Australia: Climate Policies, NDC and low-carbon pathways

Where are we?

Australia’s net energy use has historically been dominated by industry, electricity generation and transport, together accounting for 83% in 2016, while residential and services sectors contribute a relatively small amount of energy consumption. Just over a third of total primary energy is derived from oil (37%), with large shares also coming from coal (32%) and natural gas (25%). Since 2005, total energy from coal has declined by 13%, while the consumption of gas and renewables has increased by 51% and 30% respectively by 2016 (DoEE, 2017a).

There have been recent disruptions in the power sector, with a state-wide blackout in South Australia in late September 2016, several occurrences of load shedding and gas shortages, and power reliability issues experienced under severe climate situations in 2017-18 in Victoria and South Australia. To some extent the energy system transformation is happening at a faster pace and scope than expected, driven by rapidly falling technology costs for renewable energy, energy efficient appliances and batteries, and the closure of the oldest coal-fired power plants. Coinciding with rising energy prices and limited energy retail choices, a growing number of consumers have opted for electricity production at home (prosumers) and some have even gone off grid (IEA, 2018).

With regard to climate policy, Australia ratified the Paris Agreement on 10 November 2016. Its Nationally Determined Contribution (NDC) includes a target of reducing GHG emissions, including land use, land use change and forestry (LULUCF), by 26–28% below 2005 levels by 2030. The NDC translates into a total reduction from 597 MtCO$_2$-eq. in 2005 to 430 or 442 MtCO$_2$-eq in 2030. This is equivalent to a reduction of 50% of per-capita CO$_2$ emissions and to a reduction of emissions intensity of GDP of 64%-65% during the period 2005-2030 (Australian Government, 2015).

While there has been significant volatility in Australian climate policy in the past decade, current policy proposals at the national level tend towards imposing an average emission intensity constraint on the electricity sector in the period between 2020 and 2030 consistent with the NDC (Finkel et al., 2017; Energy Security Board, 2017). The policy mechanism for other sectors (beyond electricity production) is less clear, although work towards a national road transport GHG emission standard has proceeded as far as an impact statement and a consultation paper on possible alternative designs. An Emission Reduction Fund (ERF) has been operating, which directly purchases abatement using government funds from a wide variety of sectors via an auction process. Land regeneration projects have been the most successful in receiving funds (bidding the lowest cost of emission abatement). There is no long-term provision in the budget for future ERF auctions beyond 2020.

In parallel, several state and territory governments have legislated and implemented GHG emission reduction and renewable energy targets. In regard to legislated net zero GHG emissions targets, the Australian Capital Territory amended its Climate Change and Greenhouse Gas Reduction Act 2010, setting a net zero GHG emissions target by 30 June 2050. This is soon to be amended to 30 June 2045. In Victoria (Australia’s second most populated region), the Climate Change Act 2017 came into effect on 1 November 2017 establishing a long-term reduction target to net zero GHG emissions by 2050 and the setting of five-yearly interim targets.

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4 http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubStatbook.nsf/f932b66241ecf1b7ca256e92000e23be/05736C89E5B8C7C0CA2580D50006FF95/SFILE/17-005a%20authorised.pdf
along similar lines to the UK Climate Change Act\(^5\). Other states and territories in Australia have also responded setting aspirational goals for net zero GHG emissions by 2050.

Australia’s GHG emissions in 2015 were 527 Mt CO\(_2\)-eq (DoEE, 2016). Power generation was the largest source of GHG emissions (189 Mt CO\(_2\)-eq), followed by transport (95 Mt CO\(_2\)-eq), other stationary energy, mainly direct combustion (91 Mt CO\(_2\)-eq), agriculture (70 Mt CO\(_2\)-eq), fugitive emissions (45 Mt CO\(_2\)-eq), industrial processes (32 Mt CO\(_2\)-eq), waste (12 Mt CO\(_2\)-eq) and land use, land use change and forestry (-8 Mt CO\(_2\)-eq). An alternative representation of current GHG emissions is shown in Figure 1.

The 2015 inventory represents a 12 per cent reduction from 2005 levels. This has been mainly driven by:

- reductions in electricity emissions, due to increased energy efficiency, expansion of renewable energy and limited growth in electricity demand
- ongoing subdued economic conditions resulting in slower overall emissions growth
- lower deforestation rates than historical levels.

The model used for the analysis is an Australian version of the TIMES (The Integrated MARKAL-EFOM system) model, a linear optimisation energy model generator developed by the Energy Technology Systems Analysis Programme (ETSAP) of the International Energy Agency (IEA).

Under current national policy settings, GHG emissions in 2030 are projected to grow by 3.9 per cent above current levels and 3.5 per cent above 2020 levels (Figure 2). Most of the projected growth in GHG emissions would be in the transport sector, led by increased heavy vehicles activity for freight, and the agriculture sector, driven by increased cattle numbers. GHG emissions in other sectors are projected to stabilise or grow slowly after 2020. Power sector emissions are expected to be flat as demand growth is offset by the effect of policies and initiatives under the National Energy Productivity Plan (NEPP). Long-term GHG emissions from industrial processes and product use are expected to be lower following the legislated phase-down of HFCs from 2018 (DoEE, 2017b).

Where do we want to go?

Under the Paris Agreement, parties have set a goal to limit the increase in global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. The Paris Agreement also recognises that the world will need to achieve zero net emissions in the second half of the century. To achieve this level of decarbonisation, Australia will need to adopt a multi-faceted approach primarily comprising reductions in emissions associated with the land and energy sectors. The energy sector currently accounts for 79% of Australia’s GHG emissions.

