Past and projected future components of electricity supply to the ACT, and resultant emissions intensity

FINAL

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1.1 Methodology and data sources

The methodology used to calculate emissions intensity in this report is identical with that used in the 2016 report. As explained in that report, it is consistent with the approaches and methods set out in the major recognised national and international greenhouse gas emissions inventory methodology documents.

Renewable electricity supplied to the ACT consists of the following components:

1) the ACT's share of the Large Renewable Energy Target (LRET);
2) the ACT's share of electricity supplied through the National Electricity Market by large renewable electricity generators up to the level of their LRET Baseline (below baseline generation);
3) GreenPower purchased by ACT electricity consumers;
4) electricity exported to the ActewAGL network by small scale ("rooftop") photovoltaic installations;
5) electricity supplied to the National Electricity Market grid and/or the local ACT distribution network by renewable generators contracted by the ACT government and paid for by ACT electricity consumers through an additional cost component contributing to ACT electricity prices.

The first four of these components have been part of the ACT's electricity supply for some years. For convenience they are termed old renewables in this report. The fifth component is a major part of the ACT government's AP2 on climate change. The government has now awarded a number of contracts for the supply of electrical energy by new grid-scale renewable generators. The first two projects operated during 2015-16. These are FRV's Royalla solar farm, which started generating in August 2014, and Windlab's Coonoer Bridge wind farm in Victoria, which started generating in March 2016. It is expected that the Mugga Lane and Williamsdale solar farms, and the Hornsdale 1 and Ararat wind farms will start operating during 2016-17.

Note that, unlike some other networks in NSW and elsewhere, the ACT network does not have any embedded non-RET renewable generators. It has one operating RET-accredited renewable generator – the Mugga Lane landfill gas plant. All the output of this project is contracted by electricity retailers operating outside the ACT, as part of their GreenPower wholesale purchases; it is therefore excluded from the calculation of renewable electricity supplied to the ACT. A second, smaller RET-accredited renewable generator, the Stromlo mini-hydro, has not operated for some years.

The approach used to calculate each of the four components listed above is as follows.

LRET share

The LRET share is calculated by multiplying the Renewable Power Percentage (RPP) for the relevant year, as specified by the Clean Energy Regulator, by total electricity supplied to consumers in the ACT. The RPP is set on a calendar rather than a financial year basis. As an approximation, the percentages used for each financial year are simple averages of the percentages for the two calendar years which cover each financial year. Total electricity supplied in each year is taken from ActewAGL Distribution's *Benchmarking RIN Response* to the Australian Energy Regulator, which includes figures for total electricity delivered to customers by ActewAGL Distribution, i.e. the total electricity supplied by all retailers active in the ACT market.

Below Baseline NEM renewable generation

For the purpose of this analysis the relevant generators are those renewable generators which supply the NSW region of the NEM and are classified as Scheduled by the Australian Energy Market Operator (AEMO). There are six generators which meet this criterion: Blowering, Guthega, Hume (NSW share), Tumut 1, Tumut 2 and Tumut 3 (Talbingo). All other renewable (mostly hydro, a few landfill gas) generators in NSW with LRET baselines are embedded within one of the three NSW distribution networks, and so do not directly contribute to ACT electricity supply. The below baseline output of these generators, which in total is quite small, is assumed to contribute to the renewable electricity supplied through each of the three networks.

For each of the above six large hydro generators the quantity of electricity sent out each year was sourced from AEMO's public data, through the *NEM-Review* service. This quantity is then compared with the baseline for the relevant year, as specified by the Clean Energy Regulator. Total below baseline generation is then calculated as the sum of electricity sent out from each generator which has generated less than the baseline level in the year concerned, plus the baseline value for any generator which has sent out more than the baseline quantity. Because hydro generation varies quite substantially from year to year, the quantity of below baseline generation will also vary. In some past years it has been almost equal to the combined baselines of all six power stations, and in other years significantly less. The average quantity for the five years ending with the year of calculation has been used as the value for each year. This means, for example, that the below baseline quantity assumed for the year 2010-11 is the average for the five years 2006 to 2010 (calendar years are used because the LRET scheme operates on a calendar year basis). The averaging period rolls forward by one year for each subsequent year's calculation. This figure is then used to calculate the below baseline renewable share of electricity supplied from the NEM, which is the ratio of below baseline renewable electricity sent out to total electricity supplied by scheduled generators in NSW. This latter total includes output from the relevant generators in NSW, plus imports of bulk electricity from Queensland and Victoria, minus exports to Queensland and Victoria (noting that imports greatly exceeded exports in all years over the past decade or so).

