FOUR STEPS TO NET ZERO EMISSION BY 2050

Projections in the Pathways Report and work done by ClimateWorks Australia and Australian National University, together with CSIRO and the Centre of Policy Studies at Victoria University provide four simple steps that help us achieve zero net emissions by 2050.

NET ZERO EMISSIONS – THIS MEANS THAT THE EMISSIONS WE RELEASE INTO THE ATMOSPHERE ARE NO GREATER THAN THE EMISSIONS WE REMOVE.

STEP 1.

REDUCE ENERGY USE

You've probably heard the term 'energy efficiency'. It means choosing equipment and assets that use less energy and getting more out of the energy we do use. And it most certainly includes choosing appliances with a higher number of energy efficiency stars, insulating your home really well, and switching to low energy light bulbs.

But on a larger scale, it also means greatly improving our energy efficiency in all energy end-use sectors (the points where the energy ends up going). It includes:

- Improving the efficiency of passenger and goods transportation, by doing things like improving vehicle technology.
- Designing smarter infrastructure and more energy efficient urban spaces including residential and commercial. This may be achieved through improved architectural design, building practices and construction materials.
- Improving the efficiency of industry, including equipment, material efficiency and production processes in all industries, and doing clever things like re-using wasted heat.

Here's a snapshot of what could happen with energy efficiency across several key sectors in Australia:

BUILDINGS

In the buildings sector, we could achieve a reduction in energy use per household of over 50% compared to now, while commercial sector energy use per square metre could be reduced by just under 50% compared to now.

Even though this sounds like a HUGE improvement compared to where we are at right now, it doesn't actually require a big technological (or expensive) leap as these goals can be achieved through ensuring that new buildings are as efficient as possible, and by replacing existing equipment with best practice models when they reach the end of their useful life.

For example, LEDs (light-emitting diode) are light bulbs that can use at least 75% less energy - and last 25 times longer - than incandescent (standard) lighting.

Similarly, some buildings are now being built with an 8-star energy rating. These use 80% less energy use for heating and cooling compared with current homes. In most cases, the cost of energy saved over time will more than offset the additional up-front costs.

INDUSTRY

In manufacturing, the energy intensity of production could fall by approximately 40% by 2050 (not including emissions achieved through shifting to cleaner fuels, as discussed in Step 3). This can be achieved through process improvements and equipment upgrades for existing plants as well as implementing best practice technologies during the construction of new industrial facilities.

For existing plants, improvements could include things like reducing thermal losses from heating processes such as furnaces, kilns and boiler systems, or capturing waste heat to preheat materials. It also means reducing the fuel inputs required to perform other industrial processes. For companies, these improvements will usually generate financial savings and reduce production costs.

In mining, similar levels of energy efficiency may be achieved. In the short term, operational improvements such as changing the gradient of the slope where vehicles travel, reducing the amount of time vehicles stop and start and improving load management will increase efficiency.

In the longer term, technological improvements such as geological analysis and early ore and waste separation, or effective crushing and high pressure grinding rolls, will deliver significant additional savings.

However, the energy efficiency improvements of mining will likely be counterbalanced by an increase in energy intensity.

IN THIS CASE, ENERGY INTENSITY REFERS TO THE AMOUNT OF ENERGY REQUIRED TO GET THE MATERIALS THAT ARE BEING MINED.

Past energy intensity trends show that every year, around 3% more energy is needed to extract a similar volume of minerals as the year before, largely due to degradation in ore quality and increasingly difficult access to good resources. As a result, mining energy intensity is expected to double between today and 2050.

TRANSPORT

In the transport sector, a 70% improvement in the energy efficiency (i.e. litres per 100km) of cars and light commercial vehicles could be achieved. This could be done mostly through electrification of vehicles, combined with fuel efficiency improvements and a continued trend towards smaller vehicles.

These technologies are already commercially available: for example, some hybrid vehicles are already 65% more fuel-efficient than an average car.

We also require a 30% improvement in aviation energy efficiency by 2050. Again this is not an impossible dream: if you consider that the Airbus A380 of today is already 18% more efficient per passenger than the previous generation of large aircraft, then we can assume that further efficiencies will be introduced into newer generations of planes.

As for freight, we need trucks to improve their efficiency by 15% by 2030, while rail and marine freight should improve by 17% and 22% respectively by 2050.

