

Choice cuts

*The advantages of cutting emissions in the
electricity sector*

Discussion paper

Matt Grudnoff
November 2017

ABOUT THE AUSTRALIA INSTITUTE

The Australia Institute is an independent public policy think tank based in Canberra. It is funded by donations from philanthropic trusts and individuals and commissioned research. We barrack for ideas, not political parties or candidates. Since its launch in 1994, the Institute has carried out highly influential research on a broad range of economic, social and environmental issues.

OUR PHILOSOPHY

As we begin the 21st century, new dilemmas confront our society and our planet. Unprecedented levels of consumption co-exist with extreme poverty. Through new technology we are more connected than we have ever been, yet civic engagement is declining. Environmental neglect continues despite heightened ecological awareness. A better balance is urgently needed.

The Australia Institute's directors, staff and supporters represent a broad range of views and priorities. What unites us is a belief that through a combination of research and creativity we can promote new solutions and ways of thinking.

OUR PURPOSE - 'RESEARCH THAT MATTERS'

The Institute publishes research that contributes to a more just, sustainable and peaceful society. Our goal is to gather, interpret and communicate evidence in order to both diagnose the problems we face and propose new solutions to tackle them.

The Institute is wholly independent and not affiliated with any other organisation. Donations to its Research Fund are tax deductible for the donor. Anyone wishing to donate can do so via the website at <https://www.tai.org.au> or by calling the Institute on 02 6130 0530. Our secure and user-friendly website allows donors to make either one-off or regular monthly donations and we encourage everyone who can to donate in this way as it assists our research in the most significant manner.

Level 1, Endeavour House, 1 Franklin St

Canberra, ACT 2601

Tel: (02) 61300530

Email: mail@tai.org.au

Website: www.tai.org.au

Summary

Australia's commitment under the Paris Climate Accord is to reduce its emissions by 26 to 28% on 2005 levels by 2030. Australia is free to achieve this emissions reduction target however it chooses. The Turnbull government appears to favour a sector by sector approach, where each sector has a different policy for reducing emissions.

From an economic perspective, the government should target sectors that can reduce their emissions at the lowest cost. Importantly, not every sector has the same capacity to reduce emissions at the same cost. For some sectors emissions reduction is relatively cheap, while in others it is relatively difficult and expensive to curtail emission without reducing production.

In particular, the electricity sector has commercially available, mature technologies that can reduce emissions at relatively low cost. Sectors without mature technologies will find it more difficult and expensive to reduce emissions.

To reflect that it is easier for the electricity sector to reduce emissions, the government should set its reduction target higher than the overall target. This would allow other sectors to have targets lower than the overall target.

Instead, the recent announcement of the National Energy Guarantee (NEG) shows that the government is targeting a 26 per cent reduction in the electricity generation sector by 2030. The government's actual position is still unknown since it does not have a suite of credible policies that will get Australia to its emissions reduction target.

The electricity sector is best placed to make large scale emissions reductions at a low cost for a number of reasons:

- There are currently commercially available technologies in electricity generation that can substantially reduce emissions (renewable generation)
- Renewable generation is competitive with new built fossil fuel generation and the cost of renewables continues to fall
- The electricity generation sector is highly concentrated and so policies to reduce emissions will be simpler to administer as they will only need to be implemented by a small number of players
- A substantial reduction in electricity generation emissions has the potential to make emissions reduction in other sectors (like stationary energy and transport) less costly

If emissions are cut in equal proportion for each sector then sectors like agriculture and stationary energy are going to require expensive punitive policies in order to reach the target. In agriculture methane from animals is the main source of emissions. The only effective way currently available to reduce those emissions is to have fewer animals. This would probably take the form of a tax on meat in order to reduce the quantity demanded.

A large part of stationary energy emissions is the manufacturing sector. While some of their heating processes can be substituted from fossil fuels to electricity, others cannot. It is likely that this sector will also require a tax in order to reduce production. This will have a negative effect on manufacturing employment.

It is important to remember that the more electricity generation does to reduce emissions the less other sectors in the economy will have to do.

The Australia Institute looked at previous modelling of sector by sector costs for reducing Australia's emissions and found that the least cost method was to rely heavily on reductions in the electricity generation sector. The government should target emissions reductions in electricity generation of 48 per cent by 2030.