GreenPower

GreenPower purchases by ACT electricity consumers in each year were calculated up to December 2015 from sales data contained in the national GreenPower quarterly reports. As at March 2017, no reports had been published for calendar year 2016. An estimate for the balance of 2015-16 was made from the reported quantities for the first two quarters. It will be noted that the data show a sharp decline in the volume of GreenPower purchases.

Electricity exported to the ActewAGL network from rooftop photovoltaic installations

Figures for electricity supplied to the network by rooftop photovoltaic installations were based on the reported electrical energy supplied to the network from residential customers, as contained in ActewAGL Distribution's *Benchmarking RIN Response* to the AER. This approach is implicitly based on the very reasonable assumption that rooftop PV is the sole source of this supply. These data, provided to the AER by all distribution networks in the NEM states, are calculated from individual household meter data, and thus depend on whether households are on gross or net metering. In the ACT, households eligible for the gross feed in tariff are on gross metering, so that all the electricity they produce is included in the total. Some households which installed their PV systems since the end of feed in tariffs, however, are on net metering. This means that any electricity from their rooftop systems which they consume behind the meter is not included in the total supply figures. That does not mean, however, that behind the meter consumption does not contribute to the ACT's efforts to reduce emissions attributable to electricity consumption. It just means that it will appear on the demand reduction side of the ledger, rather than on the zero emission supply side.

In the last two years there has been an upsurge in adoption of rooftop solar by non-residential consumers. These installations include a number of systems of less than 100 kW, which are eligible for accreditation under the Small Renewable Energy Scheme (SRES). It also includes a small but fast growing number of installations which are larger than 100 kW, and therefore eligible for accreditation under the Large Renewable Energy Target (LRET). Typically, the owners of such installations seek to minimise the quantity of output which they export to the local network, because it is more valuable to the consumer when it is displacing electricity which would otherwise be purchased from the network. Some electricity is exported, however, and this is included in the total quantity of electricity which ActewAGL Distribution reports as acquiring from non-residential customers.

However, this quantity also includes electricity supplied from all embedded generators, including the three contract solar farms and the Mugga Lane landfill plant. An estimate of electricity exported from non-residential rooftop solar was made by subtracting the electricity supplied by these generators from the total reported acquisitions by ActewAGL Distribution.

Electricity supplied from directly contracted new renewable generators

Data on electricity output from the Royalla solar farm and the Coonoer Bridge wind farm was provided by the Directorate.

1.2 Results

The full results of the calculations are shown in Table 1. Results are shown graphically in Figures 1 and 2. The overall emissions intensity of electricity supplied to the ACT in 2015-16 (including electricity lost in the distribution system) was 0.732 t CO_2-e/MWh, somewhat lower than the 0.748 t CO_2-e/MWh achieved in 2014-15.

Table 1: Components of renewable electricity supply to ACT, and overall emissions intensity, 2011 to 2016, GWh

Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Total electricity input to ACT	3,131	3,063	3,073	2,976	2,988	3,009
LRET obligation	173	217	294	292	300	343
GreenPower	115	141	92	99	83	55
Small scale solar	10	25	39	55	56	64
"Below baseline" NEM	75	81	99	103	94	98
Contracted solar generation					33	38
Contracted wind generation						27
Total renewable	373	464	524	548	566	625
Total non-renewable	2,758	2,599	2,549	2,427	2,422	2,384
Emissions intensity (t CO_2-e/MWh)	0.818	0.788	0.764	0.753	0.748	0.732

