

Energy options for the future

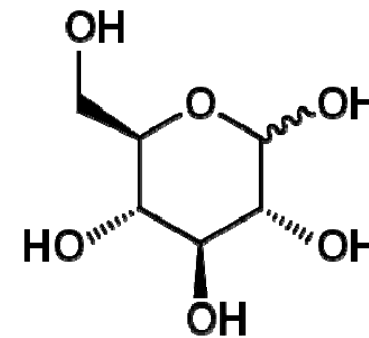
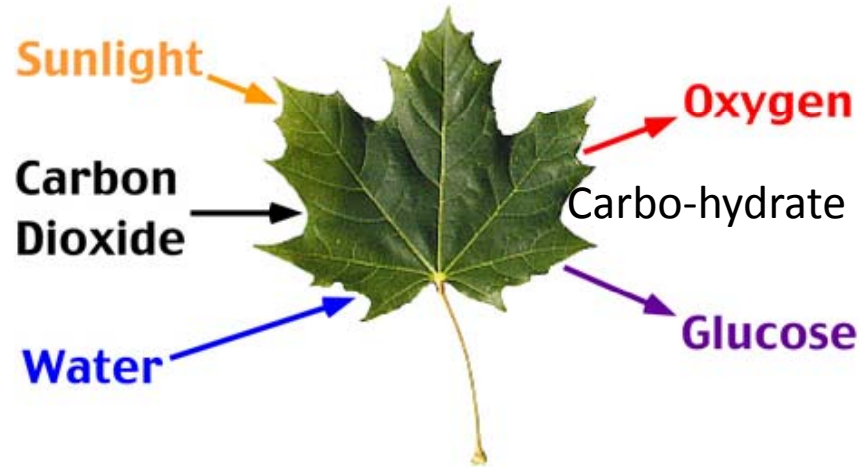
- Fossil fuels
- Climate change
- Clean energy
- Cutting your power bills



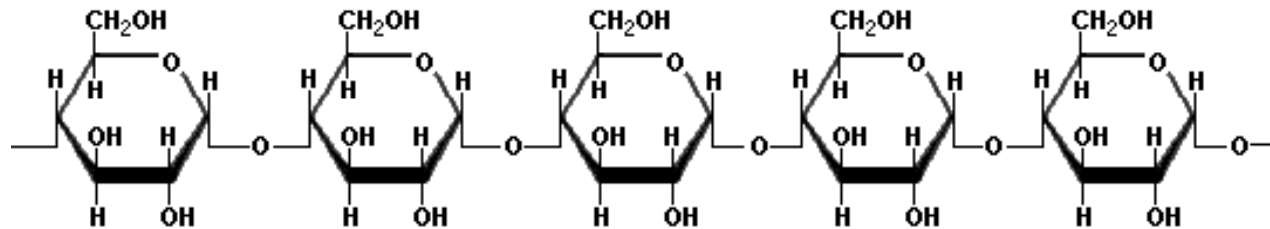


Biomass stores solar energy

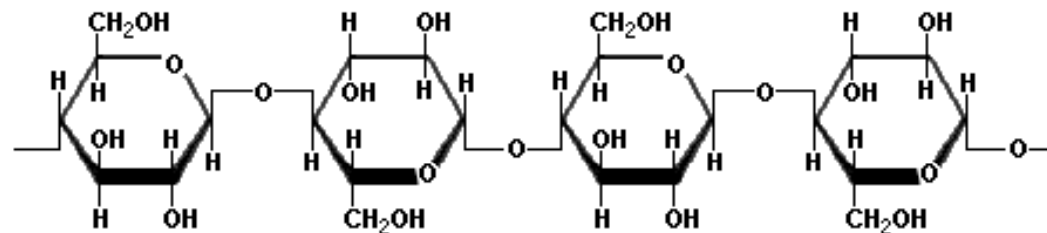
2/3 of a tree is carbohydrate



Glucose

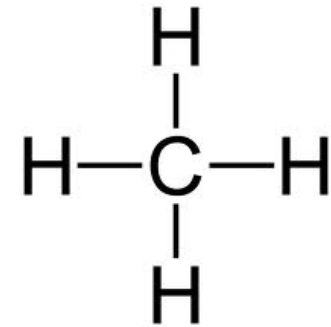
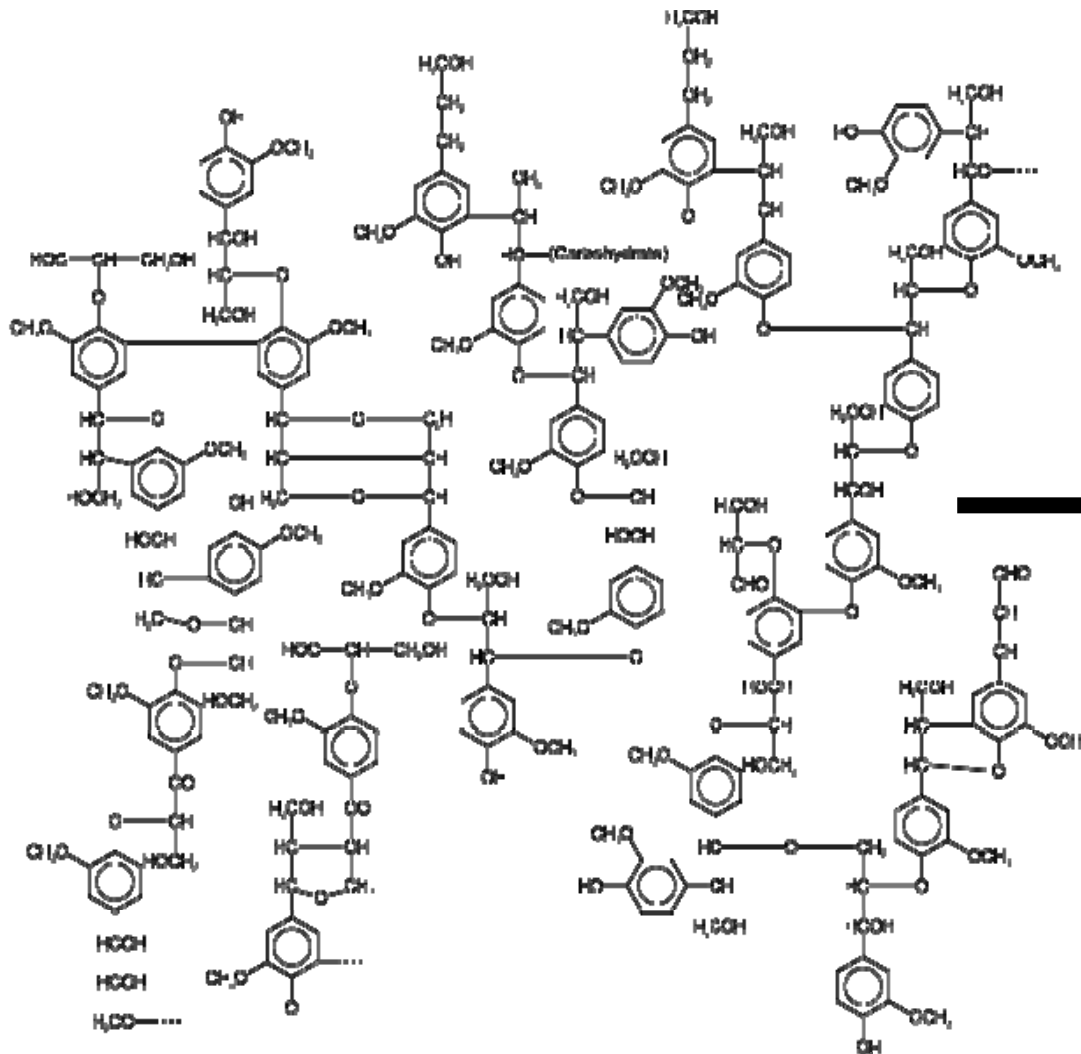