The government should, as a matter of urgency, implement policies that encourage the adoption of renewable generation, energy efficiency and storage. This is the least cost method of reducing Australia's emissions on a sector by sector basis.

Introduction

In signing the Paris Climate Accord, Australia has agreed to reduce its greenhouse gas emissions by 26 to 28% on 2005 levels by 2030. While the Paris Climate Accord sets the volume of emissions to be reduced it does not specify how the government should do this. It is up to each country that has signed up to the Paris Accord to come up with credible policies that will ensure it meets its targets.

The current government has rejected a price on carbon (like an emissions trading scheme or a carbon tax). The Australian government has yet to put in place policies that will credibly reach its targets.

The government has released some preliminary information on its emissions reduction policy for the electricity sector, the National Energy Guarantee (NEG). As part of this it has indicated that it is hoping to reduce emissions in the electricity sector by 26 per cent by 2030. The fact that the electricity sector emissions reduction under the NEG is the same as the overall target seems to show that the government is planning for each sector to make the same proportional decrease in emissions.

Requiring each sector to reduce emissions by the same proportion will be more expensive and less effective than requiring some sectors to reduce emissions by more and allowing others to reduce emissions by less. Some sectors – particularly the electricity sector – have commercially viable, mature technologies available to reduce their emissions. Other sectors are experimenting with emissions reduction methods that might be available in the future.

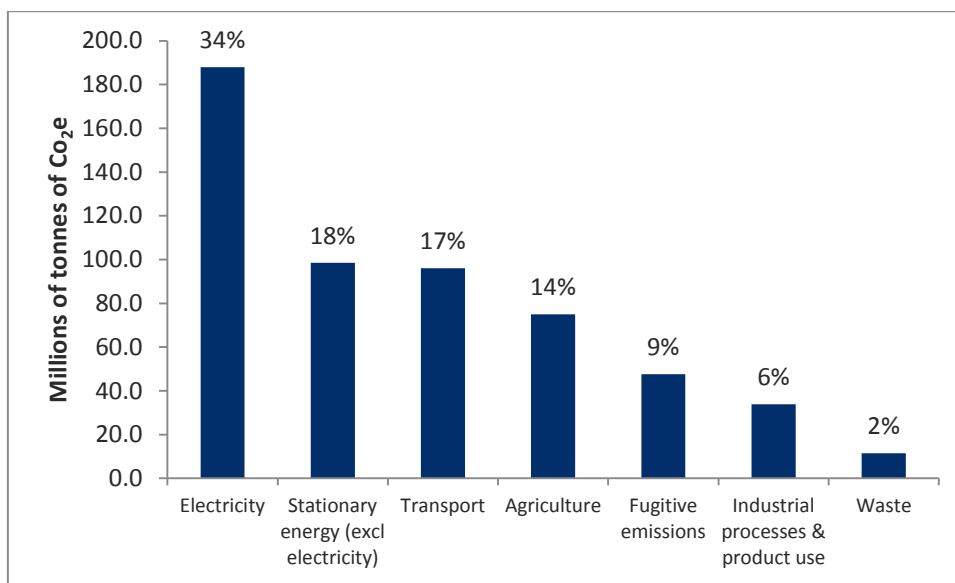
A more cost effective method would be to reduce emissions in larger amounts in those sectors that can do so at a lower cost and reduce emissions by smaller amounts in those sectors that have a higher cost.

Australia's emissions and emissions reduction pledge

Under the Paris Accord, Australia has pledged to reduce its emissions between 26% and 28% on 2005 levels by 2030. This pledge does not direct the way in which the government should reduce its emissions but is rather concerned with the quantum of emissions to be reduced. It is up to each individual country to determine the best way to reduce emissions.

Australia's National Greenhouse Gas Inventory shows the various sectors of the economy that produce emissions.¹ Figure 1 shows how much each sector emits and what percentage of Australia's total emissions this is.