Figure 1: Renewable share of total ACT electricity supply

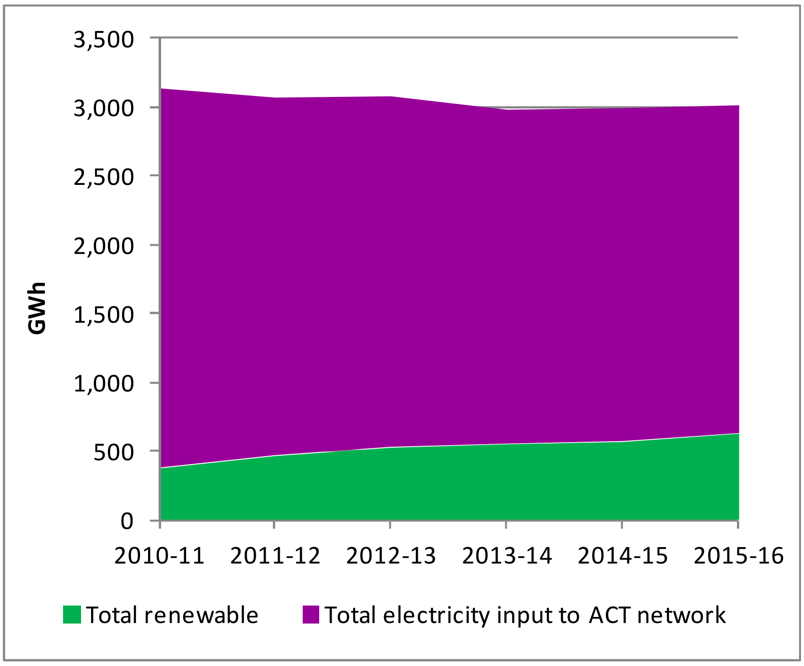
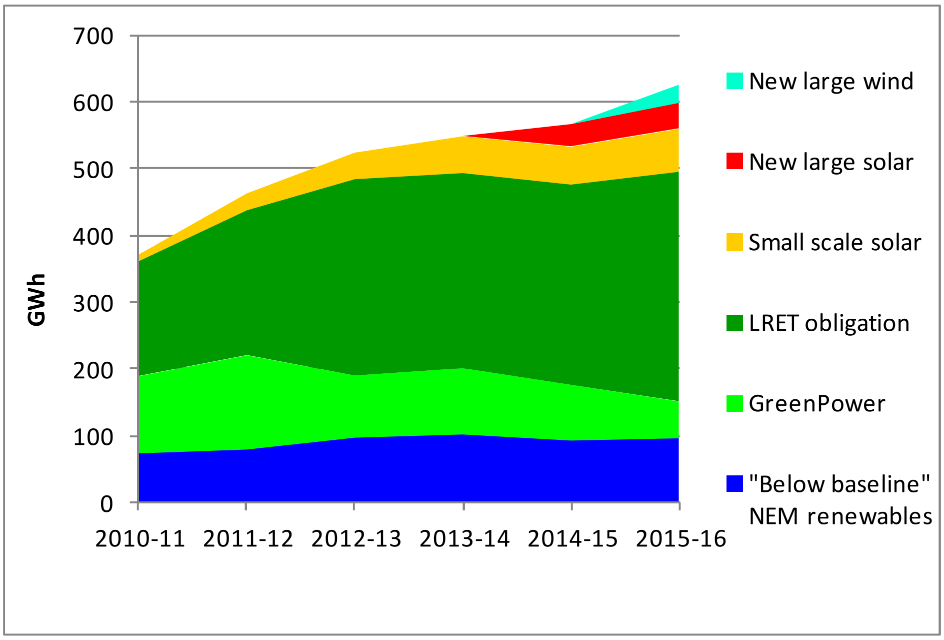


Figure 2: Components of renewable electricity supply to the ACT



2. Projected renewable share and weighted average emissions intensity of electricity supplied to the ACT, 2017 to 2025

2.1 Methodology and data sources

Projecting possible future renewable electricity supply, and the resultant weighted average emissions intensity of electricity supplied to the ACT, is a more complex task than calculating past renewable supply. The projections task has four distinct components:

- Future ACT demand for electricity;
- Future renewable electricity supplied from each of the first four components quantified in Part 1 of this report, i.e. old renewable electricity;
- Future renewable electricity supplied from new generation commissioned by the ACT through its reverse auction process; and
- Future emissions intensity of the residual fossil fuel generation component of electricity supplied through the NEM.

Each is described in turn.