Starch

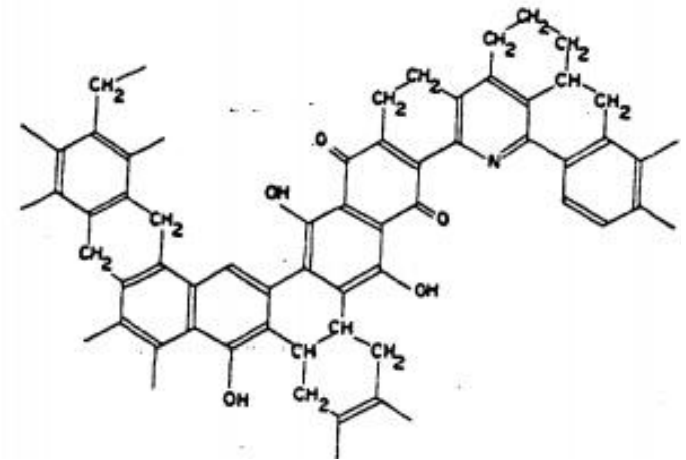


Cellulose

1/3 of a tree is Lignin



Methane - CSG



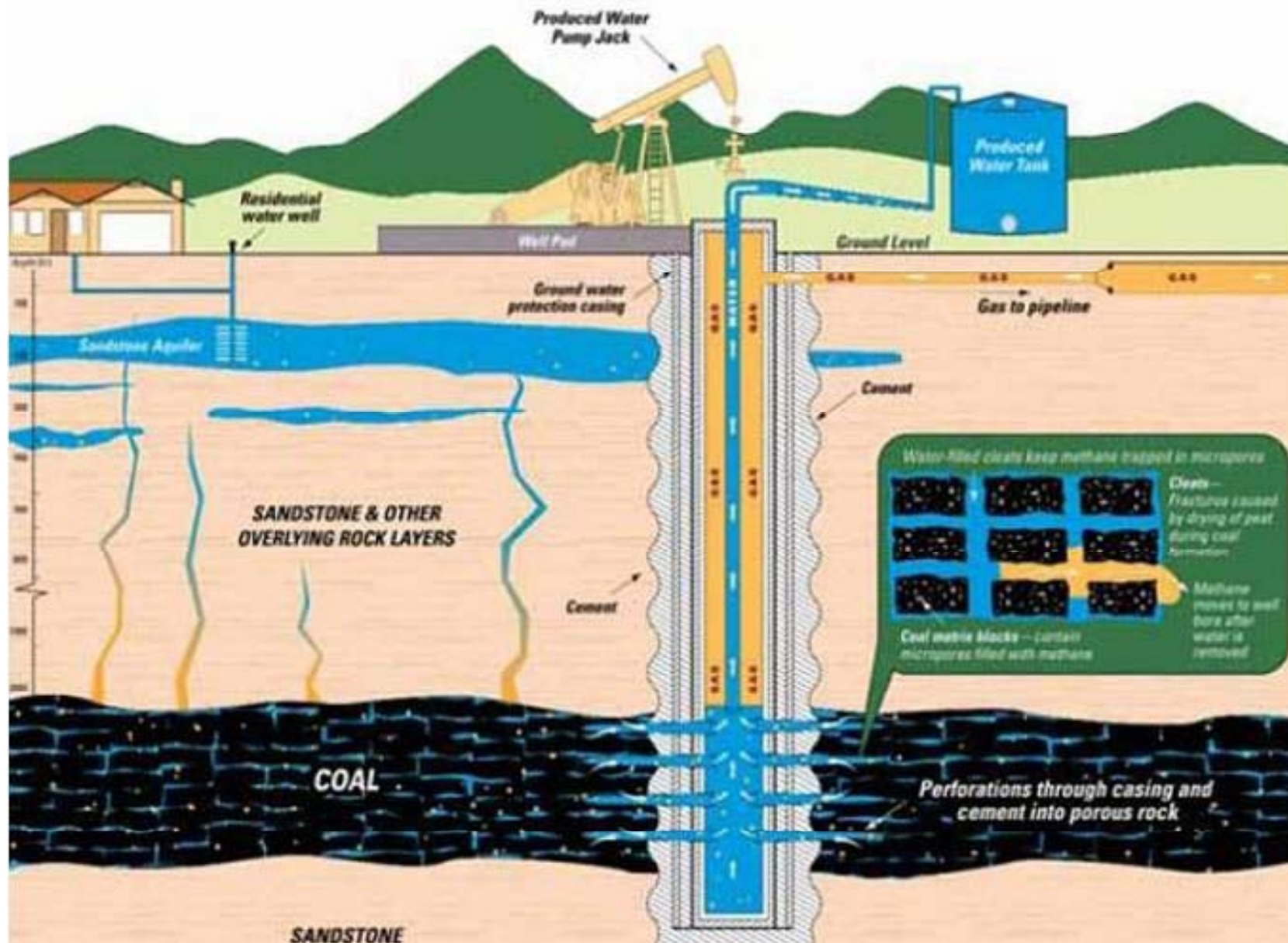
Coal

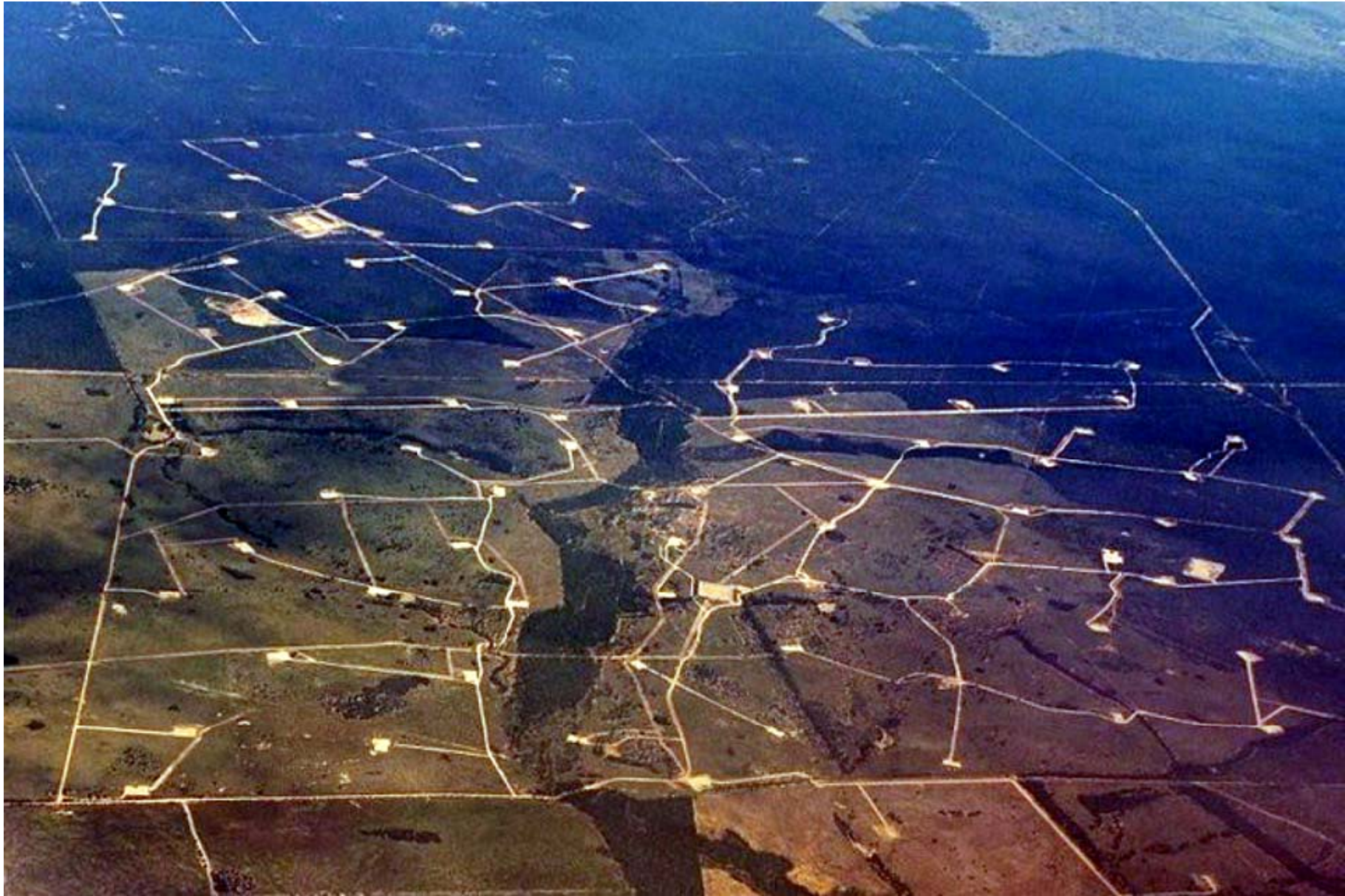


Gas explosions in coal mines

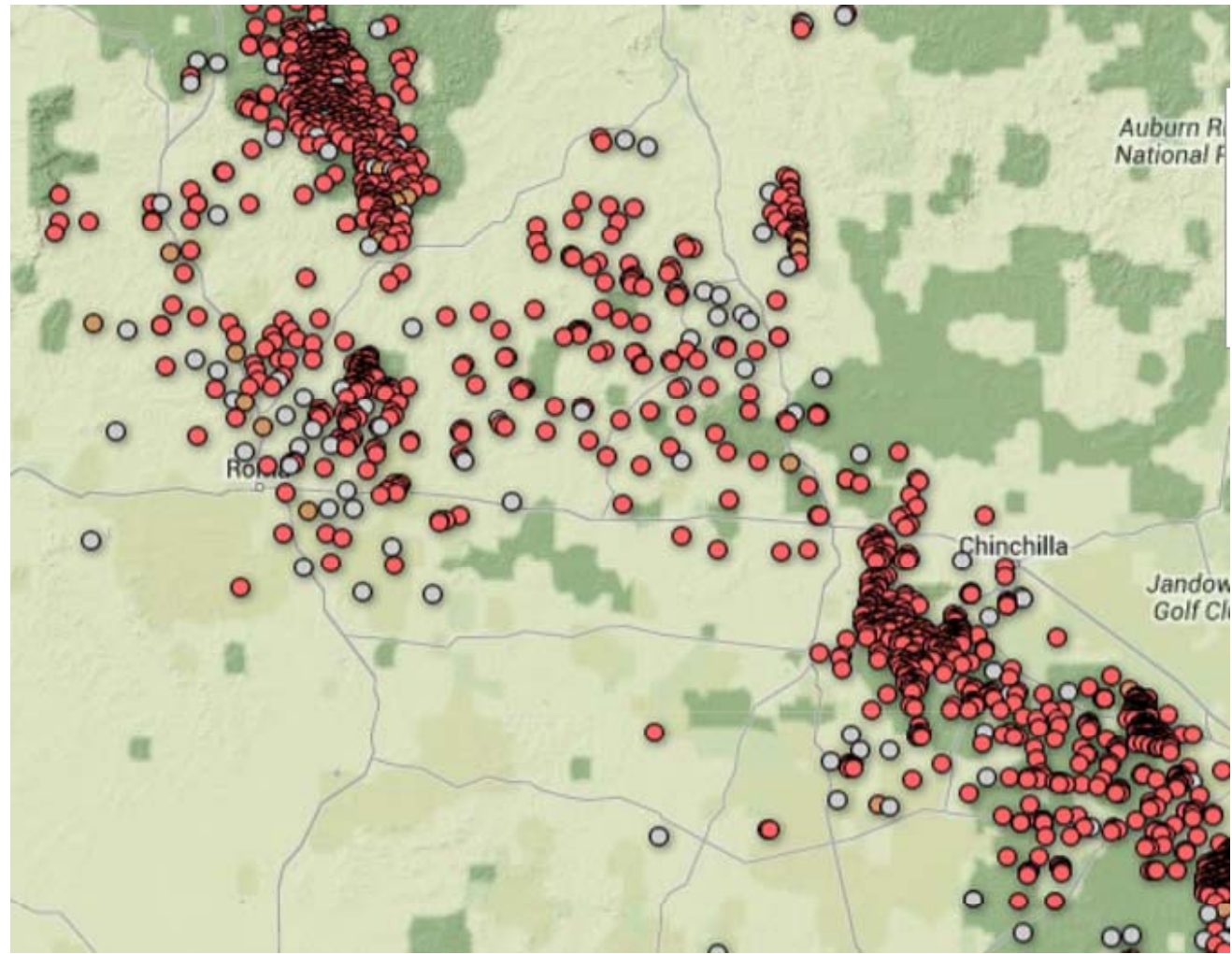
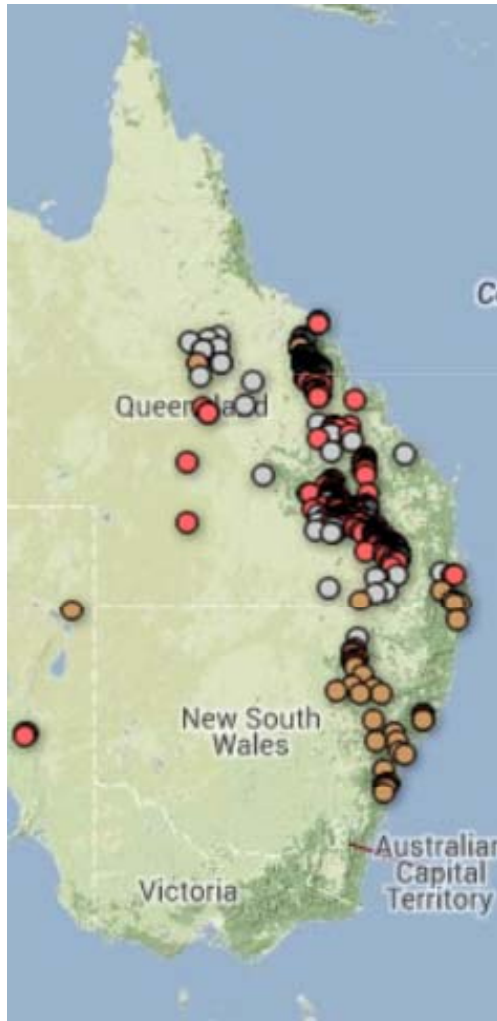


Methane – coal seam gas





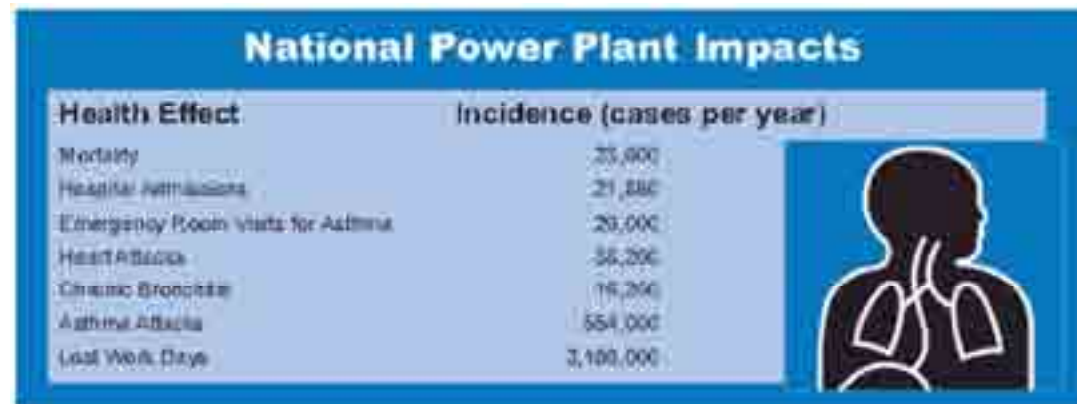
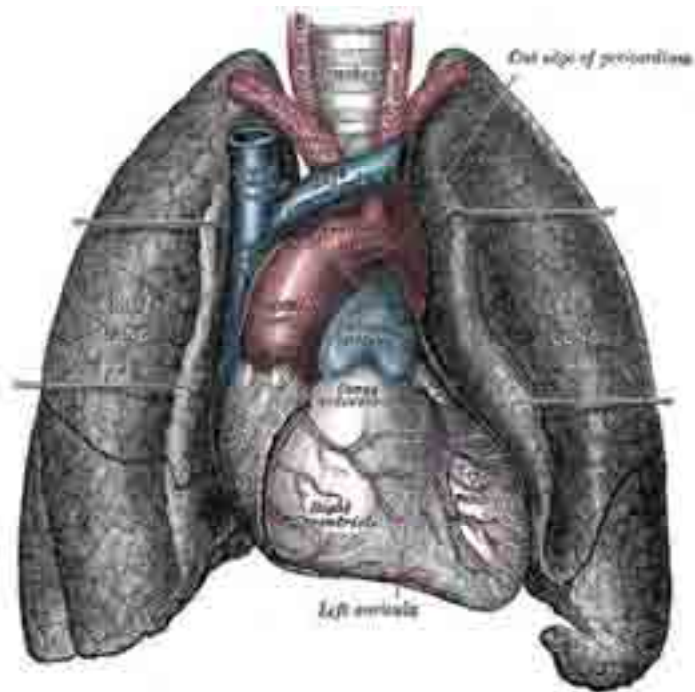
CSG wells



Coal

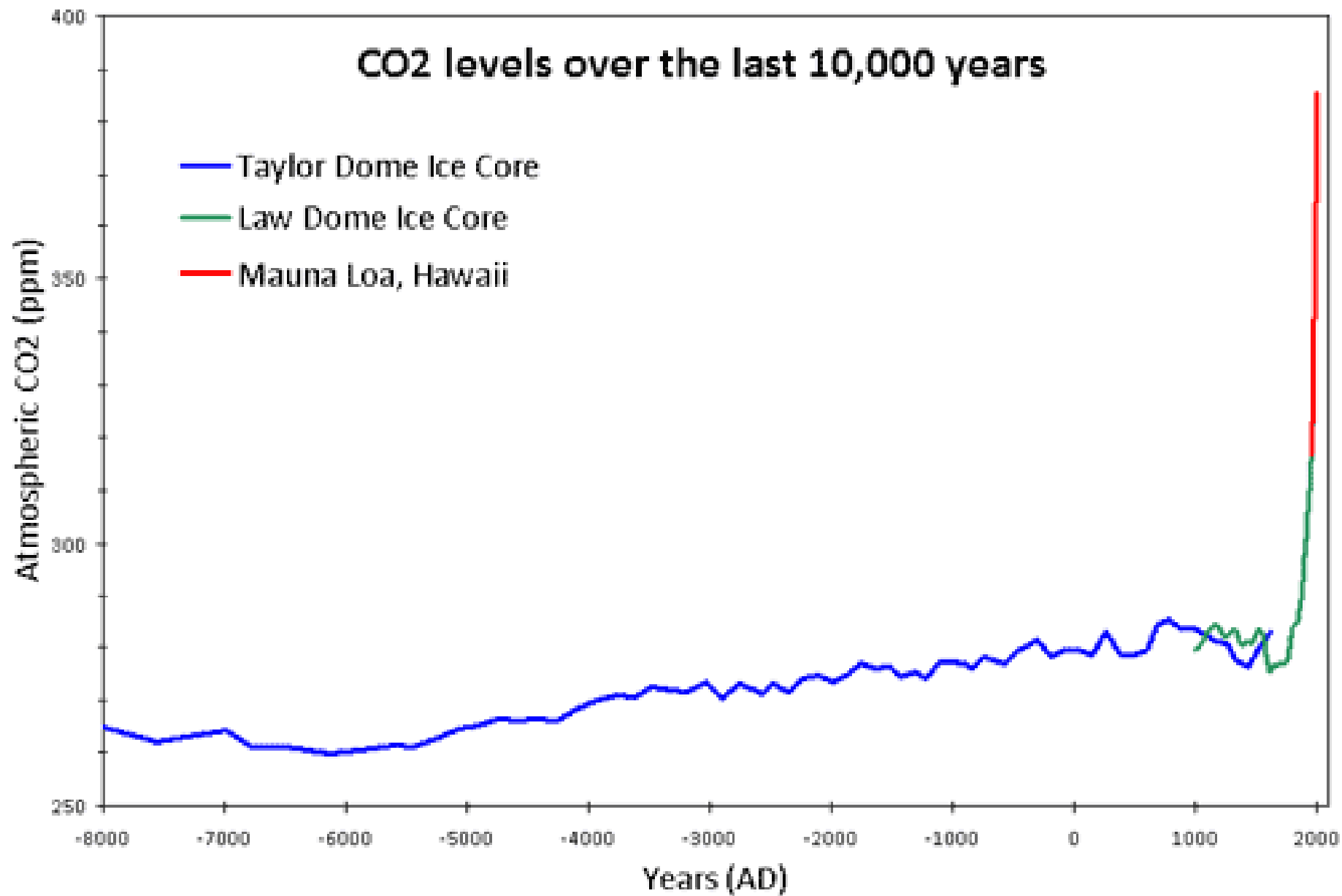


Health effects of coal

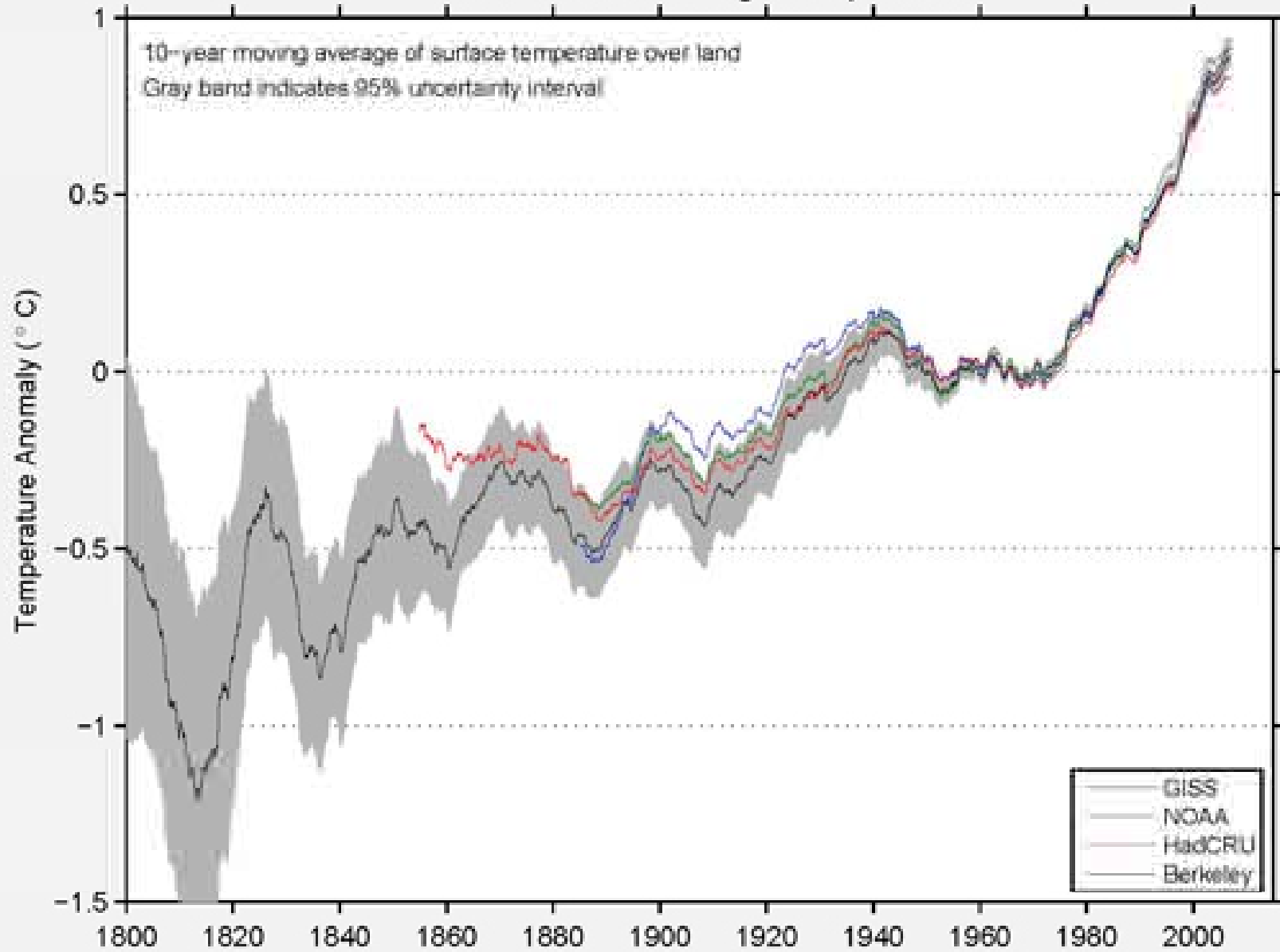


Coal and gas produce CO₂

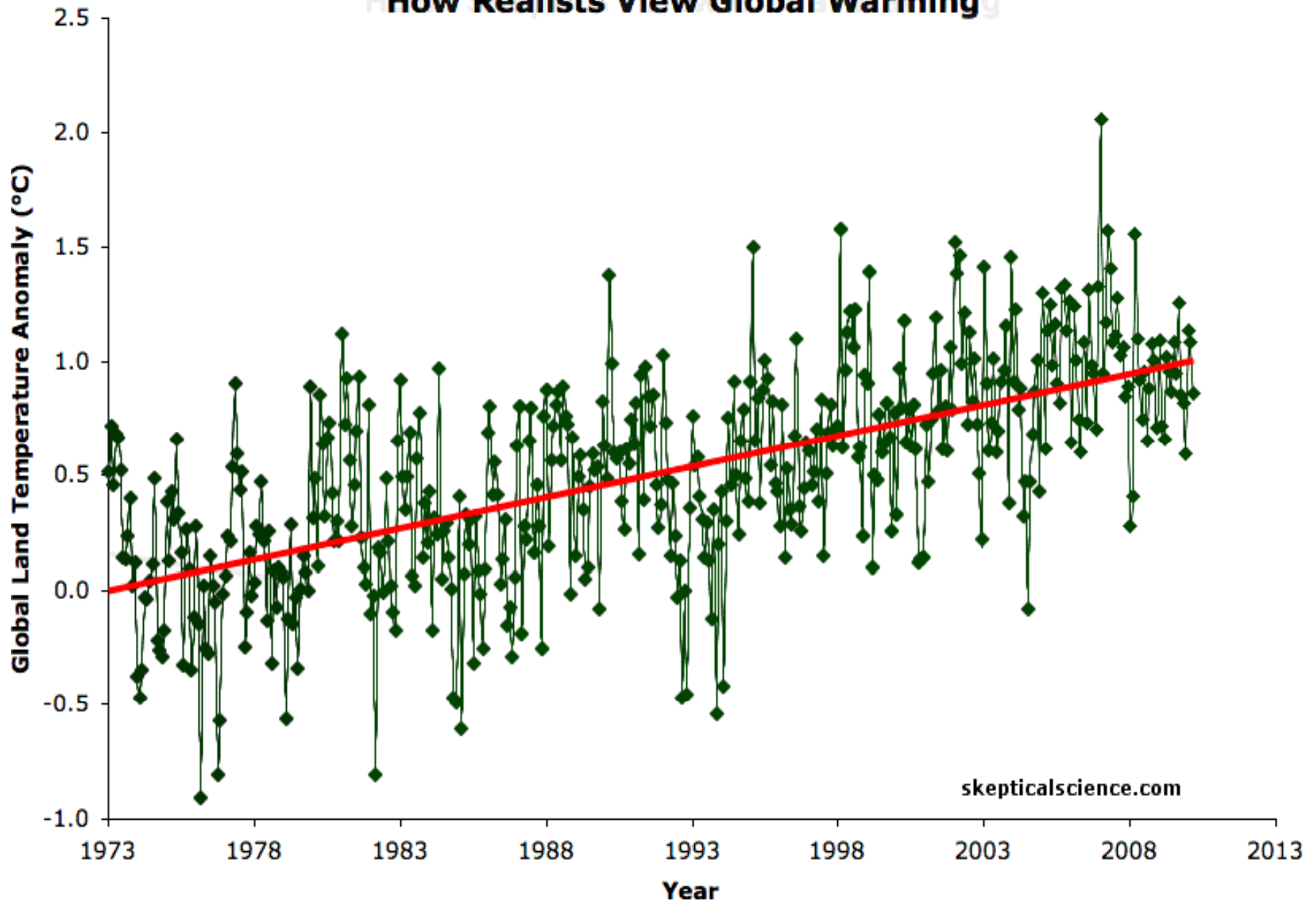




Land-Surface Average Temperature



How Realists View Global Warming



Ocean acidification – the other problem

OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO₂ absorbed from the atmosphere