Figure 1: Australia's emissions for CO₂e by sector (year to March 2017)



Source: Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

The electricity sector was the largest contributor to greenhouse gas emissions, making up just over a third of Australia's total emissions. Stationary emissions (excluding electricity) and transport emissions made up about a sixth of total emissions each. Agriculture emissions (mostly methane emissions from animals) made up about a seventh of Australia's total emissions. Fugitive emissions (mainly from the mining and

¹ Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

transport of coal and coal seam gas) are a rapidly growing emissions sector and they currently make up about a tenth of Australia's emissions.

Reducing Australia's emissions by between 26% and 28% on 2005 levels by 2030 requires the government to come up with policies to reduce emissions. Different policies are likely to reduce emissions in different sectors at different rates. For example a policy that successfully reduced agricultural emissions is unlikely to reduce industrial process emissions.

This is what a market-based system like an emissions trading scheme or carbon tax attempts to do. By imposing a financial penalty on emitting greenhouse gases, those who are emitting have a financial incentive to reduce emissions. This financial penalty only needs to be as high as the cost of reducing greenhouse gas emissions by the targeted amount from the cheapest sources. This is a cheaper way of reducing emissions than a sector by sector approach.

The sector producing the largest quantity of emissions is the electricity sector. It is also the sector able to reduce its emissions at the least cost because it has commercially available, mature emissions reduction technology.

Renewable electricity generation has been rapidly falling in price as has battery storage. These technologies offer a readily available cheap form of emissions reduction that has the ability to reduce emissions on a large scale.

Sector by sector approach

If the government is going to continue a sector by sector approach to emissions reductions then it should target the electricity sector to initially do most of the work in reducing emissions.

There are a number of reasons why the electricity sector is the most well suited to reduce a disproportionately large amount of emissions:

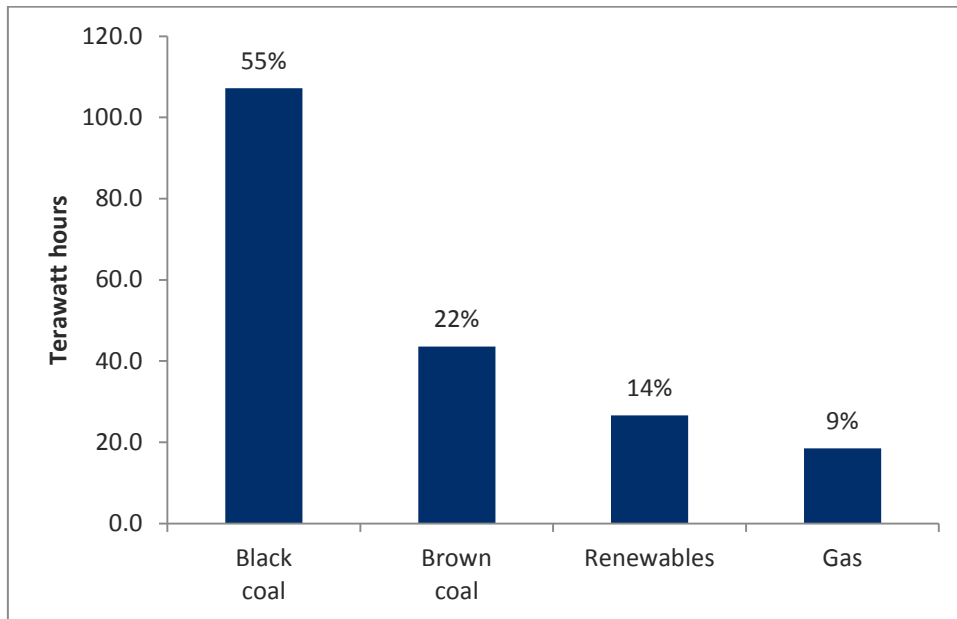
- There are currently commercially available technologies in electricity generation that can substantially reduce emissions (renewable generation)
- Renewable generation is competitive with new built fossil fuel generation and the cost of renewables is continuing to fall
- The electricity generation sector is highly concentrated and so policies to reduce emissions will be administratively more simple as they will only affect a relatively small number of players
- A substantial reduction in electricity generation emissions has the potential to make emissions reduction in other sectors (like stationary energy and transport) less costly

ELECTRICITY GENERATION

The electricity generation sector has the advantage of already having mature emissions reduction technology in the form of renewable sources of generation. This gives the electricity generation sector a large advantage over other sectors that do not have access to commercially available technology.