ACT demand for electricity

The projections of demand for electricity used in those report are those developed as the Reference Case for the concurrent project *Stationary Energy and Energy Efficiency Emissions Modelling to 2050.* That study uses a bottom-up approach to projected demand for electricity (and also for gas) from both residential and non-residential consumers. In the case of residential consumers, consumption is disaggregated into a number of different end use categories – space heating and cooling, water heating, refrigeration, lighting etc.. Separate projections are developed for each category, and then summed for each year to provide total year by year annual electricity consumption. Non-residential consumers are separated into a number of different user types or categories – office central services, office light and power, schools, retail, hotels and accommodation etc.. Consumption includes electrical energy used for street lighting and pumping of potable water and sewage by Icon Water. For each category of user, a further separation is made into one of five major types of electricity use – HVAC, lighting, hot water and cooking, refrigeration, machinery and equipment. As with residential electricity consumption, all these separate components are summed to give total non-residential electricity use. The modelling is calibrated by reconciling the totals for 2014-15 and 2015-16 with the actual quantities of electricity supplied through the meter to residential and non-residential consumers, as specified by ActewAGL Distribution in its AER RIN Template reports to the AER.

Projections of future demand are driven primarily by population and Gross State Product (GSP), as applicable, depending on the particular end use sector and category. They also embody a generalised steady improvement in electricity use efficiency (autonomous energy efficiency improvement). In addition, the approach allows a number of additional trends to be explicitly modelled. These include:

- for residential space heating, the shift towards progressively better building envelope thermal performance, driven by requirements of the Australian Construction Code (ACC);
- for residential space heating, the shift away from gas to RCAC, driven by the superior performance and operating cost of RCAC;
- for residential water heating, the shift away from large electric resistance water heaters and towards instantaneous gas, driven by ACC requirements;

- steady reductions in electricity consumption, driven by MEPS on various categories of appliances and equipment used in both the residential and non-residential sectors;
- moderate rates of uptake of electric vehicles.

The overall result for the next ten years is that total demand, excluding electric vehicles, is that total consumption of electricity is projected to be almost completely constant. Inclusion of the electric vehicle load means gradual but accelerating growth in demand. Note that demand, in this context, includes losses within ActewAGL Distribution's network, as well as electricity supplied through the meter to customers.

Finally, careful consideration was given to the treatment of behind the meter consumption of electricity generated by rooftop PV. In the last two or three years, falling PV prices and rising retail electricity prices have made it financially attractive for commercial electricity consumers to install rooftop PV, provided that the systems are sized to ensure that almost all the electricity generated is consumed on-site, meaning that it displaces purchased electricity supplied through the meter. With the end of feed in tariffs, financial incentives for residential consumers are now favouring a similar approach. Consequently, behind the meter consumption which, until recently was very small, is now starting to increase strongly. Falling battery costs will accelerate this trend, which will continue so long as current policy settings remain in place. It has therefore become necessary to take careful account of behind the meter consumption.

In order to compile the projections described above, estimates were made of behind the meter consumption by both residential and commercial consumers in 2014-15 and 2015-16, using installed capacity data from the APVI Live Solar website, representative annual capacity factor values, and electricity exported from customers to the network, as listed in the AER RIN template reports. These quantities, which were only a few GWh, were added the reported quantities of electricity supplied to customers in the base years, to give base year total consumption of electricity from all sources. These calculated consumption figures were then used to calibrate the models. This means that the models project total consumption of electricity from all sources, including both electricity supplied through the meter, and electricity generated by rooftop PV and consumed behind the meter.

Future old renewable electricity supply

LRET

The quantity of LRET electricity notionally supplied to the ACT each year in future will be a fraction of the total national LRET requirement, as specified in the legislation, as amended in 2015. The fraction will depend on two factors for both Australia as a whole and the ACT: total sales to final consumers (termed "relevant acquisitions" in the legislation) and the quantity of those sales which qualify for full exemption certificates. Sales to consumers which attract an LRET obligation are equal to total sales minus exempt sales, and the ACT share of the total obligation in each year is equal to the ratio of this difference for the ACT to the difference for the whole of Australia.

For the ACT, total sales are as described above, minus distribution losses, which are projected to remain a constant 4.5 per cent share of total electricity supplied to ActewAGL Networks. Exempt sales are zero, because none of the activities which qualify for exemptions take place in the ACT. For Australia as a whole, projections of total sales, i.e. relevant acquisitions, for the period to 2020-21 this report uses the national demand projections used by ACIL Allen as part of their modelling for the Commonwealth government's 2014 *RET Review*. The total national number of full exemption certificates for calendar year 2015 (LRET operation is based on calendar years, not financial years) is specified on the Clean Energy Regulator website to be 39,558 GWh and the corresponding value for 2016 is 41,115 GWh. Using the simple averaging approach gives a figure of 39,558 GWh for 2015-16, and this value was assumed to be the same for each year to 2024-25.

