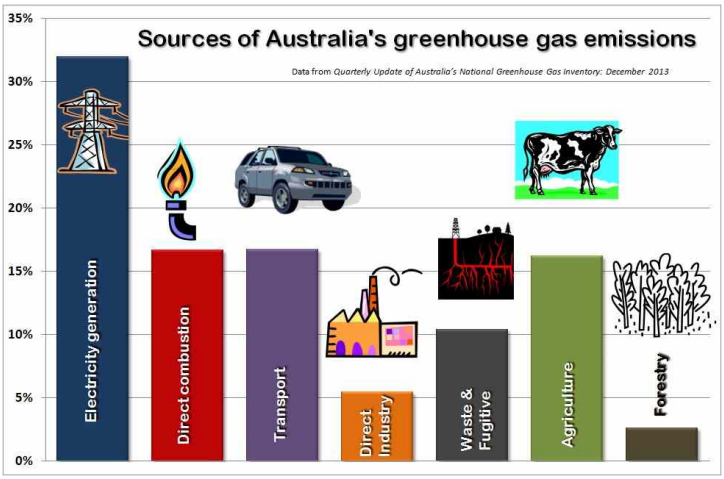
Climate Change – Solutions

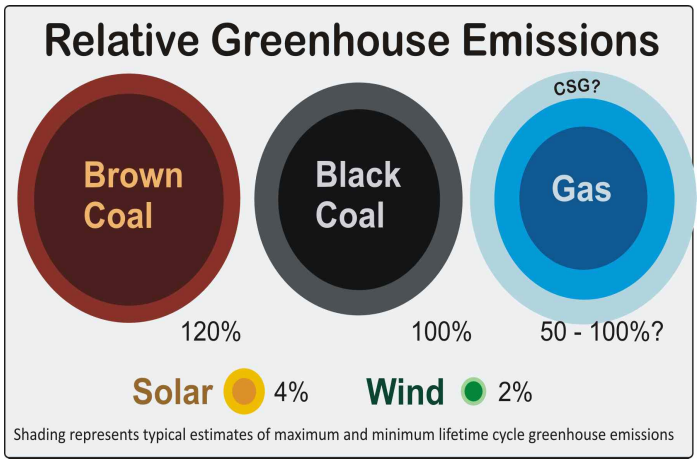
Can we stabilise the climate?

Fortunately, the answer to that question is “yes”. And clearly the first and most obvious step is to stop destabilising it! So what are the main sources of greenhouse gases in Australia?



As shown in this graph from *Australia’s National Greenhouse Inventory Dec 2013* electricity generation is the largest source, followed by transport and direct combustion (mostly heating). So most of the greenhouse gas (ghg) is from fossil fuel combustion. Agriculture is clearly also important.

The following diagram illustrates the relative amounts of ghg from different sources of electricity generation relative to black coal. Lighter shading indicates the variations due to different technologies.



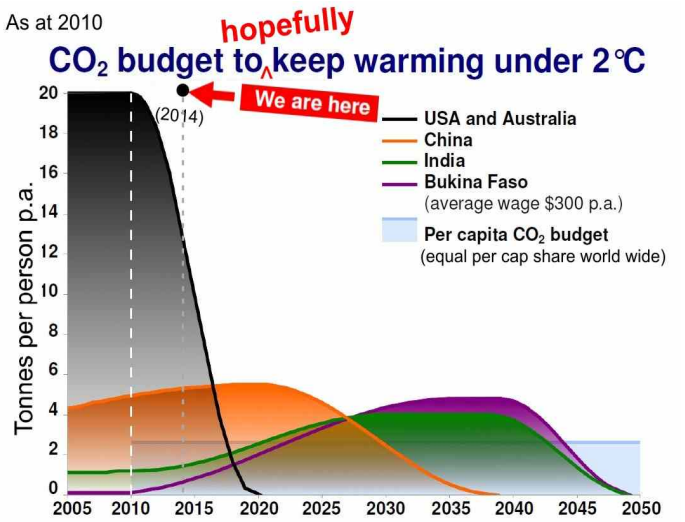
Approximate amount of CO_2 emitted relative to black coal. Figures for coal seam gas (CSG) vary due to different estimates of fugitive emissions

Although moving to gas (conventional or not) MAY reduce emissions a little, gas is NOT a stepping stone to low emissions. Building gas infrastructure locks us in to unacceptably high emissions for decades. The only genuinely low emission sources are renewables such as solar and wind. Wind and solar CO_2 emissions are FAR lower than fossil fuels.

Australia and the world

We often hear certain sections of the media telling us that we only emit 1.5% of the world’s emissions and so (apparently) it doesn’t matter what we do. What they don’t add is that as our population is only 0.3% we are emitting **five times** our per capita share! Let’s not go into the ethics of their argument, but surely, simply as an advanced industrial nation, we have a duty to lead the world away from fossil fuel dependence, not drag it backwards.