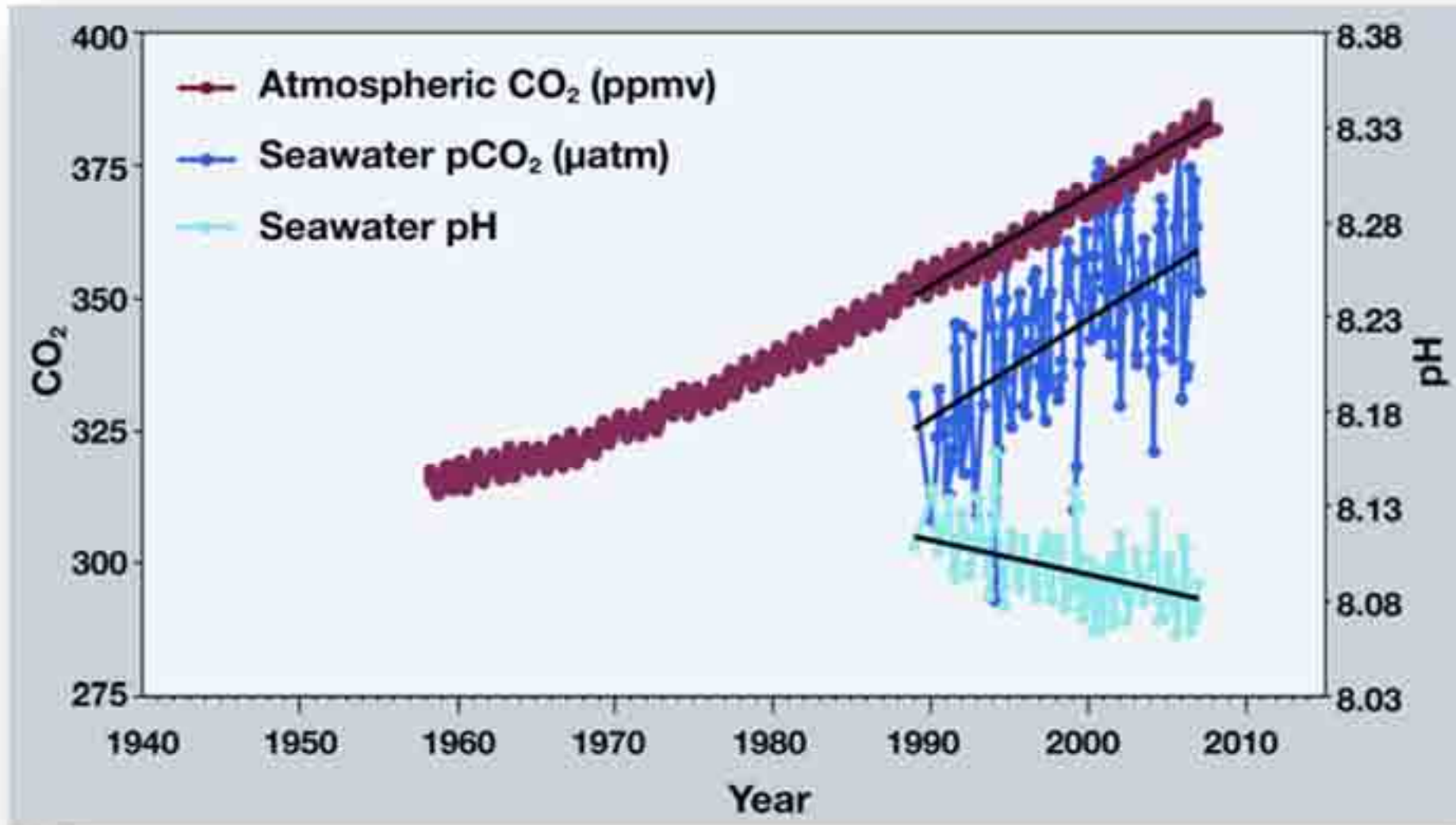
The diagram illustrates the process of ocean acidification. At the top, a blue sky transitions into a red ocean surface. Four red arrows point downwards from the sky, labeled 'CO₂ absorbed from the atmosphere'. Below the surface, a horizontal arrow points from left to right, showing the progression of the chemical reaction. On the left, a green, healthy shell is shown in a circular inset. On the right, a yellow, weakened shell is shown in a circular inset. Below the shells, the chemical equation is shown: $\text{CO}_2 + \text{H}_2\text{O} + \text{CO}_3^{2-} \rightarrow 2 \text{HCO}_3^-$. Below the equation are four molecular models: carbon dioxide (a black carbon atom bonded to two red oxygen atoms), water (one red oxygen atom bonded to two white hydrogen atoms), a carbonate ion (one black carbon atom bonded to three red oxygen atoms), and two bicarbonate ions (one black carbon atom bonded to three red oxygen atoms and one white hydrogen atom). Below the molecular models are their respective labels: 'carbon dioxide', 'water', 'carbonate ion', and '2 bicarbonate ions'. At the bottom, the text reads 'consumption of carbonate ions impedes calcification'.

$\text{CO}_2 + \text{H}_2\text{O} + \text{CO}_3^{2-} \rightarrow 2 \text{HCO}_3^-$

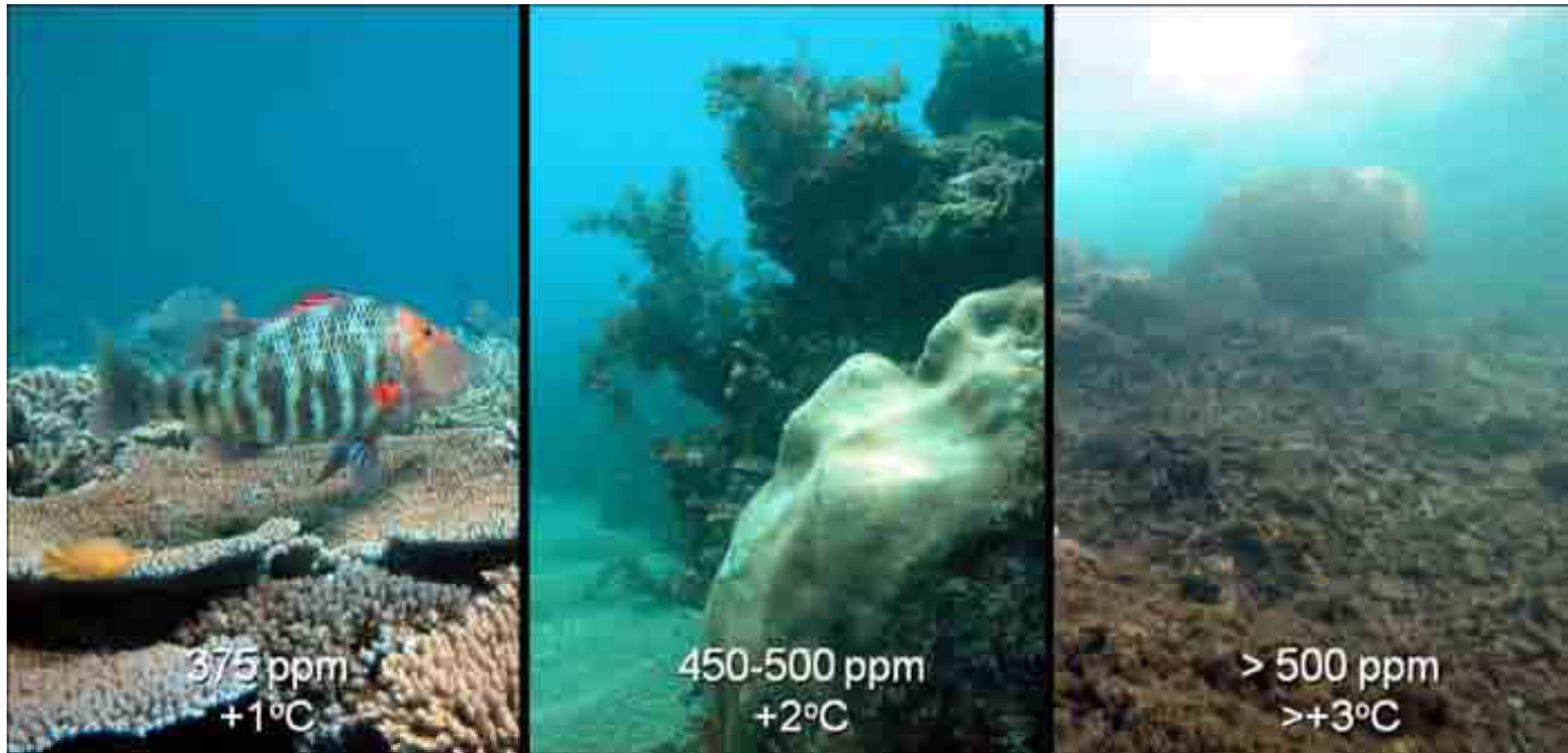
carbon dioxide water carbonate ion 2 bicarbonate ions