Renewable energy is already a significant part of electricity generation in Australia. In the National Energy Market (NEM) in June 2017 it made up 14 per cent of generation, as shown in Figure 2.

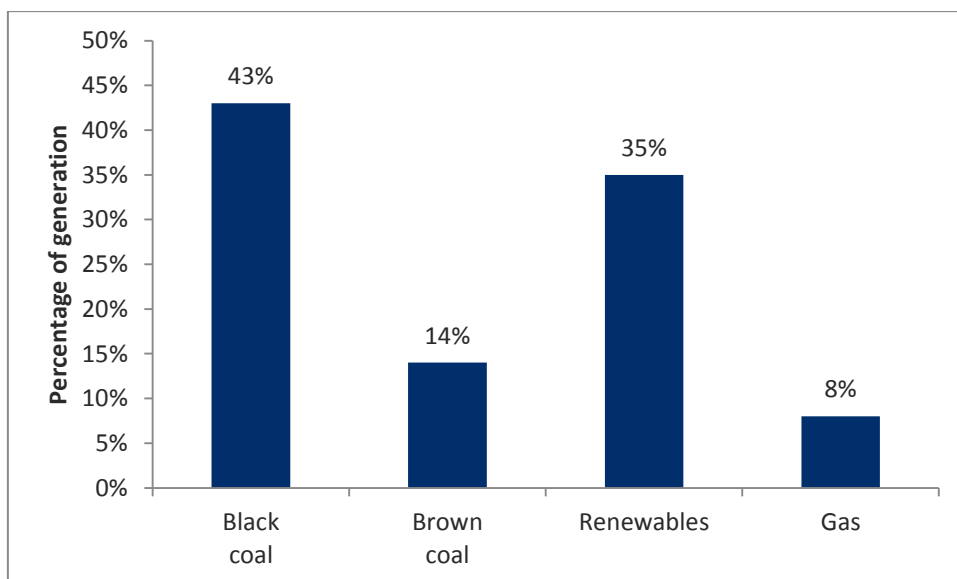
Figure 2: Electricity generation by fuel type for the NEM in June 2017



Source: Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

The proportion of renewable energy is set to grow over the coming years. Even without any more government intervention to encourage renewable generation, the Finkel Review found that renewable generation would rise to 35 per cent of all generation by 2030. Electricity generation in 2030 by fuel type if there are no policy changes is shown in Figure 3.

Figure 3: Business as usual generation by fuel type in 2030



Source: Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

Figure 3 shows that the growth in renewable generation comes mainly at the expense of coal generation. This will have a significant impact on emissions as highly emissions intensive coal generation is substituted for zero emission renewable generation. This growth in renewable energy highlights the growing cost effectiveness of reducing emissions in electricity generation. Government policy to encourage more renewable generation would enable further reductions in emissions from the electricity sector.

A study by The Australia Institute found that the most cost effective method of reducing Australia's emission, consistent with keeping warming to 2°C, would involve the electricity sector reducing emissions by 48 per cent by 2030.² To achieve this will require renewable generation to make up between 66% and 75% of all generation.

OTHER SECTORS' ABATEMENT TASK

If the electricity sector only reduces its emissions in proportion to the Paris target, 26% to 28%, then other sectors will also have to reduce emissions by the same proportion. This means that sectors like transport, agriculture and stationary energy will also have to reduce emissions by 26% to 28%. These sectors do not have the same relatively low cost solutions to reducing emissions as the electricity sector. This means that the cost of reducing emissions on a proportional basis will be higher.

Reducing emissions in a sector can be done in a number of ways. In the electricity generation sector it is possible to substitute emissions intensive forms of generation, like coal, with renewable electricity generation. This reduces emissions while having a minimal effect on price and output.