On the basis of the “trillion tonne carbon budget” referred to in the *Our Climate: Past, Present, Future* leaflet, and making the (admittedly rather wild) claim that all nations should have a fair share of the remaining carbon budget, scientists at the Potsdam Institute in Germany have come up with the graph below. It shows the emissions per person (tonnes of CO_2 per year) required to achieve even that ‘fair chance’ of avoiding the (still dangerous) 2°C target.



We have the highest per capita emissions in the world and so to do our fair share we should cut our emissions to virtually zero within ten years
(From material by Beyond Zero Emissions and H.J.Schellnhuber, Potsdam Institute, Germany)

Clearly, on this basis, we have only about ten years to reduce our emissions to virtually zero, while less developed nations have two or three decades. The problem is that this graph was published in 2010. We are now almost half way through that decade and the best our politicians seem able to imagine is that we can cut emissions by 5% by 2020!

Better ways to do it!

We burn fossil fuels to produce the energy that is so important for our lifestyles. However, there are much cleaner ways to produce energy. Renewable sources of energy—solar, wind, hydro etc. simply capture a little of the natural flow of energy from the Sun. No net CO_2 is produced and they will last forever.

Renewable energy is clearly far better than fossil fuel energy. However there are three problems: First, the initial cost of setting up renewable power plants is a little higher than continuing to use already built coal or gas fired power stations. In the longer term, of course, because there is no recurring fuel cost, renewable energy is cheaper. Second, there are many powerful vested interests keen to go on using coal, oil and gas. Not just the mining companies, but the car and road industry as well as very large

financial interests—and the politicians they support!

The third problem is often used by opponents to dismiss renewable energy—the Sun doesn't shine at night and wind is fickle. Yes, of course these are problems, but they are not insurmountable. There are a number of solutions. Broadly, the first approach is to decentralise the sources and connect them to an extended grid. The Sun may not be shining in NSW, but it might in WA. Or the wind might be blowing along the SA coast. The more sources and the larger the system, the less the overall variation in the total output.

Pumped hydro storage involves using excess energy to pump water uphill and then generating energy in the usual way when needed.

The second solution is energy storage. Pumped hydro storage is already used in Australia on a small scale in the Snowy Mountains (above) and Tasmania and could be scaled up considerably. As shown below, solar thermal with molten salt heat storage can provide 24 hour solar energy. While chemical battery storage will probably always remain relatively expensive, its cost is falling rapidly and it could become part of the overall picture–particularly if combined with other solutions such as electric cars.

The third approach is end-use flexibility. Hot water can be heated at times when there is ample supply but automatically switched off by internet based signals at times of peak use. Similarly refrigerators can be turned off for hours without problems. And as electric cars become common they can be charged at times of adequate supply and in fact can feed back into the grid at times of shortage.

World's Best Renewable Energy

Australia has the best renewable energy options in the world. Our solar and wind energy resources could supply ALL our energy needs many times over. Utilised on a large scale, spread around the continent and linked by High Voltage DC power lines, they could provide all our baseload power needs when combined with various forms of energy storage as mentioned above. In fact, just as an illustration, an area of just 100 km square in the desert, collecting energy at only 5% efficiency, would supply all our needs. And that's not even counting wind and other resources! (In practice, that area would be spread around the country for efficient use.)

Gemasolar, Spain. Concentrated solar thermal with molten salt storage already supplies 24 hr power in Spain and USA. Australia has a huge potential for concentrated solar as well as PV solar power.

The picture above is of a solar thermal plant in Spain. Molten salt (potassium and sodium nitrates) is pumped through the tower where it is heated to about 600°C. It is then stored in a large tank from where it is pumped through a heat exchanger to make steam–which runs a normal turbine generator.

The beauty of this system is that the heat stored in the tank can be used all night to continue to generate electricity, giving 24 hour solar power! While at present the cost is higher than coal generation, with experience and time the costs will come down while at the same time costs of all fossil fuels are rising relentlessly (albeit with market fluctuations). The fuel cost for solar and wind? Zero!

Solar PV has dropped around 80% in price in just a few years

Will solar PV with battery or pumped hydro storage end up being cheaper than concentrated solar thermal? Who knows? The point is that renewable technology is rapidly advancing and becoming cheaper while fossil fuel technology is very "last century" and increasing in cost. We have been told that carbon capture and sequestration (CCS) will be the answer for fossil fuels. But after years of such claims it is still yet to be demonstrated on any worthwhile scale—and will increase the cost of fossil fuels even further.

On the other hand, with our renewable resources we could be in the vanguard of new renewable technology and in fact become a supplier to the world of clean energy. That would be a far more useful role than pushing coal on the yet-to-be-developed world in the name of alleviating energy poverty. Western society might have risen on the back of coal but that doesn't mean the rest of the world has to follow. We now know there are better ways. It is up to us to help the new world find them.

For more on renewable energy see Beyond Zero Emissions an Australian 'think tank' researching ways to seriously reduce ghg emissions.

This leaflet was produced by Keith Burrows for 'Science Teachers for Climate Awareness'
scitca@optusnet.com.au & www.vicphysics.org

bze.org.au