consumption of carbonate ions impedes calcification

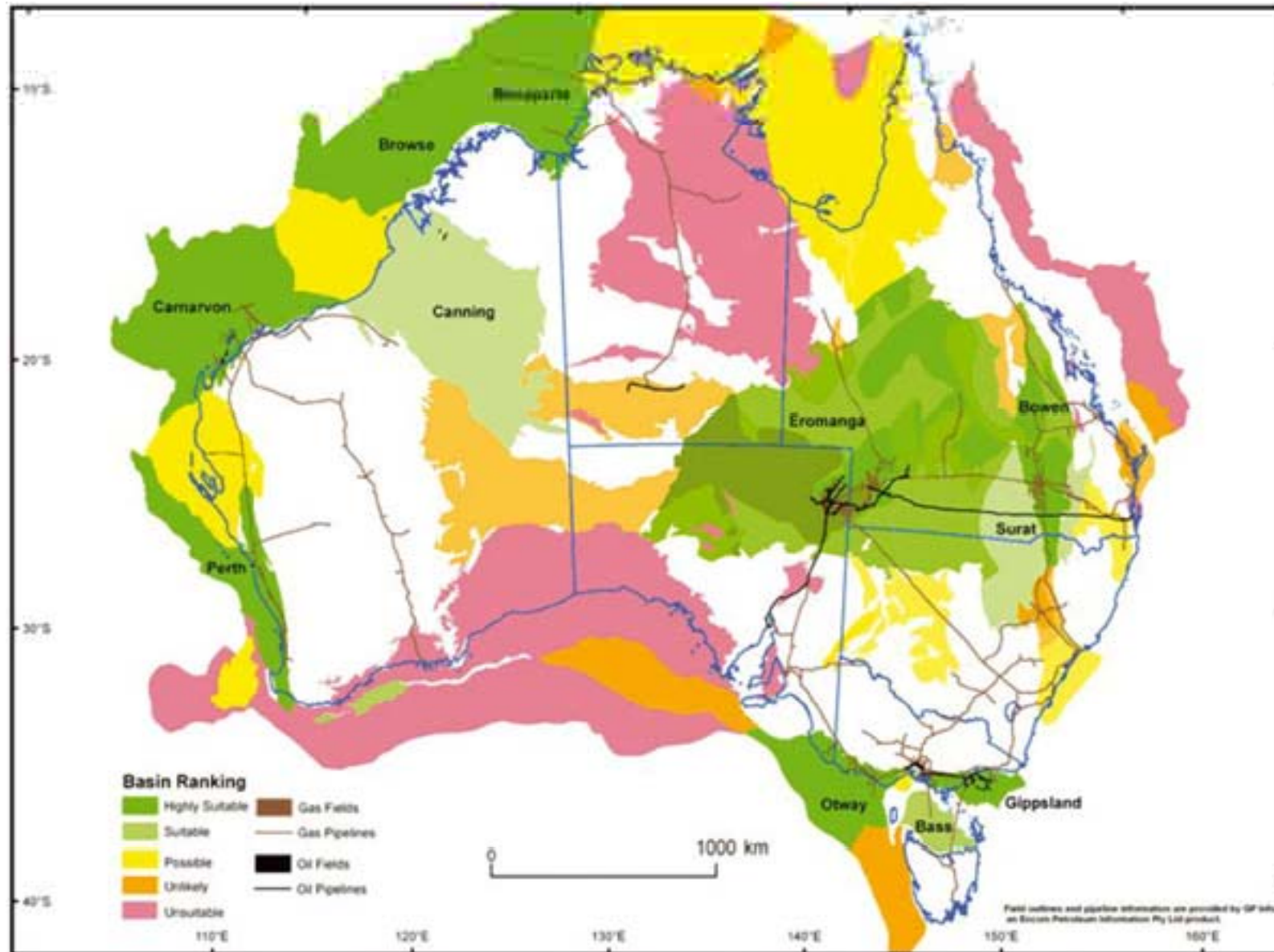
Ocean acidity increasing



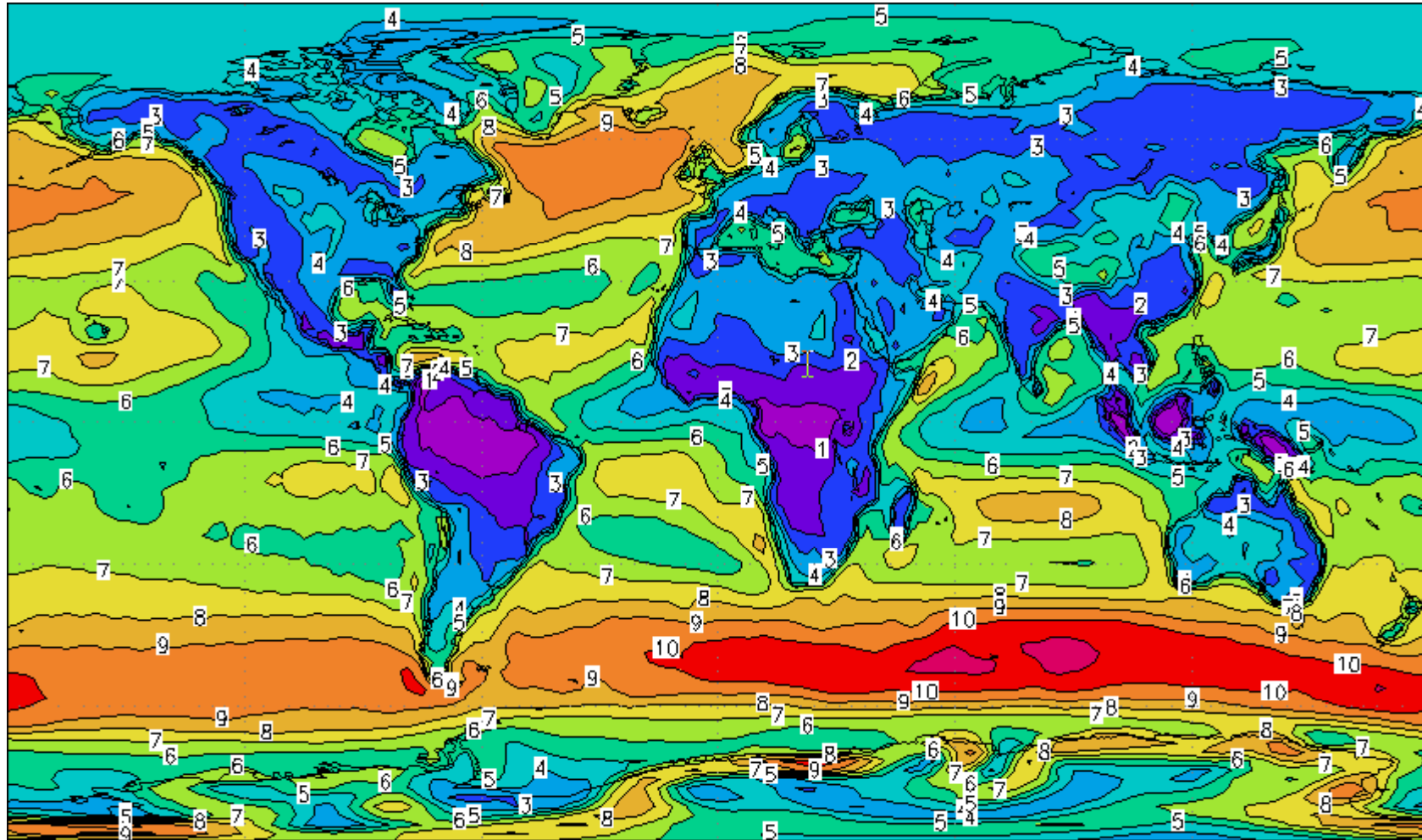
Coral reefs will die



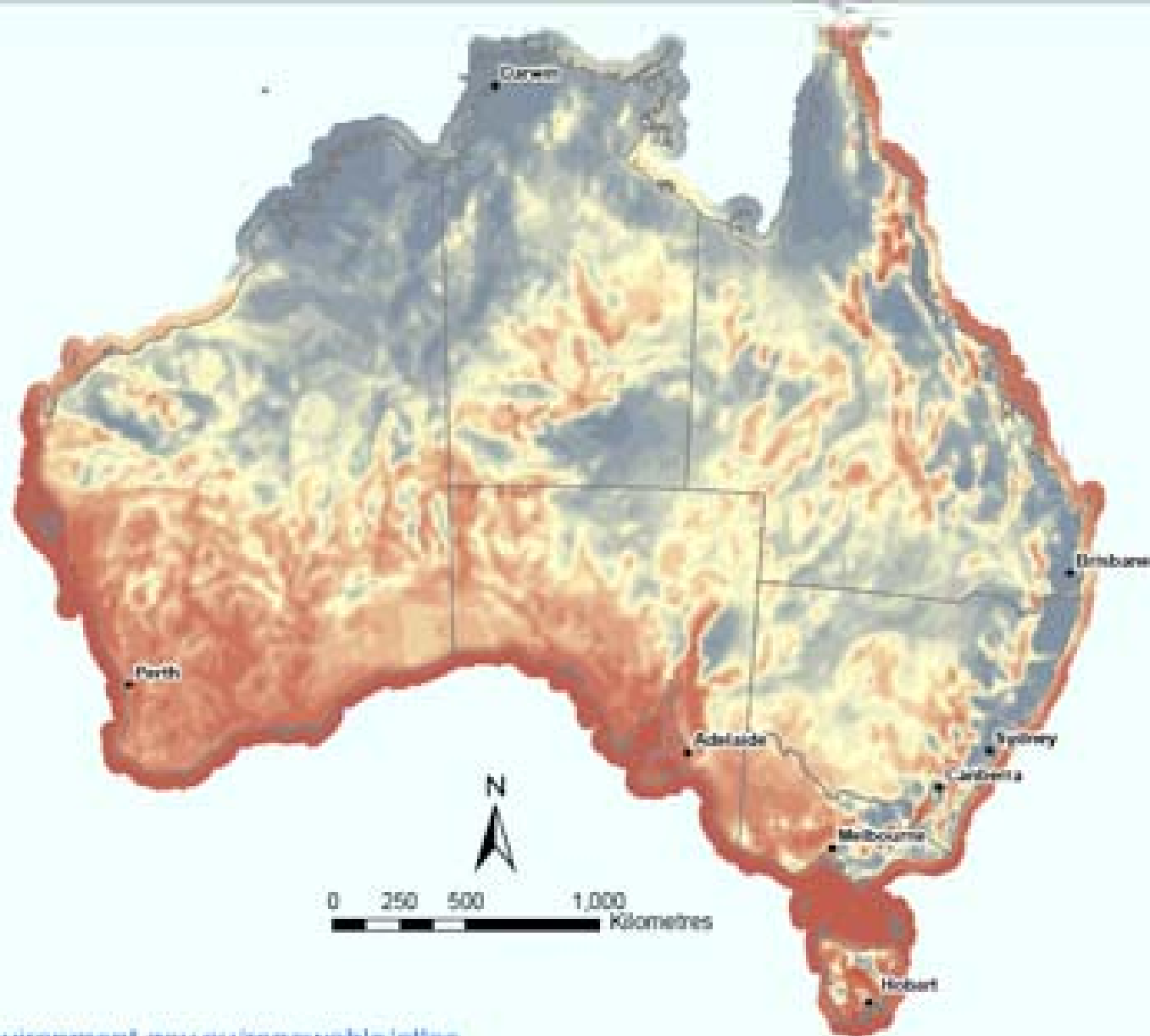
CO2 storage options



The answer is blowing in the Wind



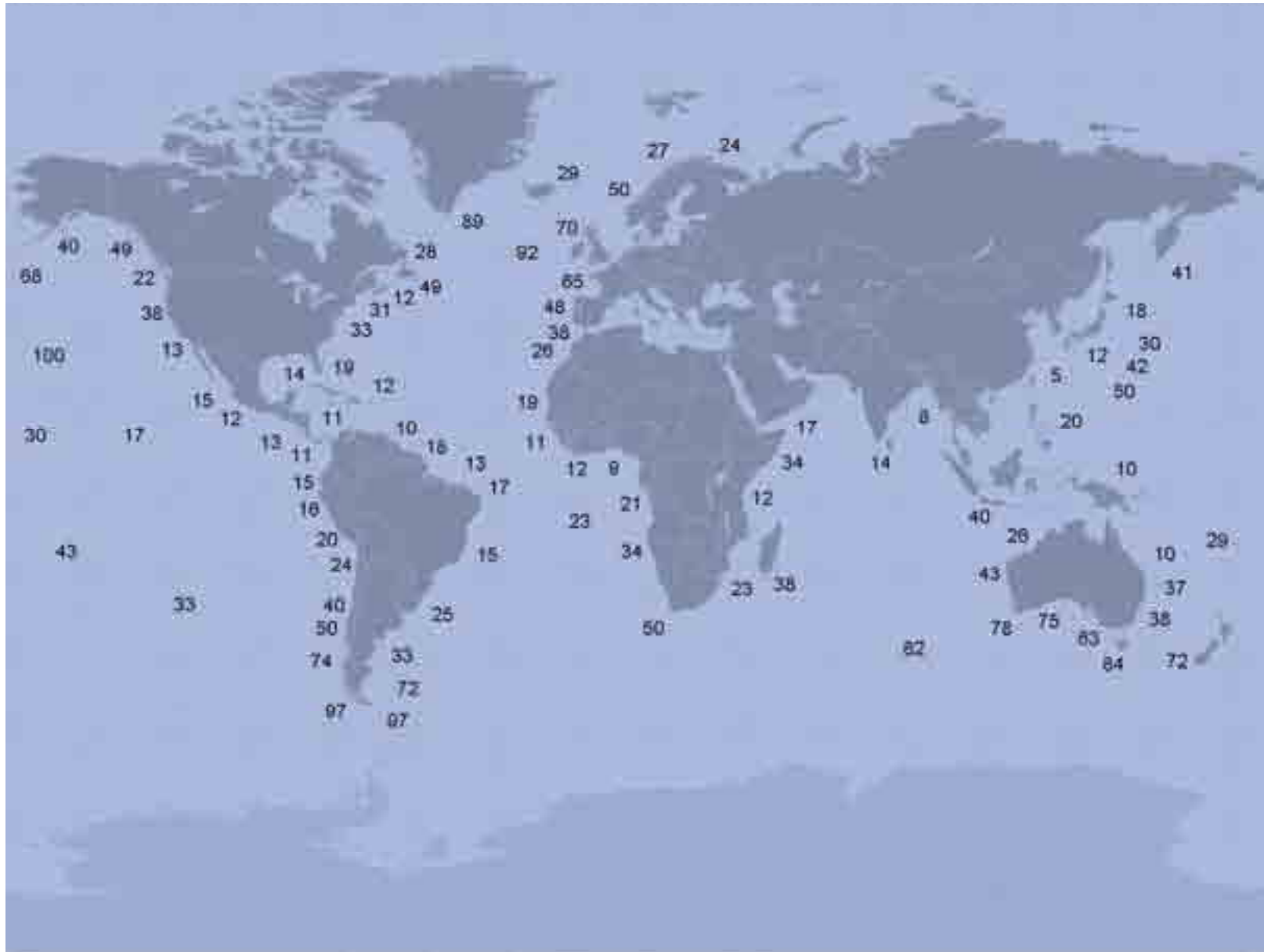
Mean Wind Speed at 80m above ground level



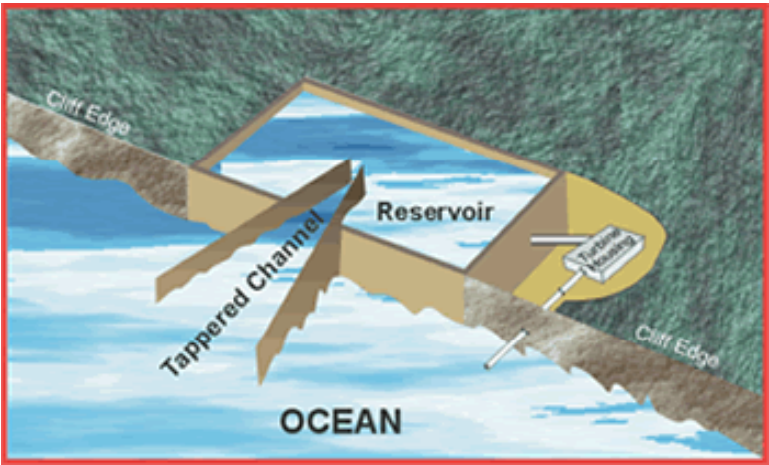
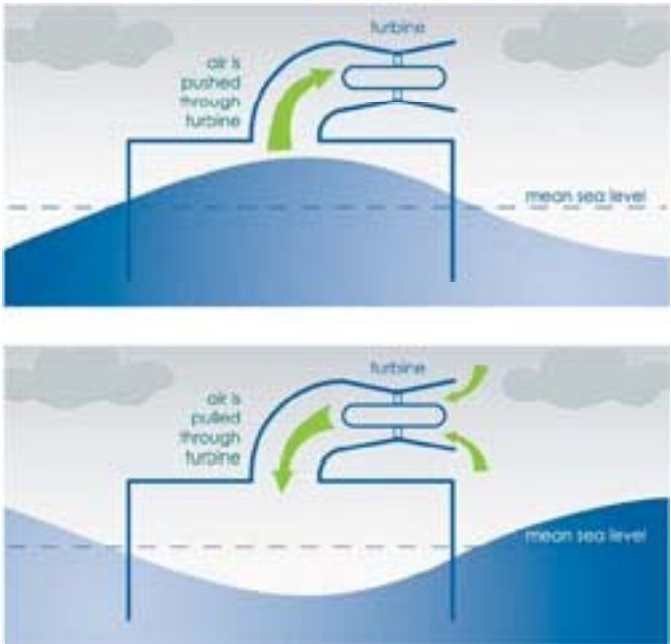
Wind