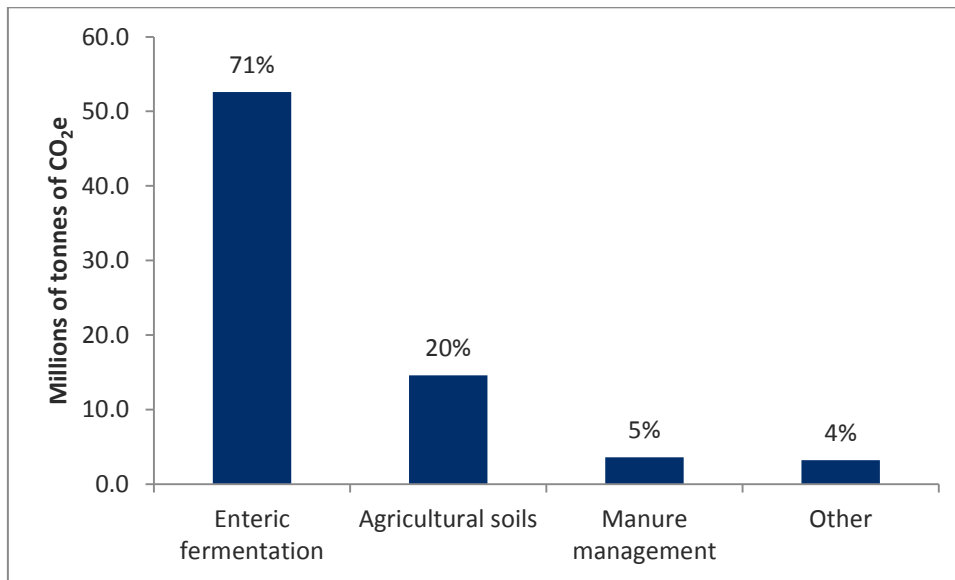
If commercially available forms of emissions reduction are not available or are still very expensive then a blunter tool to reduce emissions is by reducing the consumption of the emissions intensive good. This can be achieved by imposing a large financial penalty that drives up the price of the good and hence reduces the quantity demanded. This is a far less desirable method since it has the potential to impose large financial costs on consumers and interferes with their consumption preferences.

² Campbell (2017) *Meeting our Paris Commitment*

AGRICULTURE

In Agriculture, methane from animals (enteric fermentation) makes up the vast majority of emissions. They make up 71 per cent of agriculture emissions as shown in Figure 4.

Figure 4: Breakdown of agriculture emissions



Source: Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

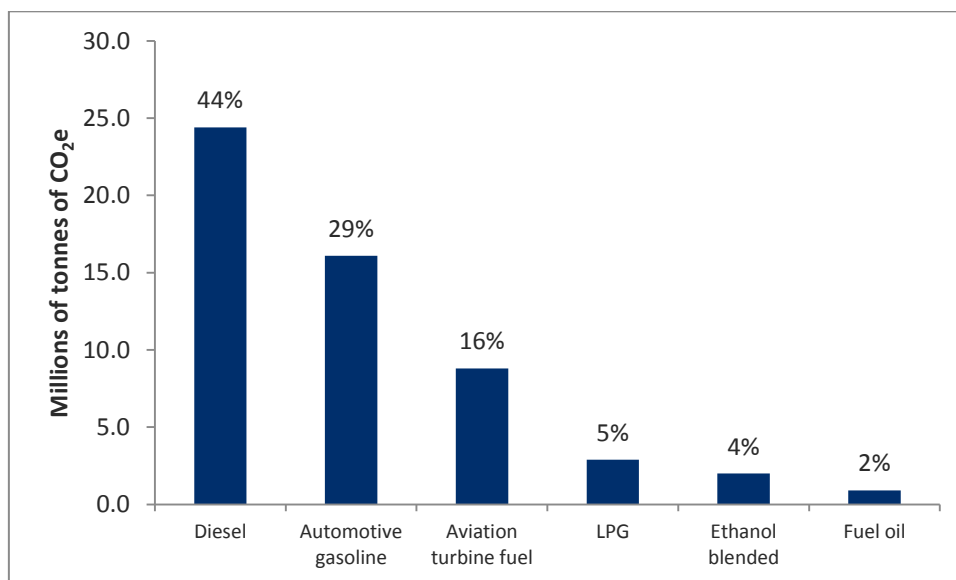
While there has been some work done in trying to reduce animal methane emissions such as experimenting with different breeds of animal and types of feed, this is at an early stage and is not commercially available. There has also been work done on sequestering carbon in soils but this too is in the early stages of implementation.

