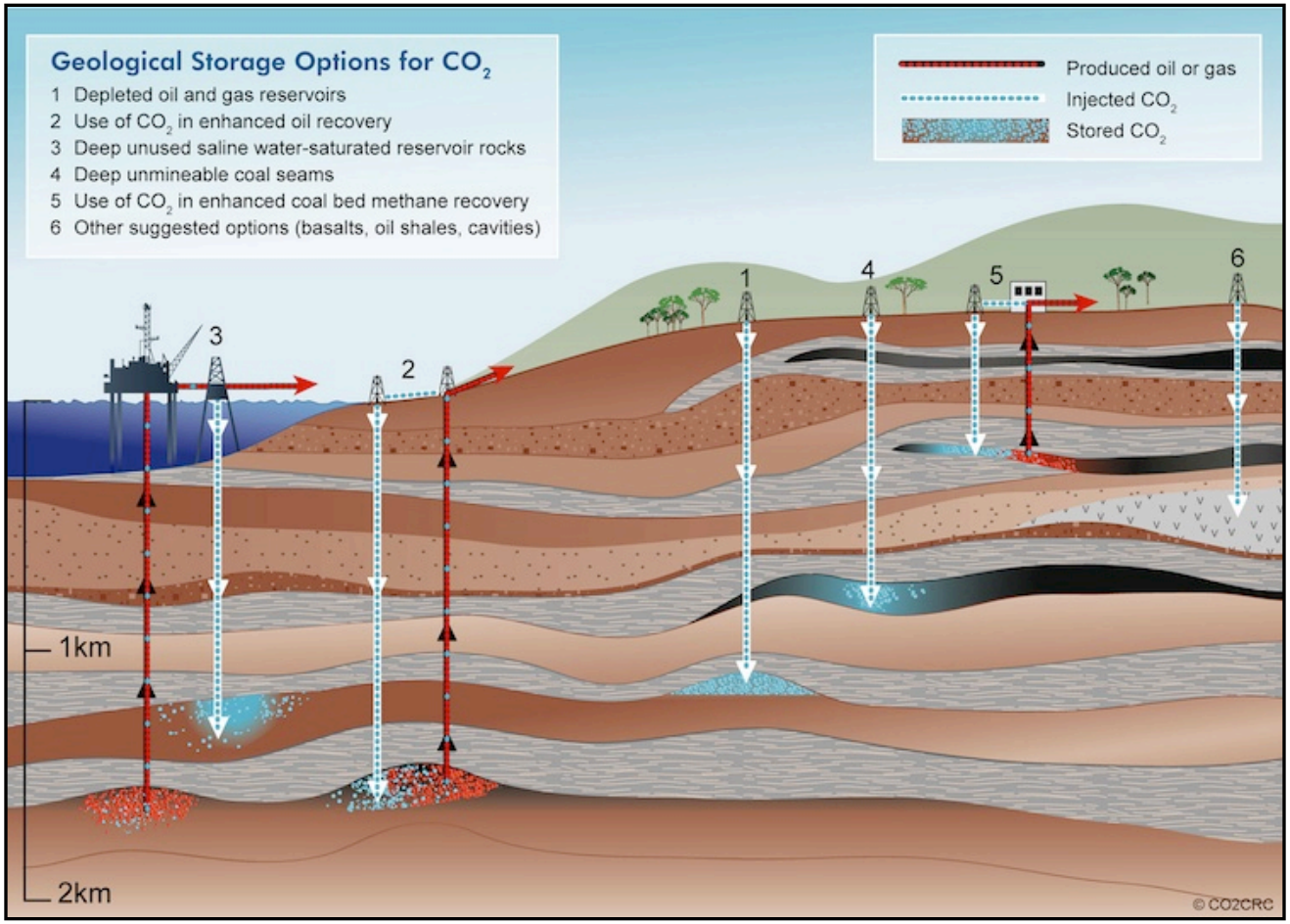




CO_2 can be removed from the exhaust of any fossil fuel fired power generation station.

The CO_2 can then be sequestered in a variety of ways, each representing a stabilization wedge.