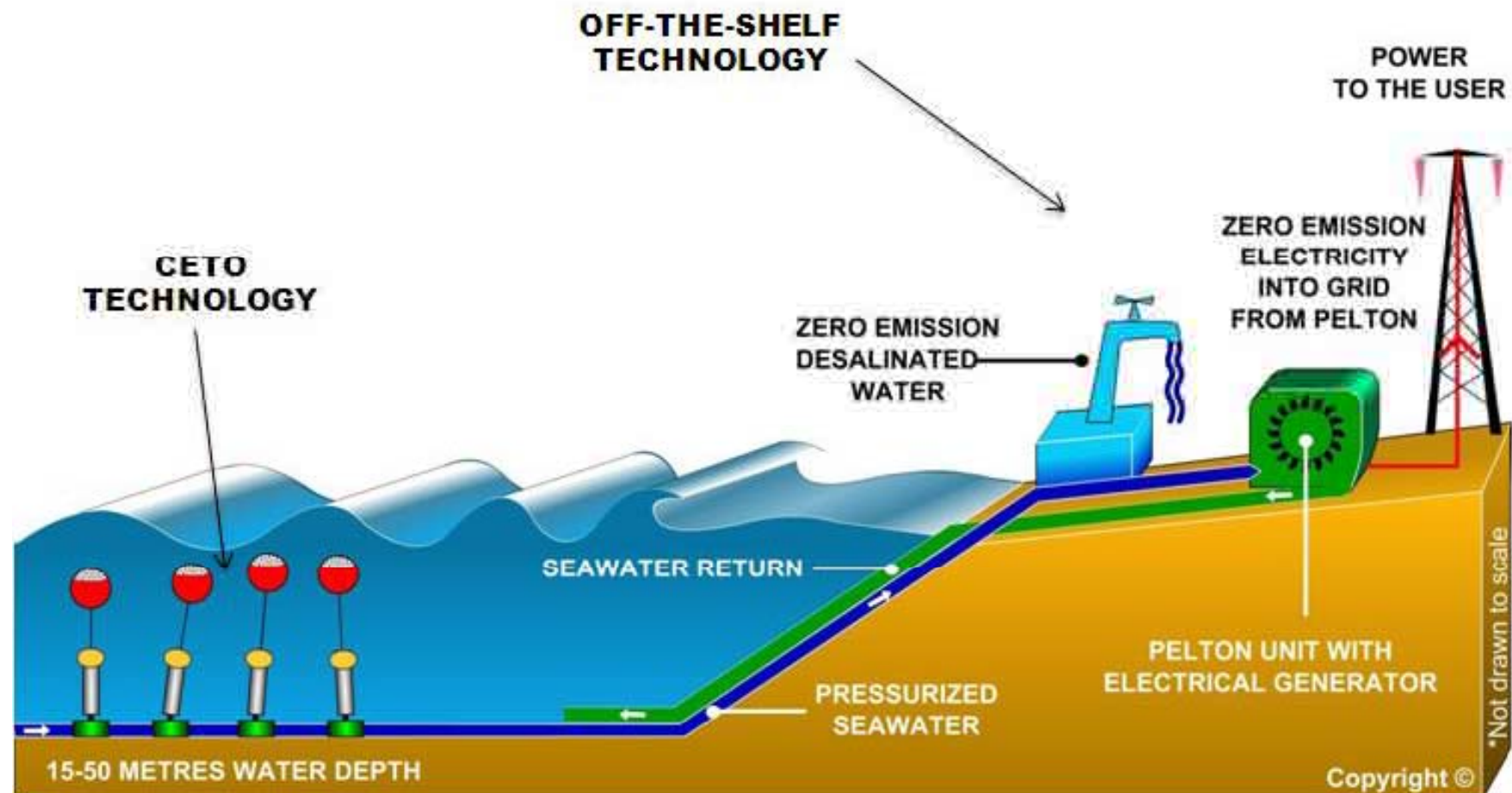
Wave energy



Wave power



Wave power





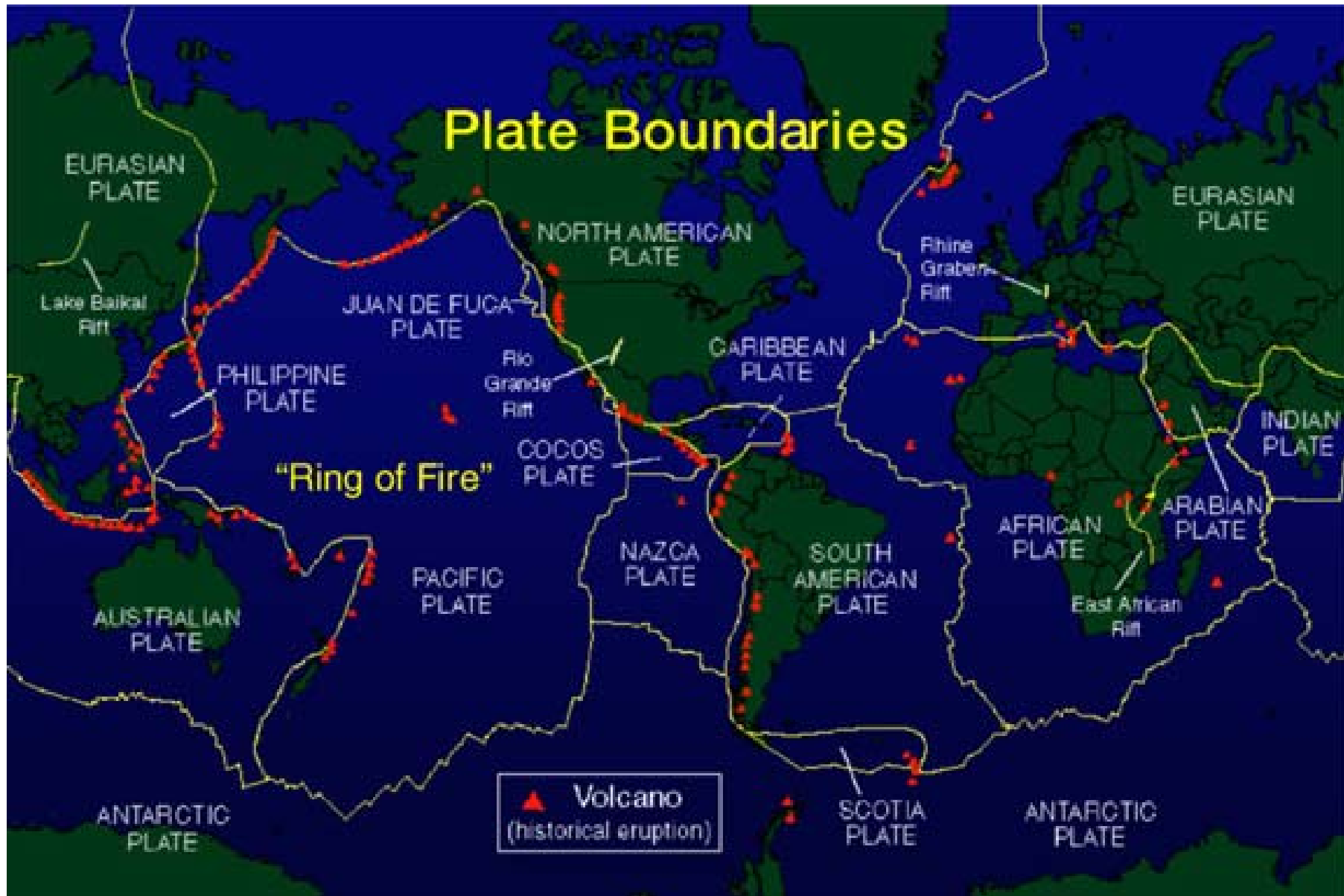
Hydro and tidal power



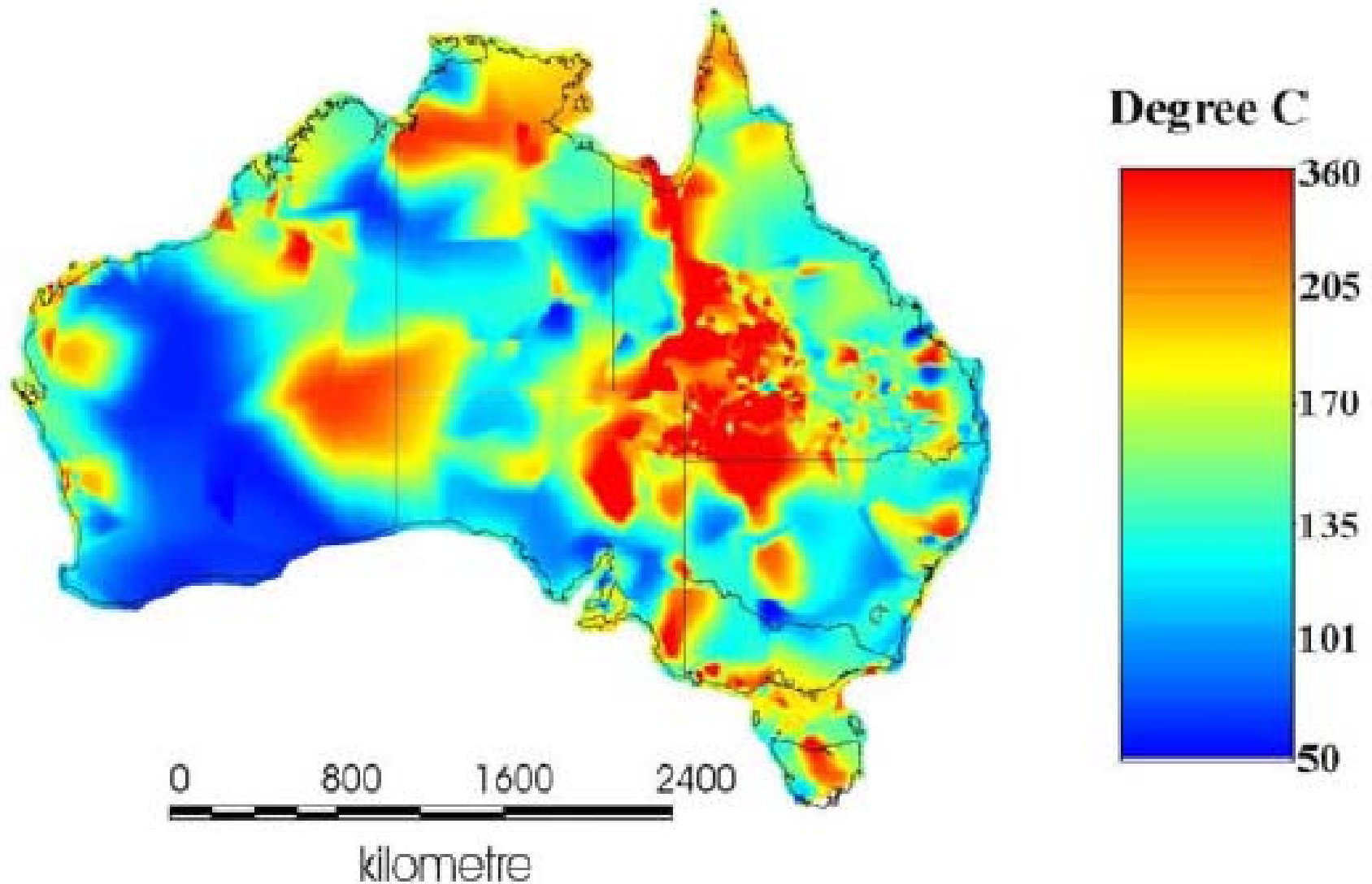
Geothermal



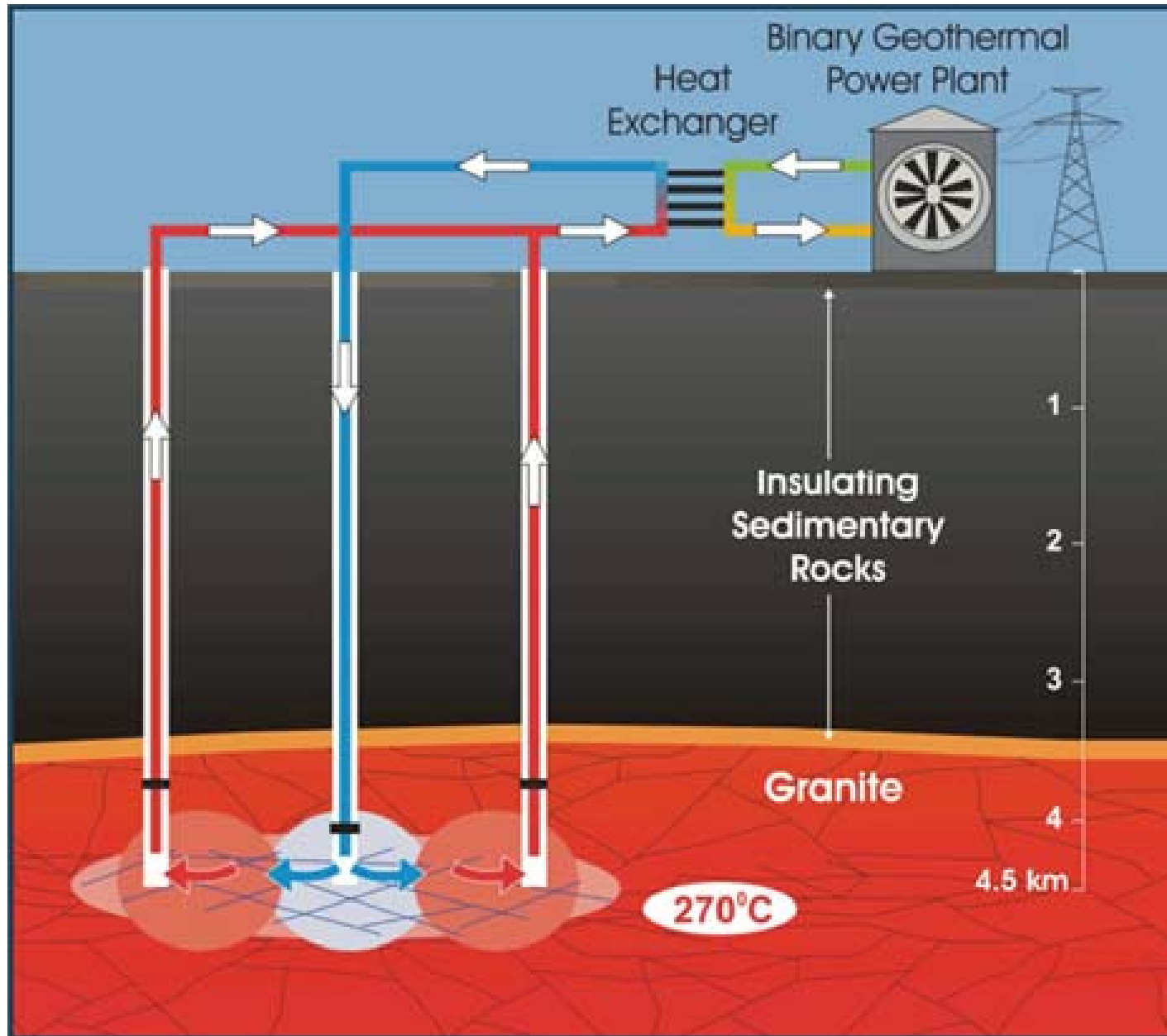
Geothermal – friction on plates



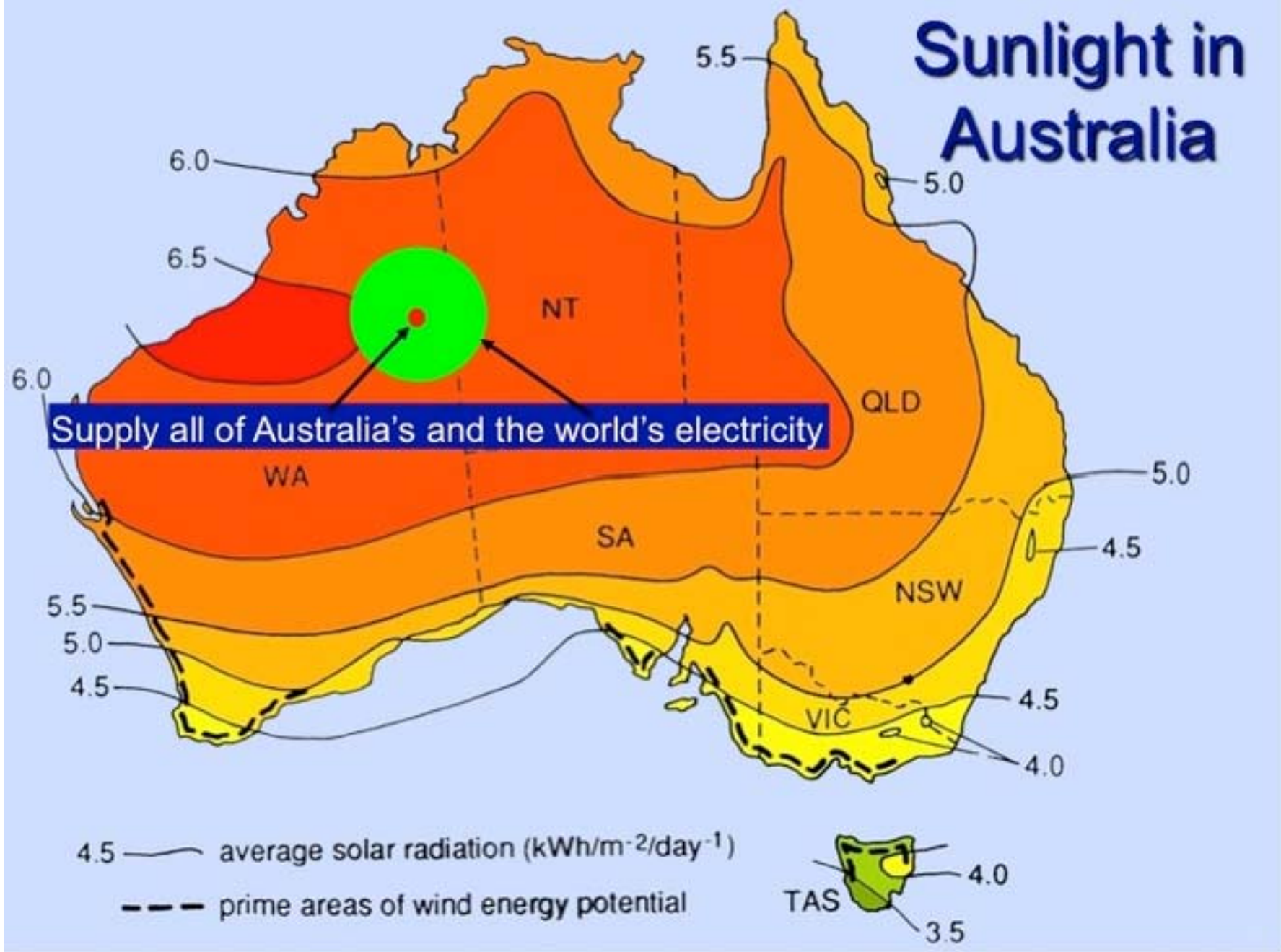
Australia has hot dry rock



Hot dry rock



Sunlight in Australia



Supply all of Australia's and the world's electricity

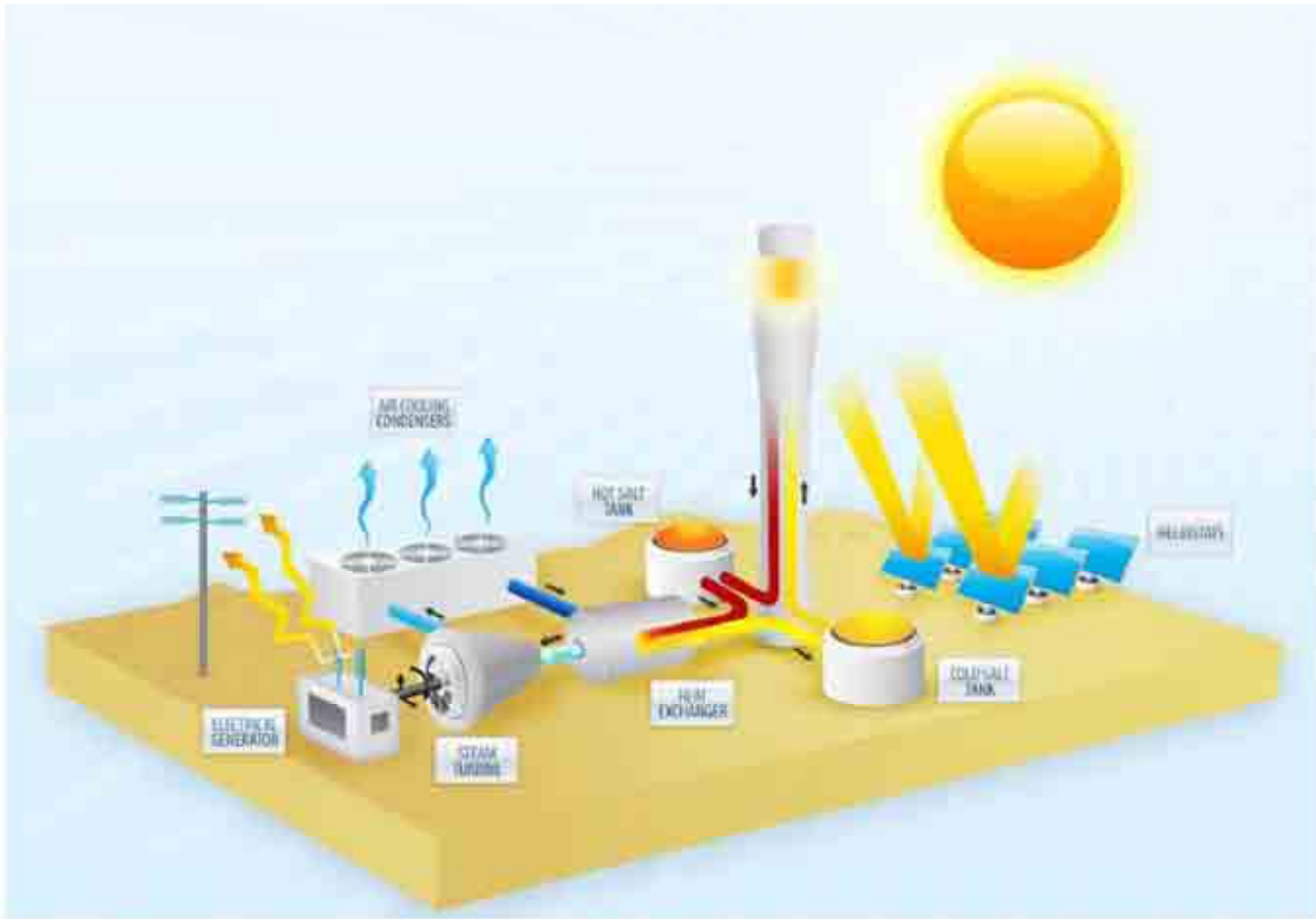


Solar thermal





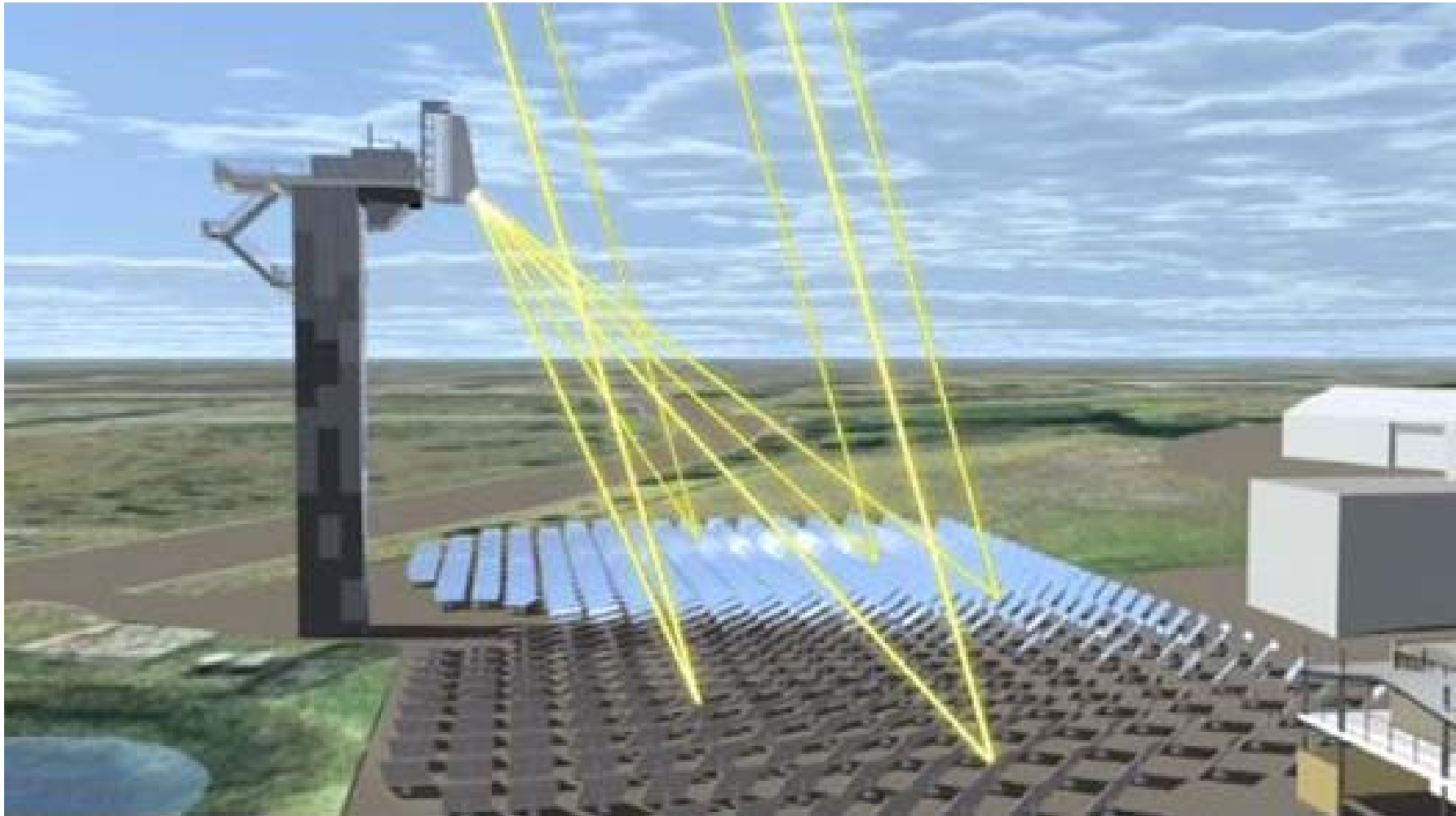
Heat storage – hot salt



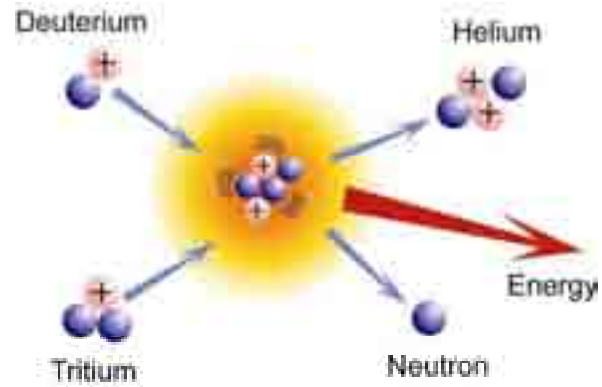
Solar updraft tower



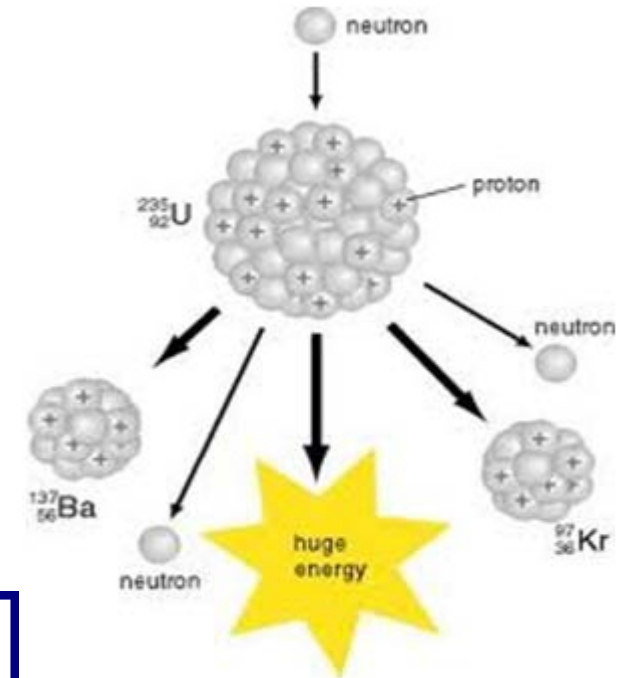
CSIRO - Heating air to run a turbine



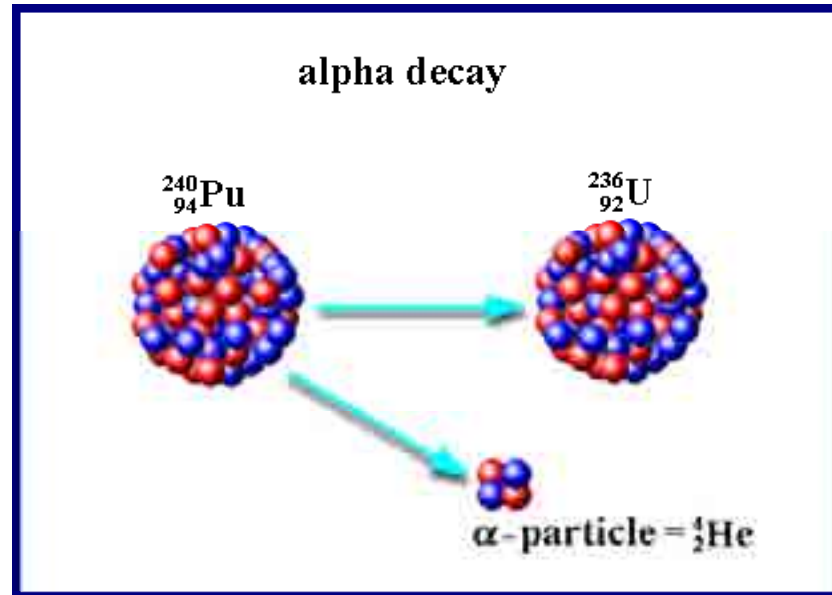
Nuclear energy



Fusion



Fission