Without a clear method for large scale emissions reductions in the agriculture sector, the only way to reduce emissions is to reduce the number of animals. This is likely to be achieved with a punitive financial penalty to reduce demand. A tax on meat would be an example of this. Apart from being politically difficult it is also economically undesirable when compared to reducing emissions by generating electricity with renewables. Taxing meat reduces consumption of a product while generating electricity from renewable resources does not.

TRANSPORT

The transport sector faces a similar problem to the agriculture sector. Most transport emissions come from burning diesel and automotive gasoline (petrol). Together these make up 73 per cent of transport emissions as shown in Figure 5.

Figure 5: Transport emissions by fuel type



Source: Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

Unlike agriculture, there are commercially available solutions for large scale emissions reduction in the transport sector. These include increasing the fuel efficiency of internal combustion engines (ICE) and substituting ICEs with electric vehicles. An electric vehicle charged on electricity from renewable sources reduces emissions more than an electric vehicle charged on coal fired power. This shows that reductions in emissions from the electricity sector can have flow on effects in other sectors. This will be discussed in more detail below.

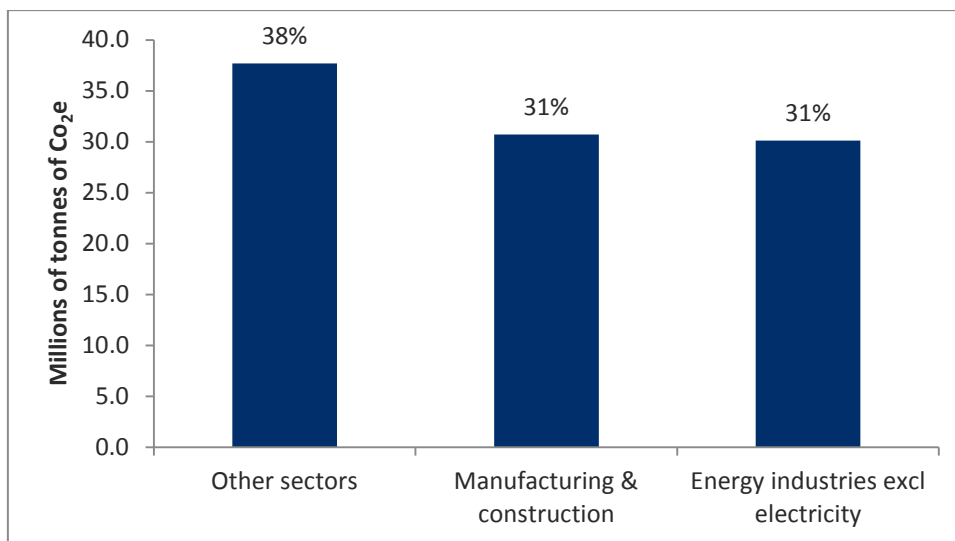
Another way of reducing emissions is through biofuels. While the use of biofuels can lower emissions they are not available on a very large scale and when they're scaled up they have impacts on food production and food prices. Increasingly using valuable productive land to service the transport sector is not a long term solution.

The other option that is available to the government is to impose a large financial penalty to reduce the use of transport, for example increasing the tax on petrol and diesel. This is a less desirable solution.

STATIONARY ENERGY (EXCLUDING ELECTRICITY)

Another large emitting sector is stationary energy. This is dominated by manufacturing, construction and energy industries. It includes areas like mining and commercial and residential buildings. Energy industries include combustion of fuels used in oil and gas extraction, oil refining, coal mining and solid fuel manufacturing sectors. Emissions from this sector are dominated by manufacturing, construction and energy industries. This is shown in Figure 6.

Figure 6: Breakdown of stationary energy (excl electricity)



Source: Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*

There are a number of ways that this sector could reduce emissions. In the energy and manufacturing sectors, businesses could switch away from coal towards electricity. Most emissions from this sector involve heating in a manufacturing process. Some of these processes could substitute heating with coal and gas for heating with electricity or using electricity to reduce the use of coal and gas.

Substituting electricity for coal and gas will be more effective the more that the electricity sector reduces its emissions. This will be discussed in more detail below. It should be noted that many manufacturing processes can be less easily substitute electricity for fossil fuels in heating. Other ways the stationary energy sector can reduce emissions is with better designed buildings that reduce the need for heating and cooling.