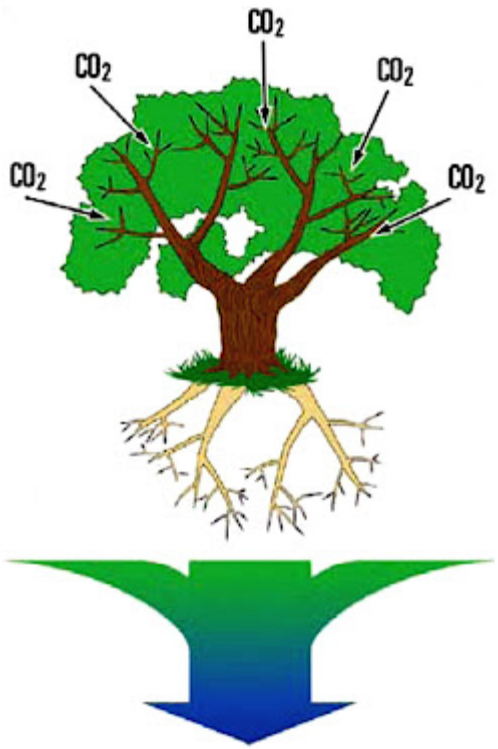
Geological Sequestration of CO_2



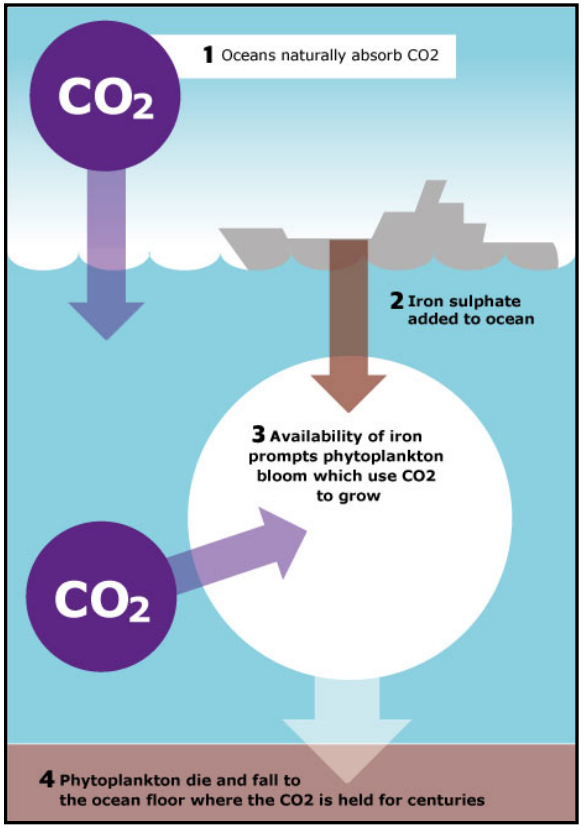
CO_2 from a capture system is pumped into underground storage chambers.

In some cases, the CO_2 injection can be used to extract additional fuels.

Biological Sequestration of CO_2



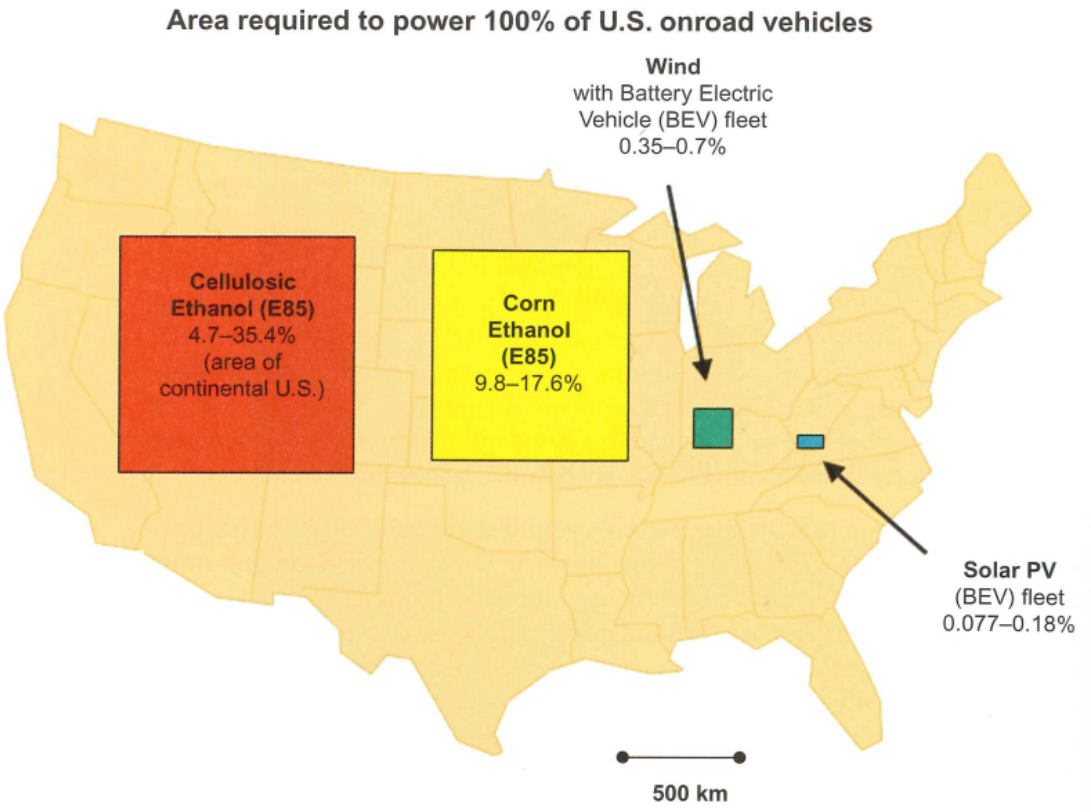
Carbon stored in wood and soil



While biological systems absorb CO_2 directly from atmosphere, captured CO_2 can be added to terrestrial and to both freshwater and marine aquatic ecosystems.