Radioactive decay



Nuclear power

Uranium

12 % of world's electricity
80 years of Uranium
20 years to build a plant
Expensive – all are subsidised
Dangerous



Thorium

Better, but after 50 years not yet working

Retail electricity prices

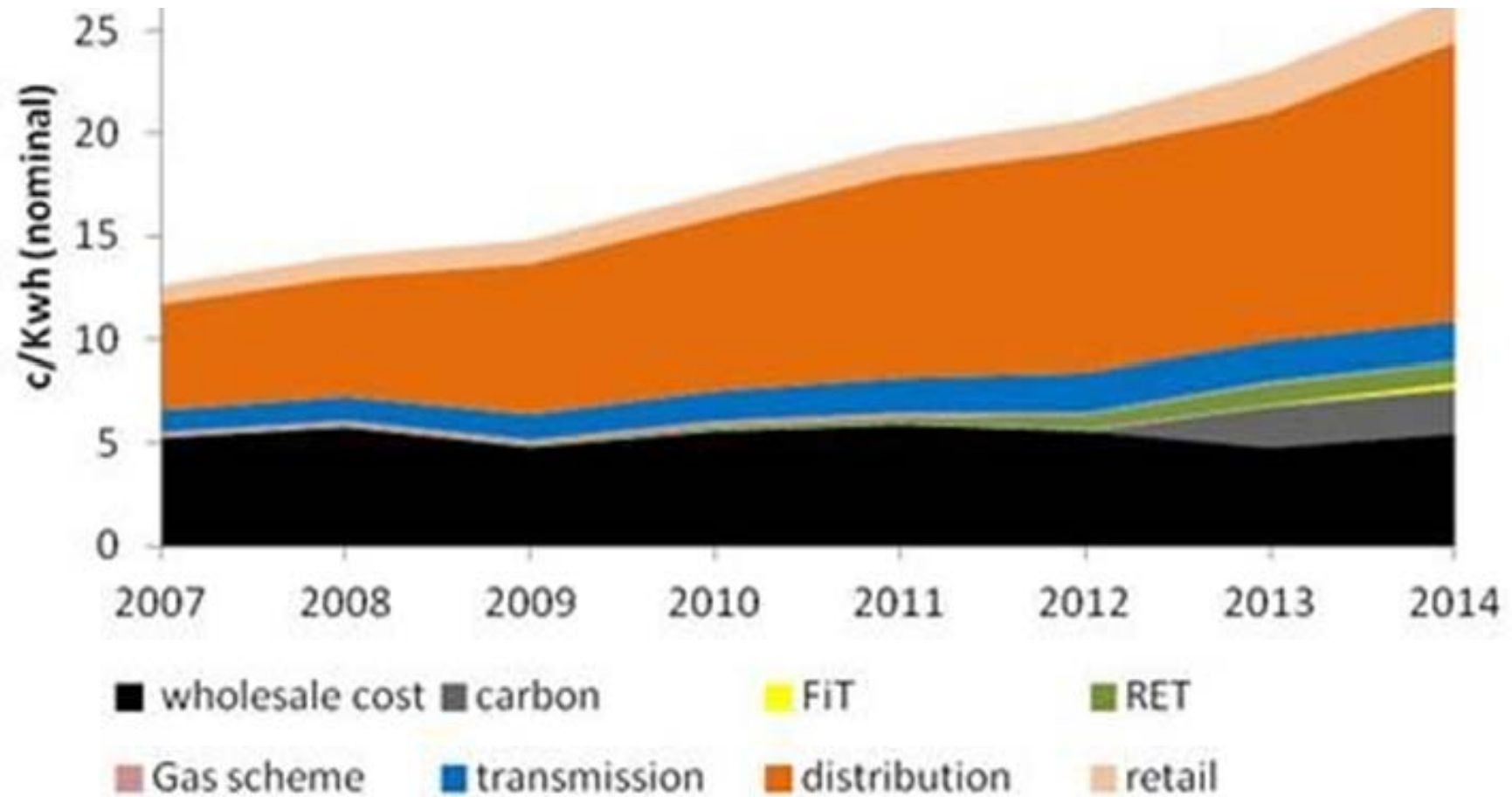
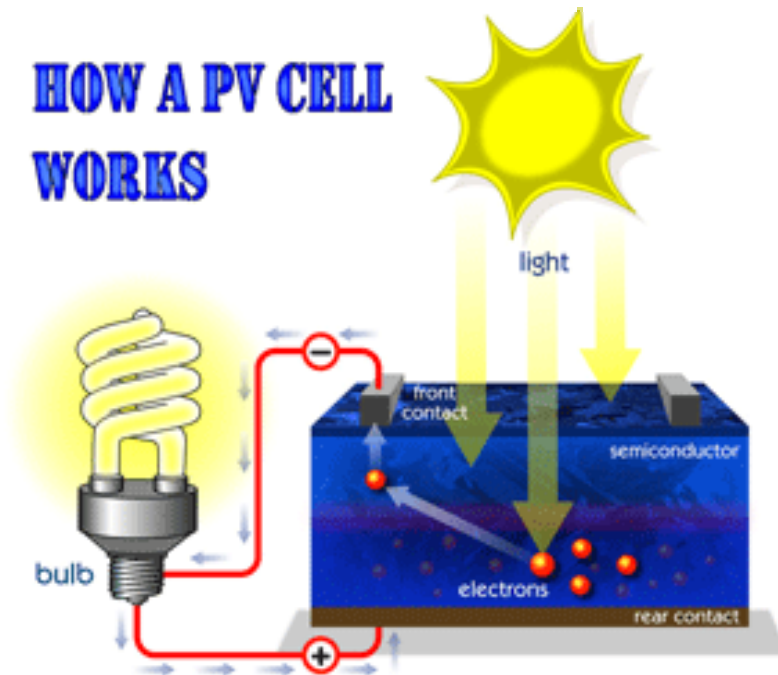


Photo Voltaic cells PV



HOW A PV CELL WORKS



Cost of rooftop PV

17 c/kWh

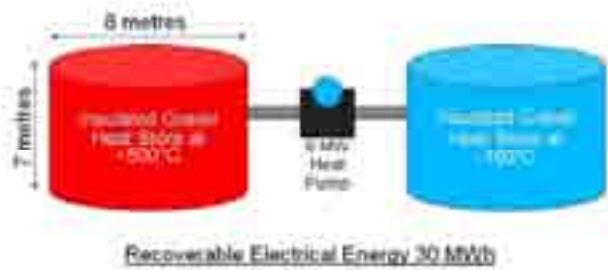
*Peak - 48 c/kWh,
shoulder 19.4 c/kWh,
off peak 12 c/kWh.*

Feed In Tariff 8 c/kWh

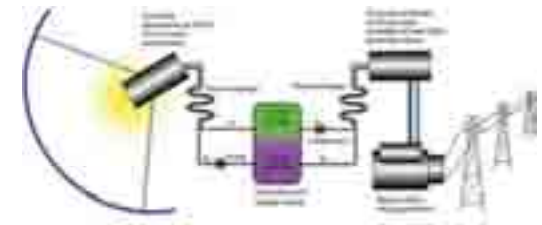
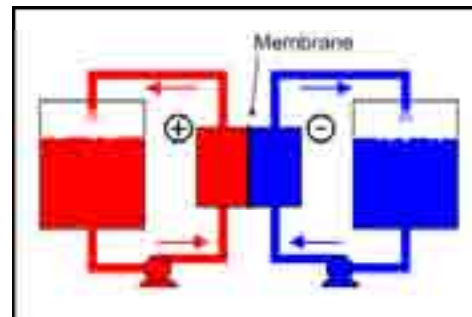
The price paid to the
generators is 5 c/kWh



Cost of 2KW PV system	\$3,560	
KWh/day for PV - Sydney	6.8	
KWh / year generated by PV	2482 kWh/y	
Cost of PV electricity at 12% depn.	17 c/kWh	