The Low Emission Technology Roadmap (Campey et al., 2017), while not recommending specific policy settings, identified two main areas where policy could support low emissions technology uptake. First, achieving improvement in energy productivity in buildings, industry and transport through increased uptake of lower emissions technologies will require policy support to overcome market and firm-level failures such as split incentives, competing priorities, lack of information and access to finance. This could take the form of energy and emissions standards, targeted incentives and market reform (such as developing financial instruments to help tenants and owners co-finance energy efficiency, or pricing externalities). This is likely to be incremental to the existing measures in the National Energy Productivity Plan (NEPP).

The second main area in which policy measures are required to address market barriers is in the electricity sector, where stable, long term policy is required to drive uptake of low-emissions electricity generation technology to 2030 and beyond. This will be required to enable investors in new, low emissions generation to achieve acceptable returns on investment with sufficiently low market risk. Market reform may also be required to allow providers of dispatchable supply to achieve sufficient returns in the electricity market. Market reform may also be necessary as system optimisation becomes dependent on coordination of regulated electricity markets and contestable wholesale markets, with tariff reform also playing an important role. Market reform or other policy drivers will also be required to drive uptake of enabling technologies for variable renewable energy sources (VRE), by allowing these enablers to capture the full value of services provided to the grid (e.g. fast frequency response, inertia and voltage control), and by enabling all technology owners to participate, including consumers with behind-the-meter batteries.

Another area where policy measures may be required is in fugitive emissions from coal mining and oil & gas production. Technologies to reduce these emissions (e.g. Ventilation Air Methane (VAM) abatement)
technologies in underground coal mines) typically impose a net cost on operations, and hence require policy to drive their uptake. The Emissions Reduction Fund (ERF) has recently been revised to include VAM abatement technologies, but it is not yet clear whether this will drive uptake to the full extent of the cost-effective technical potential.

The Australia “low-carbon” scenario presented here is considered to be in line with the objective to limit global warming to well-below 2 °C, as cumulative Australia’s CO₂ emissions are 14 Gt CO₂ in the 2010-2050 period; this is consistent with the range projected by a number of global models⁶ for cost-optimal scenarios assuming a global carbon budget of 1000 Gt CO₂ considered equivalent to limit global warming to likely below 2 °C.

Figure 3: Greenhouse gas emissions in 2015 and by 2050 in the reference scenario (NDC), emission reductions between the reference and low-carbon scenarios by sector (energy supply, industry, residential and commercial buildings, transport, non-energy CO₂), and 2050 emissions in the low-carbon scenario. Non-energy CO₂ includes emissions from AFOLU and industrial processes. Model: AUS-TIMES.

How do we get there?
Previous studies in the Australian context of low carbon scenarios have identified the key role of decarbonisation of the power sector and the electrification of end-use sectors (industrial, commercial/services, residential, transport) to achieve significant cuts in GHG emissions. Other decarbonisation opportunities include fuel switching from fossil fuels to bioenergy and other renewable sources, and from coal and oil to gas (e.g., Denis et al., 2014).

In closing the gap between current emission trends and reduction pathways compatible with least cost trajectories to limit warming to 2/1.5 °C above pre-industrial levels (Figure 3), the power sector has a crucial role due to its current high emissions intensity. The main opportunities for least cost decarbonisation of the power sector are:

- The retirement of emissions-intensive (mainly coal-fired) power plants
- Deployment of variable renewable energy (VRE) power generation, mainly in the form of onshore wind farms, utility-scale solar PV and distributed (rooftop) solar PV in the near-term, combined with

concentrating solar power (CSP) with thermal storage, pumped storage hydro and other forms of electricity storage in the longer-term.

The main opportunities for electrification in the end-use sectors include (Campey et al., 2017):

- Industrial process heat through fuel switching from natural gas
- In some industrial sub-sectors (e.g., mining), significant increases in energy productivity may be achieved through improved materials handling equipment (i.e. conveyors) and comminution processes (i.e. crushing and grinding)
- Deployment of more efficient general equipment such as electric motors and variable speed and frequency drives in industrial processes
- Space heating in commercial and residential buildings through the uptake of high efficiency air-conditioning and other electric appliances displacing natural gas
- Hot water provision in commercial and residential buildings through the uptake of heat pumps or electric boosted solar hot water systems
- Electric vehicles (EVs) particularly in the light vehicles segment (i.e., motorcycles, passenger and light commercial vehicles) and some opportunities in the heavy vehicles segment (i.e., some bus routes, small rigid trucks, potentially articulated vehicles)
- Fuel switching mainly away from diesel and towards biofuels in some non-road transport modes (i.e. rail and shipping).

Other non-electrification opportunities for fuel switching from fossil fuels include:

- Bio-synthetic paraffinic kerosene substituting for crude-derived jet fuel
- Use of biodiesel or hydrogen in off-grid remote areas (e.g., remote communities, isolated mine sites)
- Fuel switching mainly from diesel to biodiesel or hydrogen in segments of road transport (e.g. heavy vehicles) and non-road transport (i.e. rail and shipping).
- Fuel switching from natural gas to solar fuels for low-temperature industrial process heat.

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Figure 4: Illustration of energy system transformation towards decarbonisation. 2 °C consistent scenario from AUS-TIMES. Numbers in graph indicate change between 2015 and 2050 (intensity indicators: %, share indicators: percentage points, pp)