GOING EVEN FURTHER

Other advances in technology should see other energy efficiency improvements. These could include new technology developments such as material efficiency to reduce the amount of resource extraction and primary metals production (e.g. through 3D printing), or in mining energy efficiency (e.g. through moving to landfill mining or other innovative practices).

Likewise in the transport industry, we could see improved energy efficiency through reducing travel activity (e.g. through increasing the use of public transport, a growth in choosing teleconferencing over business travel, and an increase in local sourcing of products meaning many of the things we need in our lives won't need to be shipped half way around the world to get to us.)

STEP 2.

PRODUCING CLEANER ELECTRICITY

So much of our lives are dependent on electricity. We also have vast swathes of infrastructure that support our use of electricity. The key to reducing the emissions generated as a result of our electricity use is to change the way we produce that electricity. We need to move away from burning fossil fuels that produce greenhouse gas emissions, to using cleaner, low emissions alternatives such as wind and solar (also known as low carbon electricity).

EXAMPLES OF LOW CARBON ELECTRICITY INCLUDE:

- WIND POWER – ELECTRICITY GENERATED FROM THE WIND
- SOLAR POWER – ELECTRICITY GENERATED FROM THE SUN
- HYDROELECTRIC POWER – ELECTRICITY GENERATED THROUGH THE USE OF THE GRAVITATIONAL FORCE OF FALLING OR FLOWING WATER
- GEOTHERMAL POWER – ELECTRICITY GENERATED FROM THE HEAT EMANATING FROM THE EARTH'S CORE
- TIDAL POWER – ELECTRICITY GENERATED FROM THE TIDES

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The Pathways Report modelled several options for low carbon electricity. Each of these could be achieved at similar costs. These include:

- 100% renewable energy
- Renewables plus carbon capture and storage (CCS)
- Renewables plus nuclear

All three scenarios would lead to similar emissions intensities by 2050, with the 100% renewables grid resulting in the lowest emissions by 2050.

MODELLING FOR THESE THREE SCENARIOS PRODUCED SOME IMPORTANT FINDINGS:

- All scenarios include a dominant share of renewables, driven by the decrease in cost of renewable technologies such as solar and wind over recent years. At this rate we could see 48% of our energy being produced by 2030 and 71% by 2050. They are expected to be the lowest cost technologies to achieve decarbonisation until their penetration requires significant additional costs for the management of variability. The wind doesn't always blow or the sun always shine, meaning that there have to be systems in place to provide back-up for any energy shortages due to the variability of wind or sunshine.

DECARBONISATION – TO REDUCE THE AMOUNT OF GREENHOUSE GASES RELEASED INTO THE ATMOSPHERE AS A RESULT OF HUMAN ACTIVITY.

- The major difference between scenarios is how the variability of wind and solar is managed. In the CCS and nuclear scenarios, back-up for variability is met by these technologies combined with peaking gas (gas that is only supplied during peak times). In the 100% renewables grid scenario the variability is met by combining storage with renewables and use of non-variable renewable technologies such as geothermal (geothermal energy comes from the heat of the earth which remains at a constant temperature and therefore doesn't have the problems of variability associated with solar and wind power).

- Solar could become the dominant technology by 2050. The high share of solar power (either photovoltaic or solar thermal) in the electricity generation mix is a reflection of both their cost advantages and also that a third of electricity consumption occurs in Western Australia, due to increases in mining activity and electrification of mining processes, where conditions for solar power are particularly favourable. Taking into account the need to invest in back-up capacity to cover variable supply, solar will more profitable than wind power by 2050.

- Analysis of retail electricity prices under the 100% renewable grid scenario showed households using only electricity today could expect the percentage of household income spent on electricity to halve by 2050.

GOING EVEN FURTHER

The results of this step could be further enhanced if demand for electricity was reduced - doing this in the mining sector alone would significantly impact total electricity generation in 2050.

On the supply side, additional technologies could be considered, such as:

- Biomass with Carbon Capture and Storage (CCS), generating electricity with net negative emissions, or the use of biogas to power remaining gas turbines without CCS. Both of these options would need additional biomass feedstocks.
- Accelerated reduction in the cost of low carbon energy technologies and storage could also speed up this step.

STEP 3.

SWITCH TO CLEANER FUELS

Now we are getting to the pointy end of our net zero emissions roadmap. This next stage is about looking at broadening the places where low emissions electricity can be applied.

That means switching every energy-using activity we possibly can to electricity powered by clean energy and everything else to low emissions alternatives (such as switching from coal and oil to biofuels).