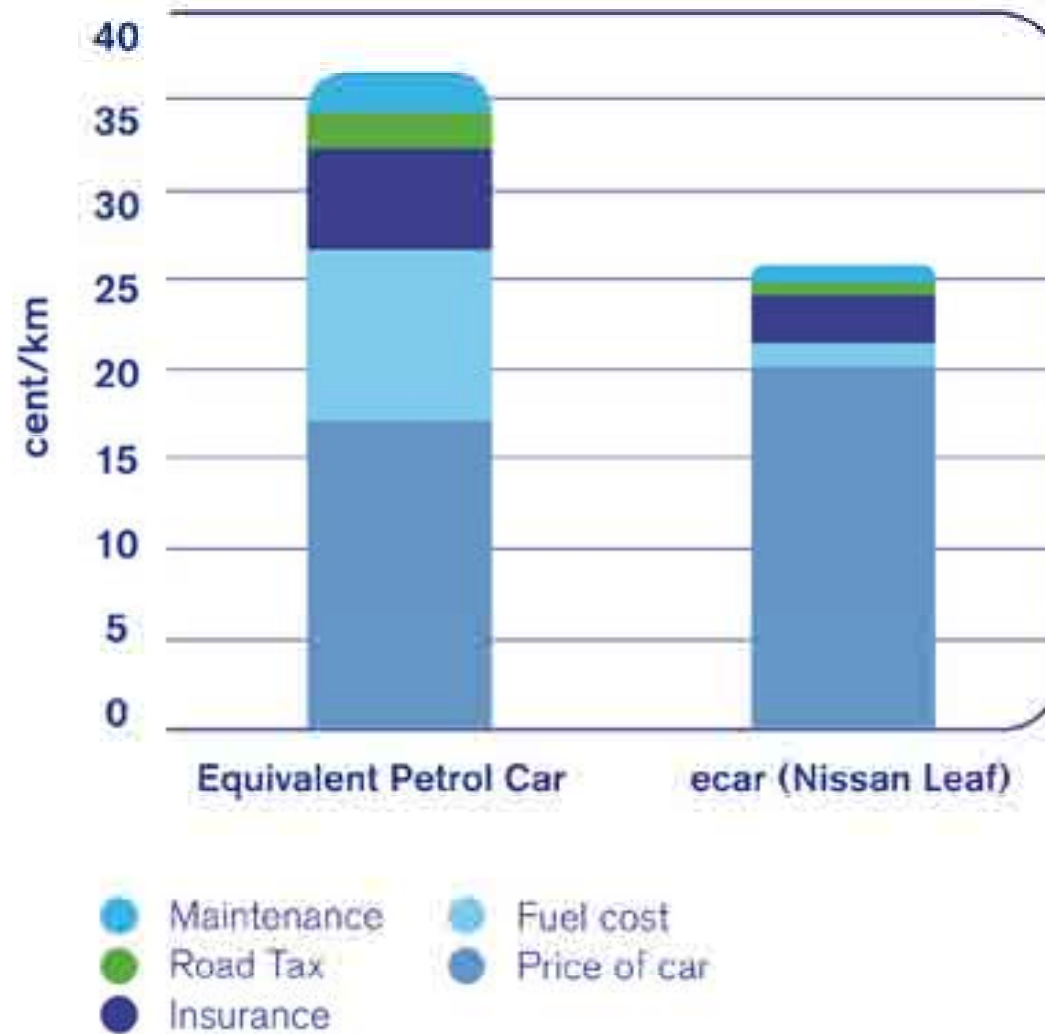


Batteries





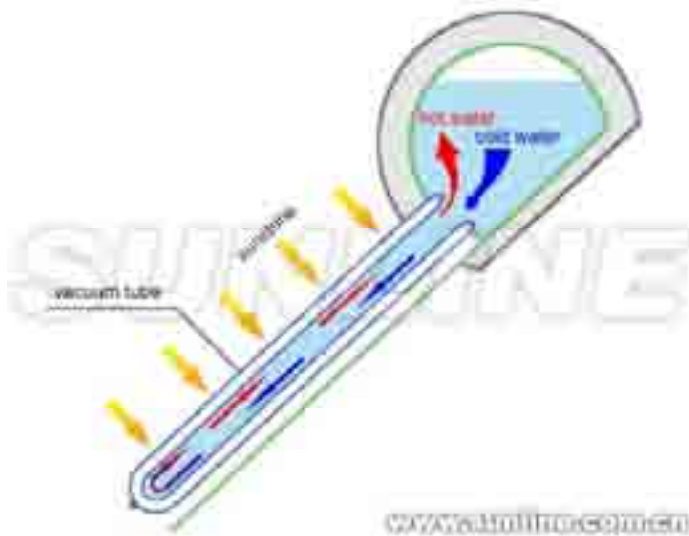
Cost of electric cars



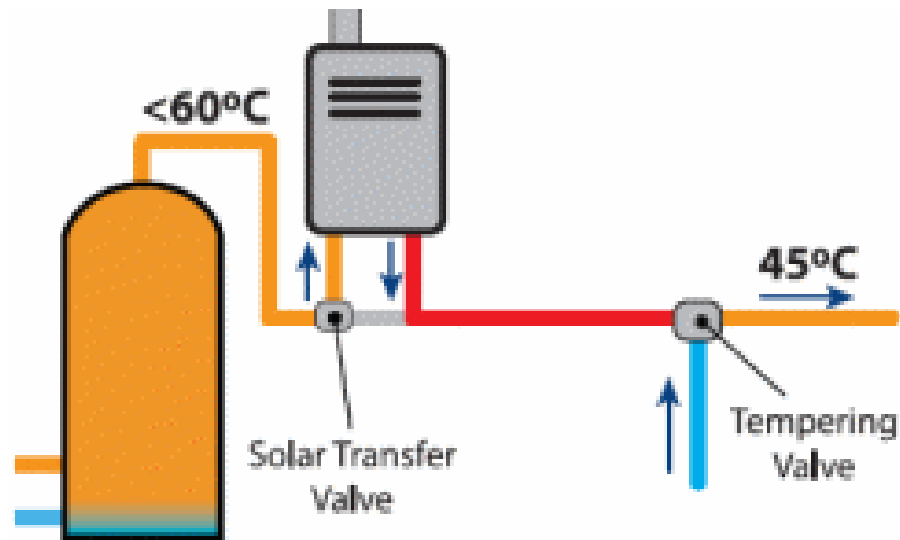
Solar hot water



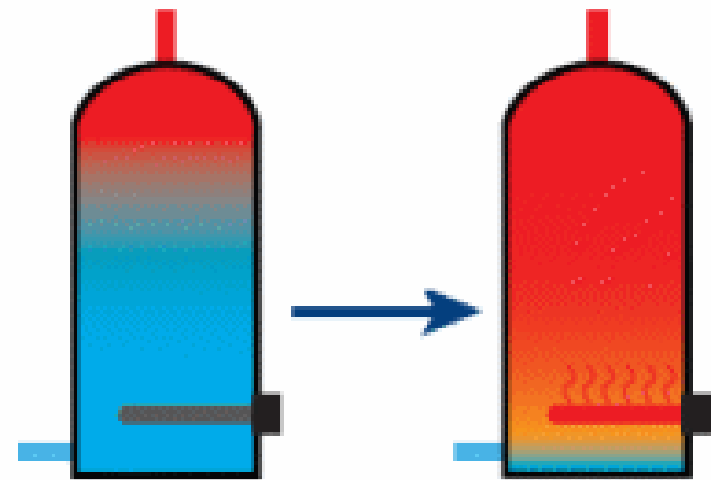
Evacuated tube collector



Boost



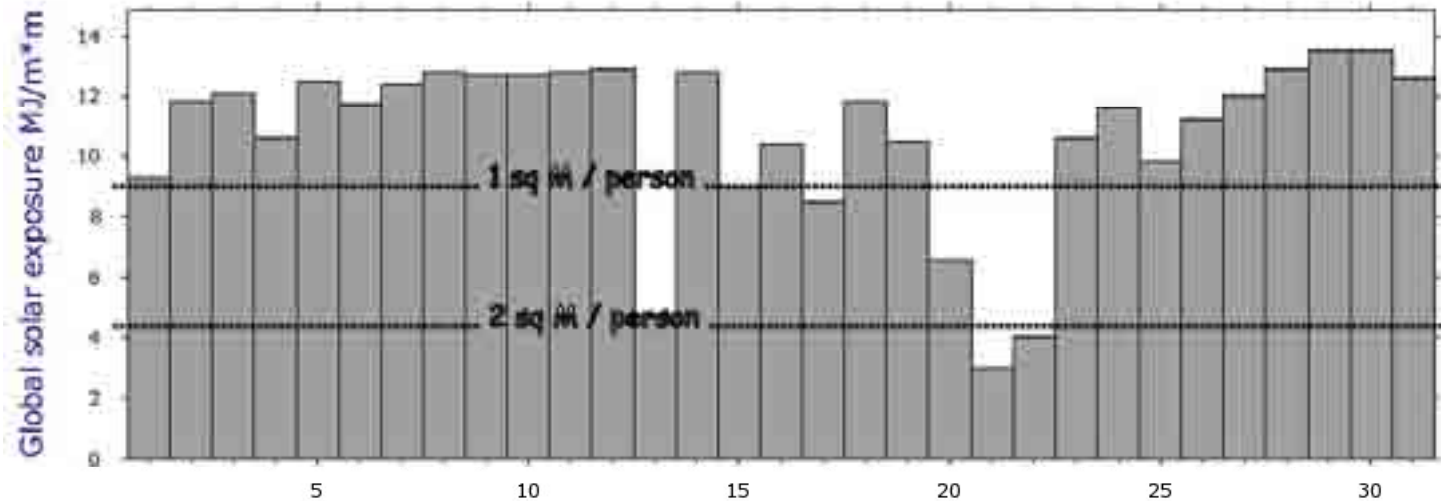
Gas boost system



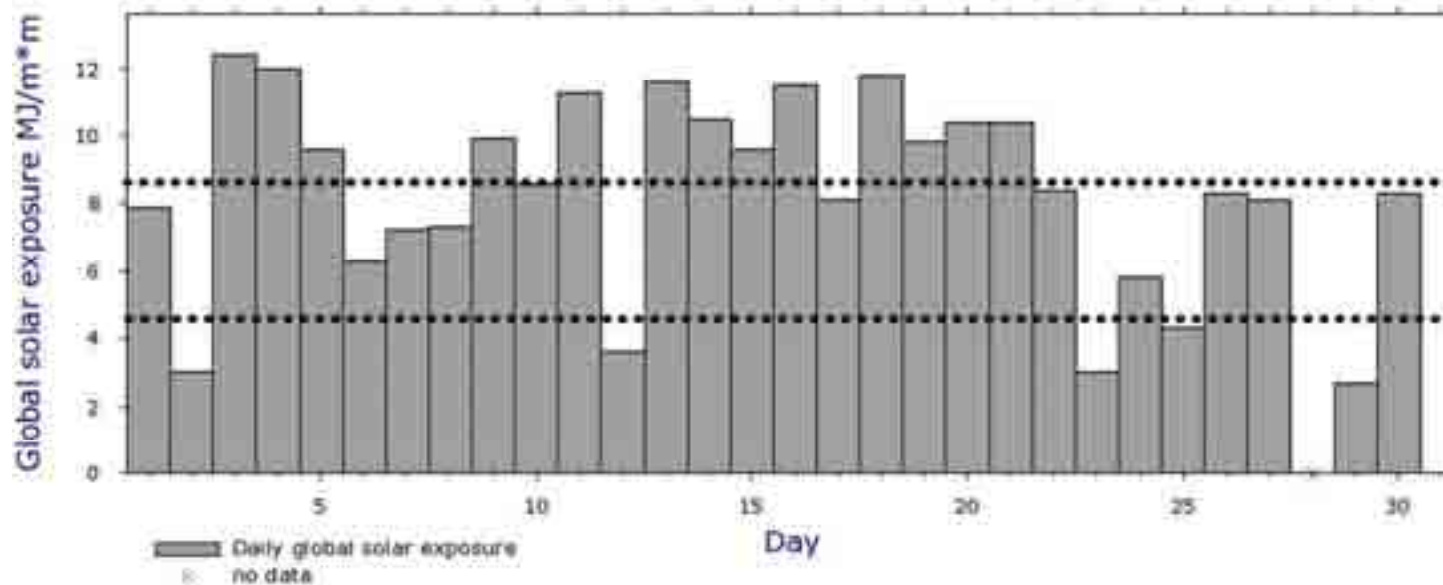
Electric boost system

Sunlight in Sydney winter

Sydney (Observatory Hill) (066062) Jul 2011 Daily global solar exposure



Terrey Hills AWS (066059) Jun 2013 Daily global solar exposure



Payback time – water heaters

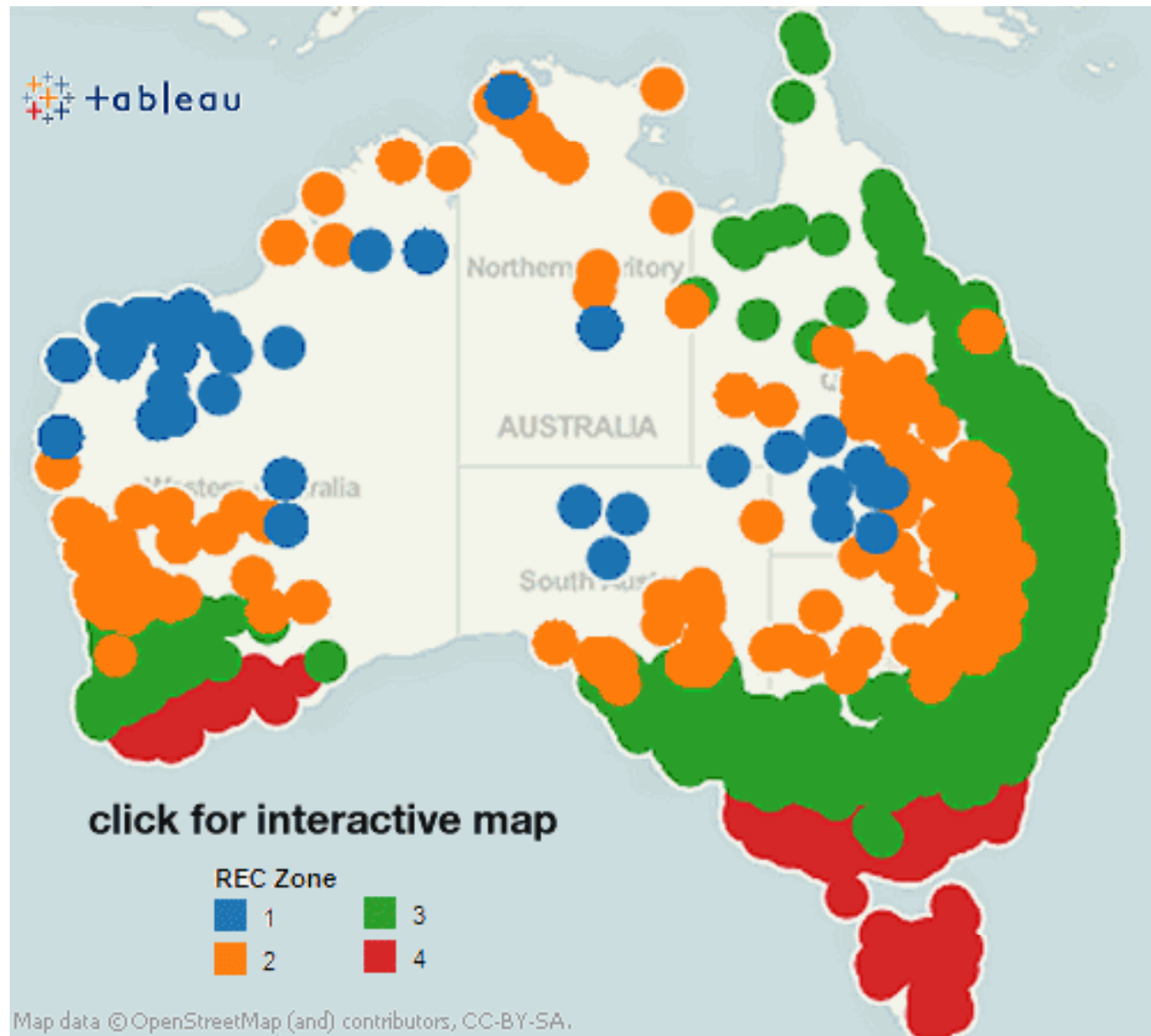
200 L/day	\$ / yr	Payback Yrs
HW storage - Continuous tariff	1100	
HW Storage - Off peak	700	
solar HW - Gas boost	200	6
solar HW – Electric boost	300	6
Solar HW - no boost	0	4.5
LPG	Very expensive	

Heat pumps



Most suppliers quote wonderful COP figures, and cost savings, but with no air temperature. It is dishonest!

Heat pumps and location



Saving energy - Lighting



Halogen 350W



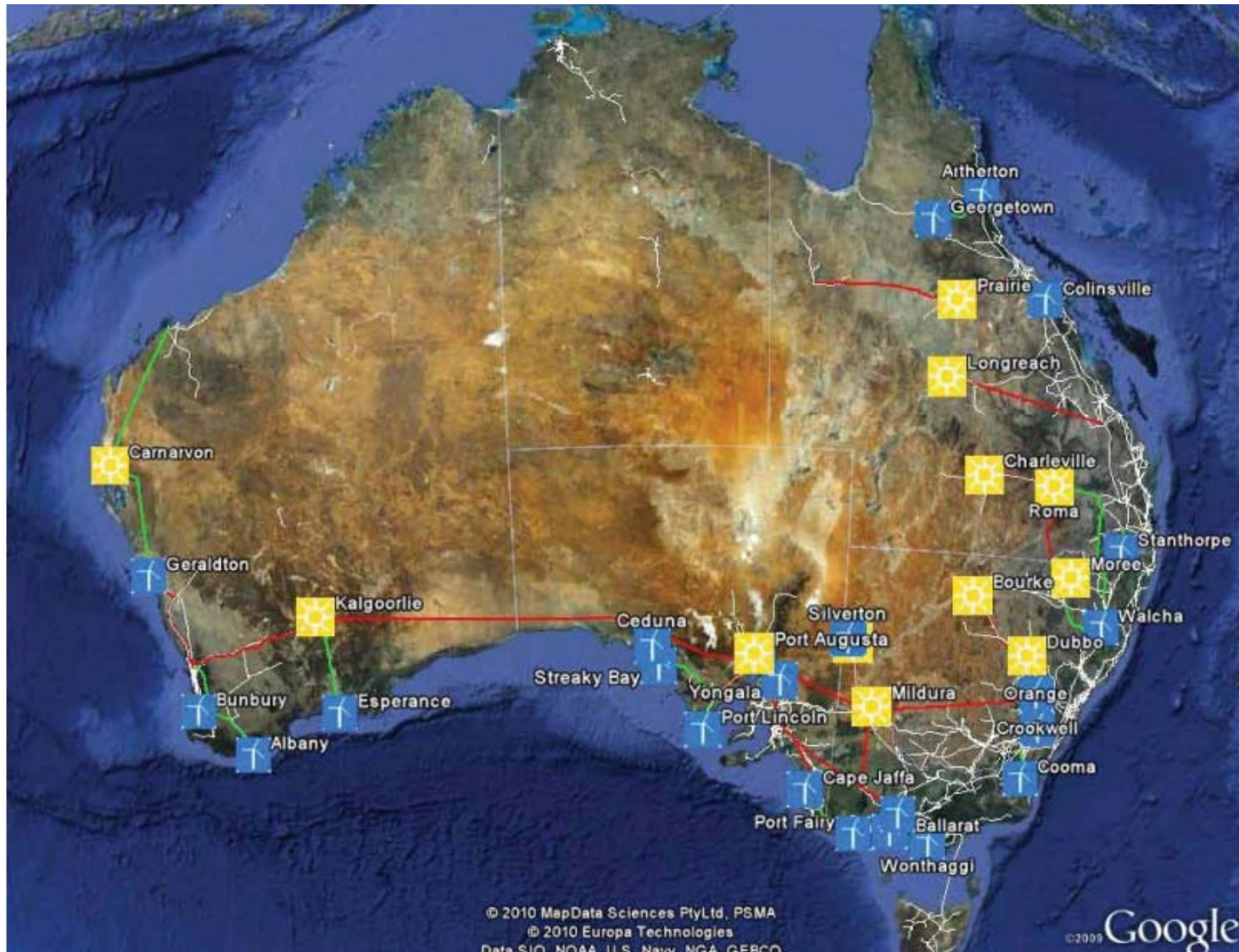
LED 70 W

skylights



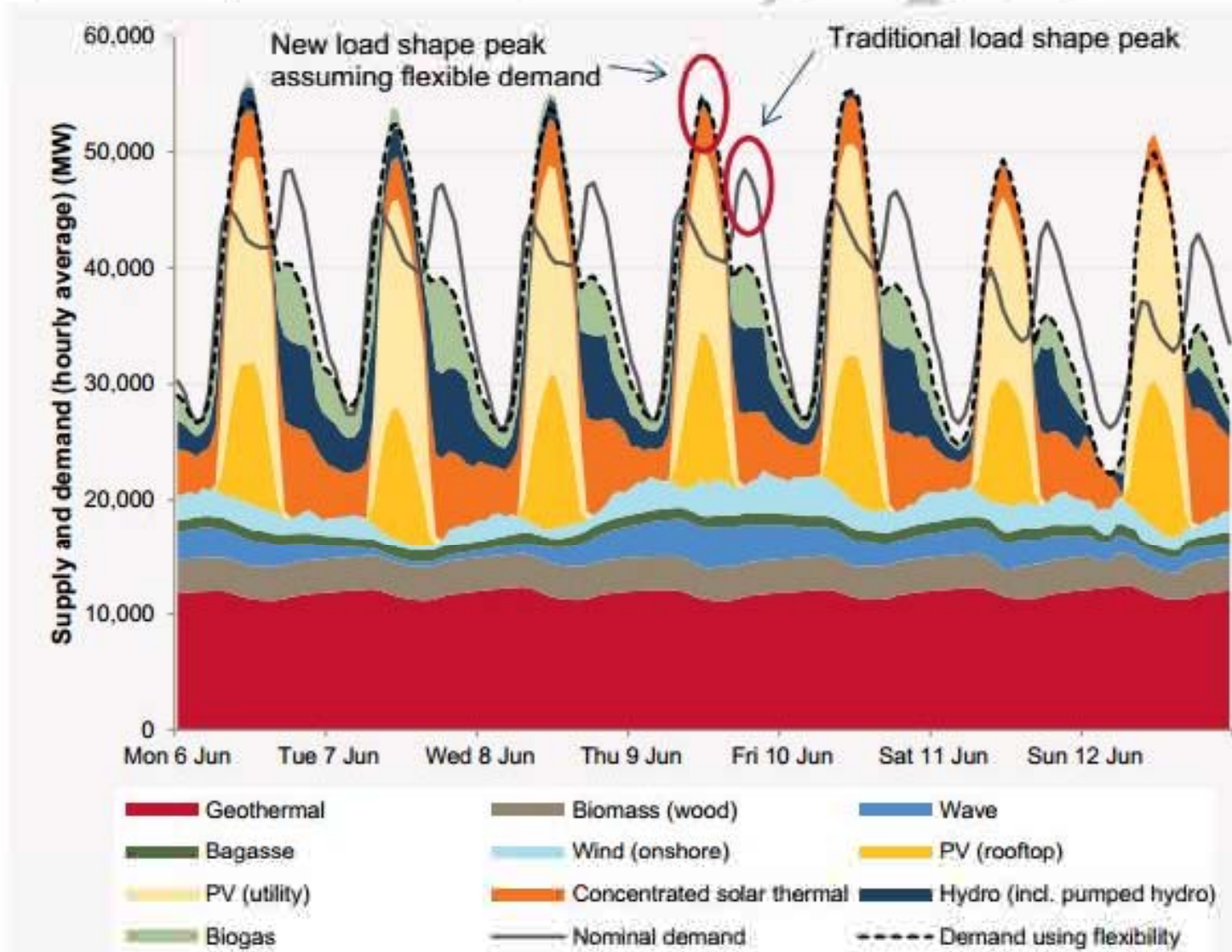
30 year \$ cost	5 hr / day		
	\$ Power	\$ globes	\$ Total
50 W downlight			
LED	250	50	250
Tungsten	1550	50	1600
Fluoro	370	75	445