It is also possible to use the increased phytoplankton from aquatic systems as food.

Footprints of Alternative Energy Wedges

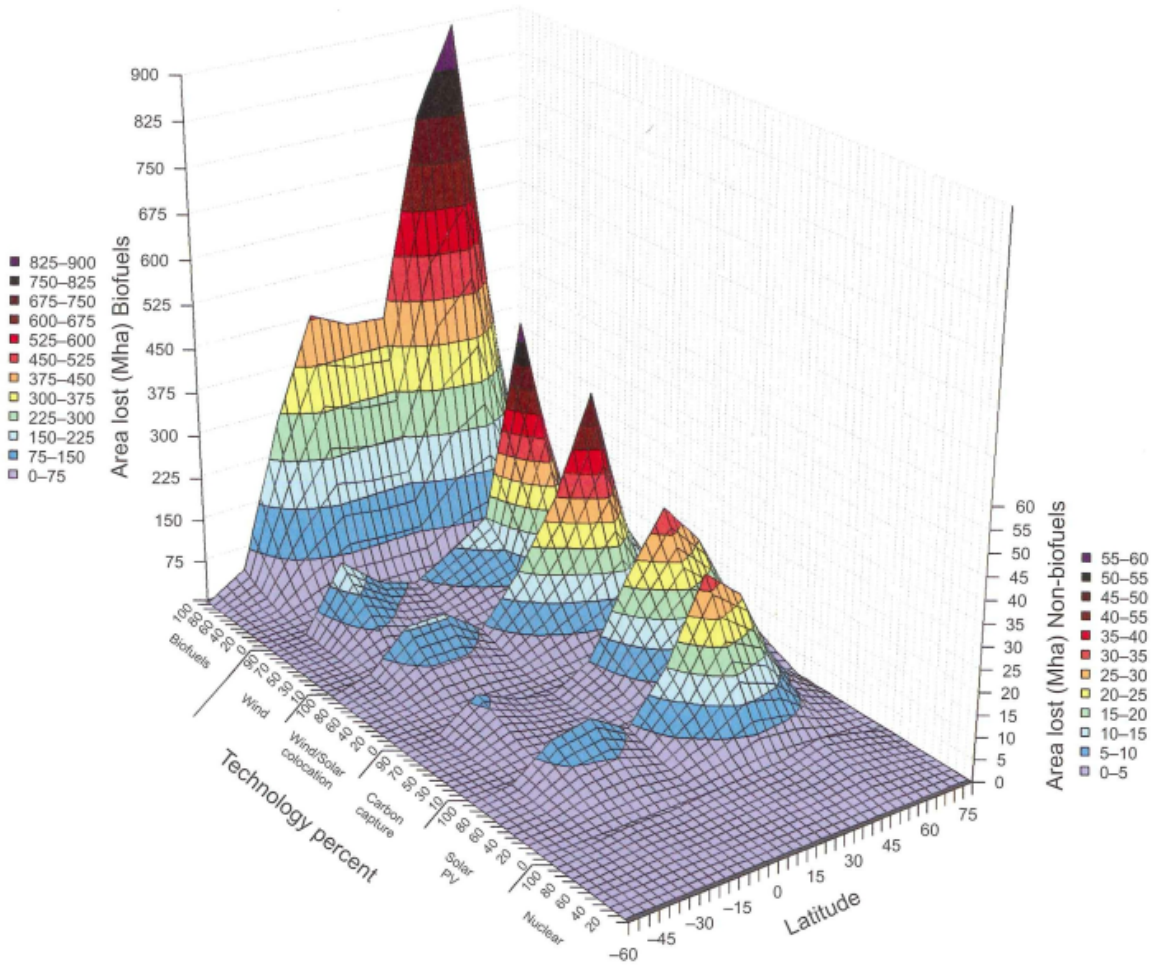


Although alternative energy sources are thought not produce GHG's, they do require space.

Requirements for solar can be reduced even further if solar arrays are integrated into existing architecture.

Extinction Risks of Alternative Energy Wedges

note that biofuels are on a scale more than an order of magnitude higher



These are “loss of area” based extinction risks and do not take into account other ecological costs like – water use, chemical pollution, toxic waste in recycling, etc.