BIOFUELS ARE FUELS PRODUCED FROM RENEWABLE PLANT AND ANIMAL MATERIALS.

As the Pathways Report indicates, using electricity from sources that produce very low amounts of carbon dioxide means that electricity becomes the least emissions intensive energy source.

And if we were to see a widespread shift to electrification across transport, buildings and industry, this would lead to a substantial decrease in emissions from these sectors. This would mean that we could increase our use of low carbon electricity to 46% in 2050.

BUILDINGS

If we were to switch from natural gas to low carbon electricity we could eliminate nearly all emissions from buildings by 2050. This requires moving from gas to electricity for all heating, hot water and cooking equipment.

INDUSTRY

In industry, we need a significant shift from coal and oil use towards electricity, bioenergy and gas. This would see a (approximately) 60% reduction in energy emissions.

We would also see electricity use tripling; this would be driven most significantly by a shift in mining from trucks to electricity-based technologies such as conveyors for materials handling.

Bioenergy could be used for about half of the remaining mining oil use, increasing bioenergy consumption nine-fold when compared to 2012 levels.

15% of the remaining direct fuel use could be shifted to biomass/biogas in manufacturing.

TRANSPORT

Cars and light commercial vehicles could shift from internal combustion engines to electric and hybrid drive-trains, and to a lesser extent hydrogen fuel cells. Hydrogen is created through electrolysis so can be considered another form of electrification, therefore providing an attractive opportunity for the use and storage of any surplus renewable electricity generation.

Natural gas can be used in place of oil extensively for road freight, lowering oil use in the sector by 85% between 2012 and 2050. As a result, CO_2 emissions may be reduced by two thirds, while vehicle kilometers travelled can nearly double.

Approximately 15% of air travel could be replaced by electric fast rail between the large east coast cities in Australia. In addition, biofuels could replace 50% of oil use in aviation, as it's the only fuel switch option currently available for this sector.

The marine and rail sectors need only make a relatively modest switch to gas and biofuels.

In the future, alternative opportunities could include the use of hydrogen to power large trucks, or increased use of biofuels if additional feedstocks are available.

STEP 4.

SORT OUT AND STORE THE REST

Finally, we look at the need to bring any remaining emissions down to net zero. And this leads us to solutions including capturing - or sequestering - those emissions (known as carbon capture and storage).

CARBON CAPTURE AND STORAGE – THE PROCESS OF TRAPPING CO_2 AND STORING IT IN SUCH A WAY THAT IT IS UNABLE TO AFFECT THE ATMOSPHERE.

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We can also reduce emissions generated through activities other than energy production - such as through livestock.

LIVESTOCK PRODUCE METHANE, ANOTHER POTENT GREENHOUSE GAS. METHANE IS A MORE POTENT GREENHOUSE GAS THAN CO_2: HOWEVER, THERE IS OVER 200 TIMES MORE CO_2 IN THE ATMOSPHERE THAN METHANE.

Finally, there are many ways to offset the remaining emissions imbalance - through activities such as planting trees (also known as bio-sequestration).

INDUSTRY

In addition to emissions produced through primary actions such as the combustion of fossil fuels, industrial processes produce significant added emissions called 'fugitive' emissions. These occur through leaks, venting and the irregular or unintended release of gases released during extraction, processing, production, storage, distribution and transmission of greenhouse gas emitting fuels.

Following Step Four of our plan, process emissions and fugitive emissions from the industry sector can be reduced via means including the partial use of bio-coke in iron and steel production, and CCS. It's worth noting that these non-energy emissions are well suited to CCS, given the relatively high purity of CO_2 outflows.

AGRICULTURE

Soil and livestock emissions can be reduced through widespread use of best practice farming techniques. In the example of beef production, this includes intensification of breeding (increasing the productivity of livestock without increasing the amount of land needed for that livestock - for example, by choosing breeds of cows with a higher milk yield), improvements in feeding and pasture practices, as well as enhanced breeding and herd selection for lower livestock methane emissions.

CARBON FORESTRY

Australia has great potential to offset emissions via forestry bio-sequestration.

The implementation of price incentives for planting and raising carbon forests would assist large shifts in land use - from agriculture (in particular livestock grazing) to carbon forestry. Carbon forests provide farmers with an opportunity to diversify incomes, enhance biodiversity, and control salinity and erosion.