100% renewables



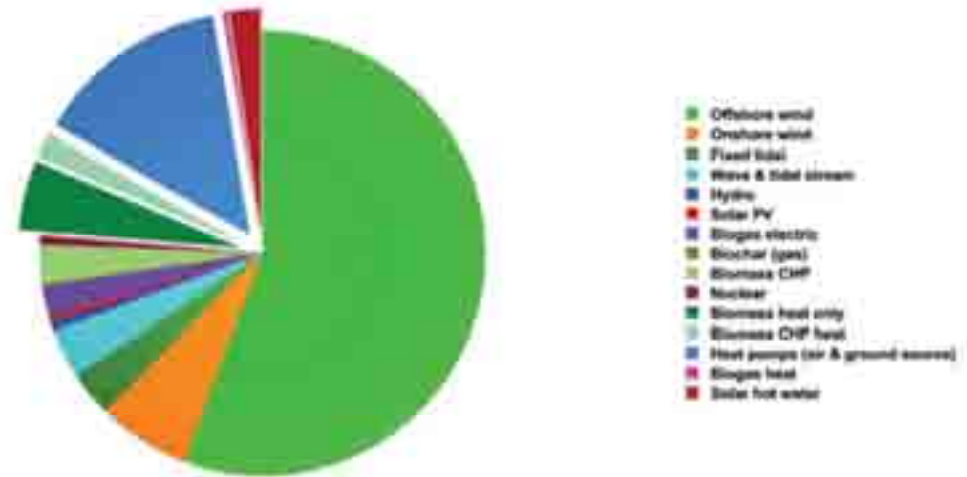
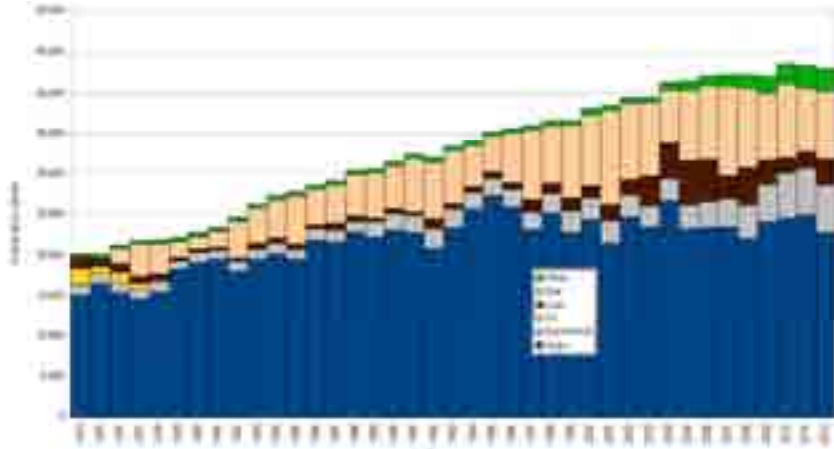
Australia

Figure 2: A sample forecast demand profile demonstrating load shape changes



100% clean energy

Fig. ES.2 Delivered energy provision in ZCB2030



Delivered energy provision for heat and electricity, by source (%), in ZCB2030. Segments displaying heat sources are pulled out from main pie chart.

NZ

UK

Germany

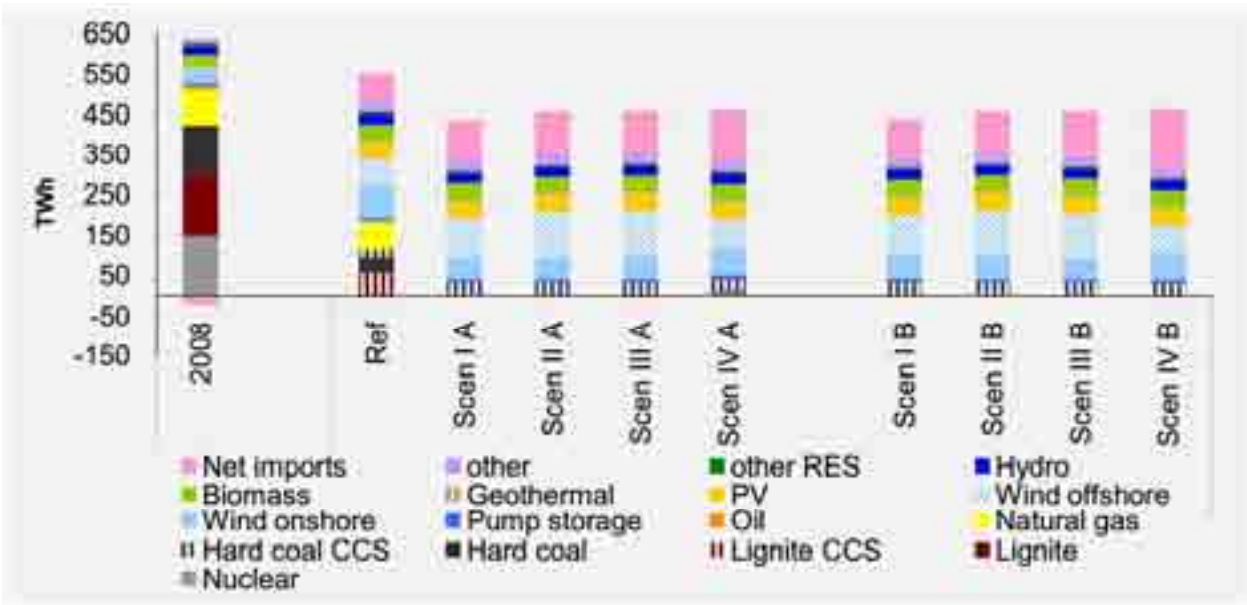
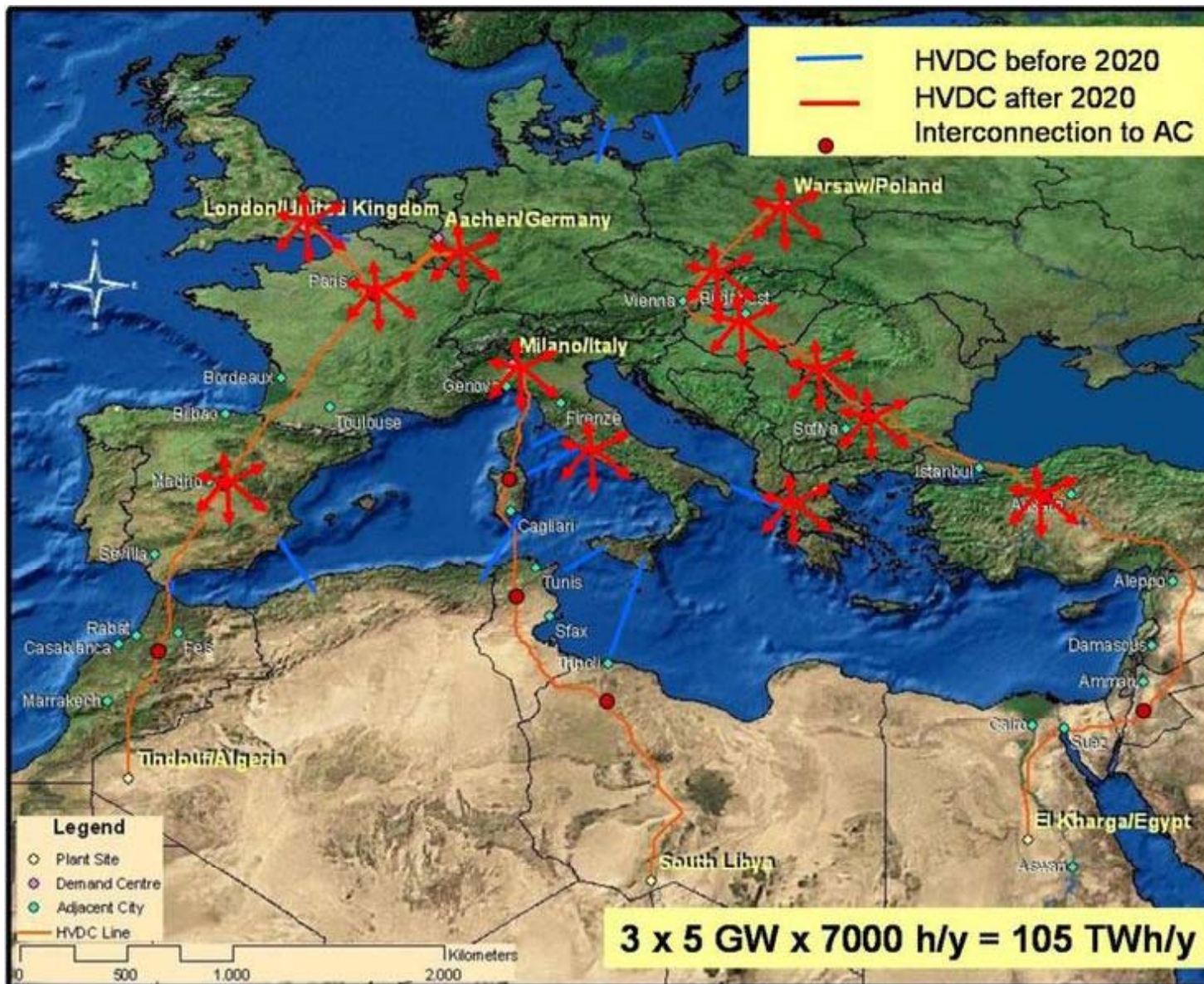
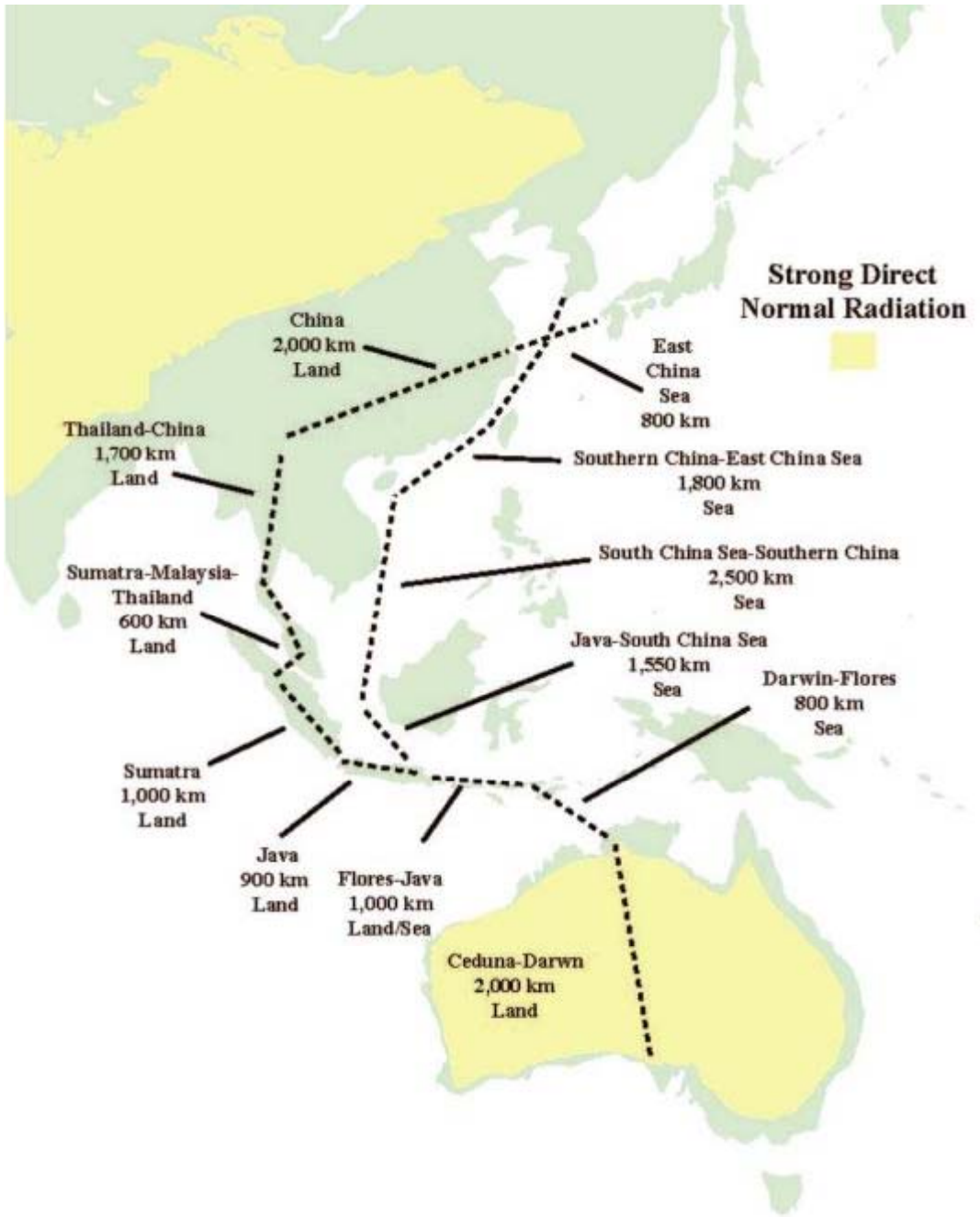


Figure 1: Electricity generation by fuels in TWh



Europe – Middle East





Aust
SE Asia
China

www.energy-without-carbon.org

Political

State govts – own coal fired power

Greens – stopped the ETS

Labor – gave up on climate change

Liberals - Direct action policy

Will pay companies who volunteer to reduce CO2

Bury carbon in the soil - 85 MT – reverts to CO2

Plant trees – max 3 MT of CO2 – we emit 1300 MT

Will abolish:

carbon tax

Emissions trading scheme

the Climate Change Authority,

the Climate Change Commission,

Energy Security Council

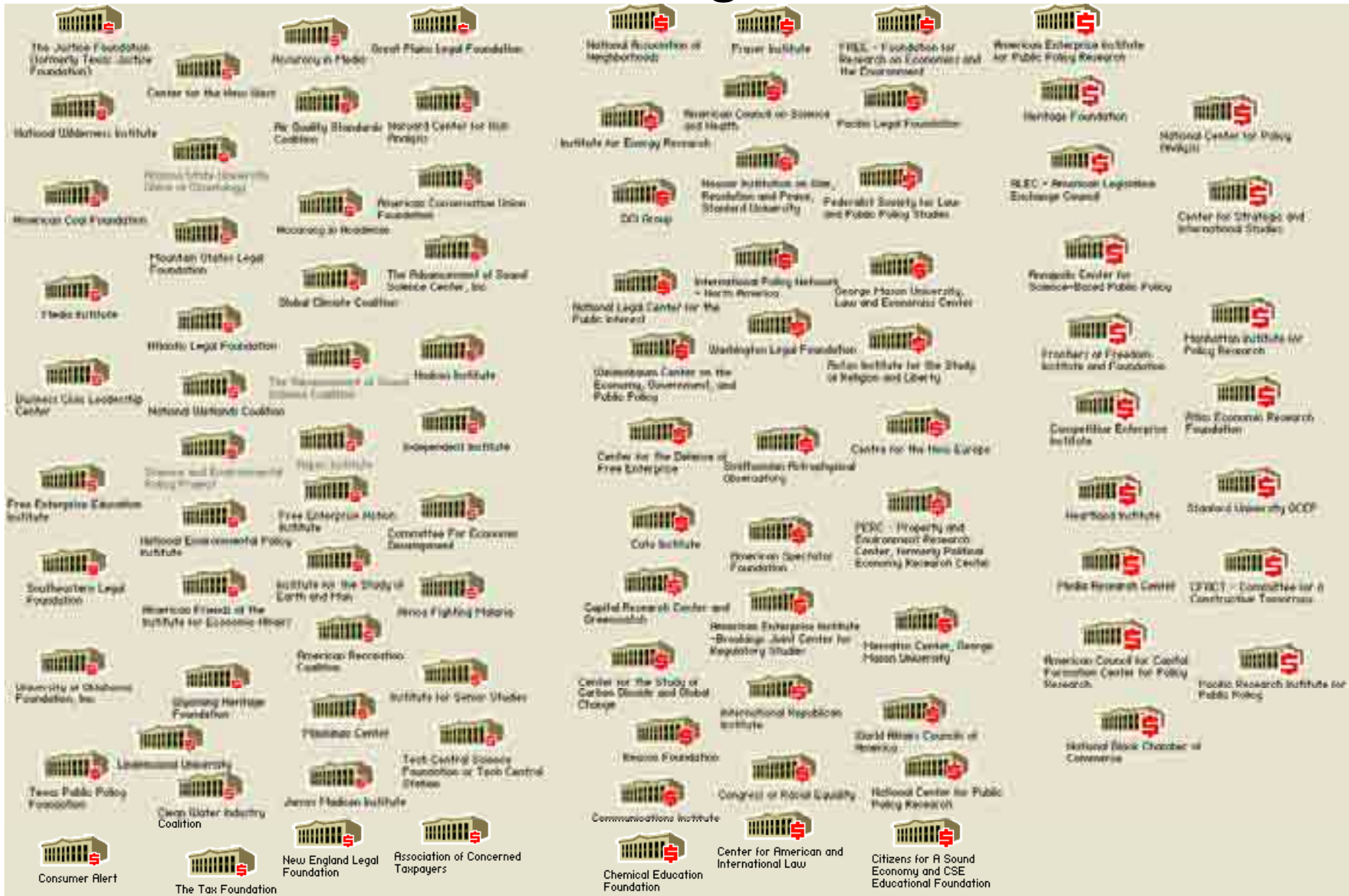
the Clean Energy Finance Corporation

Standard denial script:

We need more research.
Scientists are not agreed.
There are natural causes



Exxon funding of denial



Australian denial