Imposing a large financial penalty could be the only realistic way of reducing emissions in this sector by such a large amount. This would have a negative effect on a number of

sectors which are big employers like manufacturing. Such a penalty would have negative economic impacts and while the sector has the potential to reduce emissions, it is likely to struggle to reduce emissions on a large scale.

Concentration of electricity generation sector

The ability to implement policies to reduce emissions is made easier when there are fewer economic actors affected. If a relatively small number of large economic actors are involved, the government can implement a more targeted policy because there are fewer actors to engage with. It also makes the administration of a scheme easier. When there are a large number of economic actors, the policy needs to be more simplistic and it becomes more expensive to administer.

The electricity sector has relatively few firms. According to a recent Australian Competition and Consumer Commission report, 10 firms produce about 95 per cent of all electricity that is fed into the National Energy Market.³ The top three firms produce about half of all electricity generation into the National Energy Market.

Take for example a policy that requires economic actors to measure and submit the quantity of greenhouse gas emissions they produce each year. This is already done for the electricity generation sector because there are so few firms and these firms are very large. But the transport sector includes a very large number of economic actors. Everyone who drives a car is producing transport emissions. It would be very difficult to expect everyone who drives a car to measure the amount of greenhouse gas emissions they produce and report that to the government.

This means that policies that target the electricity generation sector can be more sophisticated and cheaper to administer. This can potentially lead to better more targeted policies than if other sectors were targeted with emissions reduction policies. This can lead to lower cost emissions reduction.

³ Finkel (2017) *Independent Review into the Future Security of the National Electricity Market*

Emissions reduction in electricity generation and the flow through to other sectors

The reduction of emissions in electricity generation can reduce the costs of emissions reductions in other sectors. In some cases the use of fossil fuels in other sectors can be replaced with electricity. An example of this is electric vehicles. Replacing the internal combustion engine in vehicles with electric engines reduces emissions. This reduction in emissions can be increased if the electricity used to charge electric vehicles comes from renewable sources.

For example imagine a policy that results in an additional 100,000 electric vehicles. The reduction in emissions from this policy will be greater if the emissions from electricity generation used to charge these vehicles are reduced. This means that policies that increase the use of electricity in transport have a greater emissions reduction for the same cost.

It is not just the transport sector that would benefit in this way. Stationary energy emissions come in large part from burning fossil fuels to heat things up. In some cases electricity can be used to do this rather than coal or gas. A conversion from using on-site fossil fuel burning to using grid electricity will achieve a greater reduction in emissions if a large share of grid electricity is generated by renewables.

Conclusion

If Australia is to meet its Paris commitments then it will need a credible plan to reduce emissions. If the government wants to reduce emissions on a sector by sector basis then it should not assume that every sector has the same capacity to reduce emissions at the same cost. The government should target those sectors that can reduce their emissions at the lowest cost.

The electricity sector, with commercially available zero emission generation, is the sector best placed to reduce emissions at the lowest cost. As the sector that currently produces the largest amount of greenhouse gas emissions, it also has the capacity to make significant reductions.

Studies of previous modelling of the costs of reducing emissions suggest that the electricity sector should reduce emissions by 48 per cent by 2030. The government should urgently consider policies that will encourage more renewable generation and battery storage.

The alternative that the government looks to be pursuing is where each sector will make the same proportional contribution to the emissions reduction target. This is a far more expensive and inefficient method that will require the introduction of financial penalties in sectors like agriculture and transport.

The government needs to put in place credible policies to meet its Paris emissions reduction targets and the choices it makes will have a large impact on the costs that Australia could face in meeting those targets.

References

Campbell R (2017) *Meeting our Paris Commitment*, The Australia Institute, September, available at <<http://www.tai.org.au/content/meeting-our-paris-commitment>>

Department of Environment and Energy (2017) *Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2017*, Commonwealth of Australia, available at <<http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/publications/quarterly-update-australias-national-greenhouse-gas-inventory-mar-2017>>

Finkel A (2017) *Independent Review into the Future Security of the National Electricity Market*, Commonwealth of Australia, June, available at <<https://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf>>