These calculations yield annual values for ACT LRET obligation which is 1.693% of the total national obligation in 2015-16, falling to 1.675% in 2020-21. This latter value was assumed to apply in each subsequent year to 2024-25. The slight decline in the ratio to 2020-21 occurs because national electricity demand is projected to grow somewhat faster than ACT demand.

Applying the projected ACT share to the national total LRET generation, as specified on the Clean Energy Regulator website, it was found that LRET electricity supplied to the ACT is projected to increase from 343 GWh in 2015-16 to 560 GWh in 2020-21, and then remain virtually constant at just below this level out to 2024-25. There is of course considerable uncertainty about both total national electricity sales and exempt sales. If national sales grow more slowly than projected by ACIL Allen, the ACT share of the national LRET total will be higher, and conversely if ACT electricity demand growth is faster. Changes in the annual quantity of exemptions may also affect the result, though to a much smaller extent. Given these uncertainties, projected values should be regarded as best estimates, which may change.

Below baseline NEM generation

The quantity of below baseline renewable generation in NSW over the historic period was calculated as a five year rolling average, as described in Chapter 1. In the absence of detailed modelling of the future operation of Snowy Hydro, including rainfall and run-off, irrigation discharge requirements, NEM wholesale prices and many other factors, it is obviously meaningless to apply the five year rolling average approach to projecting future levels of below baseline renewable generation. The approach taken has been to assume a gradual decline from the actual 2015-16 value of 2,174 GWh in 2015-16 to 1,900 GWh, assuming that the value then remains constant at this level to 2024-25. This value is less than the five year values over the past three years, which were affected by the high levels of generation during the carbon price period, as well as slightly above average rainfall, according to BOM data. However, it is larger than earlier five year average values, which were affected by drought conditions during the years up to 2010, and also slightly higher than the value assumed in last year's report. It therefore seems to be a reasonable middle range value.

The ACT share of this total was calculated as the ratio of total ACT demand for electricity to the corresponding total demand figure for NSW plus the ACT, as contained in AEMO's 2016 *National Electricity Forecasting Report*.

GreenPower

The historic data shows GreenPower sales falling quite sharply between 2011-12 and 2014-15. We project that steady falls will continue, as the number of consumers, both residential and commercial, with their own rooftop PV installations continues to increase, and as ACT policy results in a steady increase in the renewable share of total electricity supplied to the ACT. We project that GreenPower sales will fall from 83 GWh in 2014-15 to zero in 2020-21.

Exports from rooftop PV

The total quantities of electricity exported from both residential and non-residential rooftop solar installations in each year up to 2015-16 was calculated as described above. For future years, steady linear growth in capacity of both residential and non-residential installations was projected. It was further assumed that 75% of output from residential installations and 90% of output from non-residential installations will be consumed behind the meter, resulting in a quite gradual growth in solar electricity exported into the network. The high assumed share of behind the meter consumption reflects the fact that new entrants are no longer entitled to a high feed in tariff, making exports economically unattractive for most consumers. The falling cost and growing popularity of batteries will also support increased behind the meter consumption.

Future supply from new renewable electricity

All output from renewable generators which are contracted through the ACT government's reverse auction process are defined as new renewable electricity. The Directorate provided expected quantities of year by year supply from contracted projects. These include the Royalla, Mugga Lane and Williamsdale solar farms contracted through the first solar auction, the three wind generation projects contracted through the first wind auction, the Hornsdale 2 and Sapphire wind farms, contracted through the second wind auction, and the Hornsdale 3 and Crookwell 2 wind farms contracted through the Next Generation Renewables tender. No biomass waste to electricity plant is assumed to be operational by or before 2020-21.

Emissions intensity of "residual" NEM fossil fuel generated electricity

Projecting total emissions associated with the supply of electricity to the ACT requires projections of the emissions intensity of fossil fuel electricity supplied through the NEM in NSW. A key data source for this part of the modelling was the NGER Designated Generation Facilities public reports, of which there are now four, for 2012-13, 2013-14, 2014-15, and 2015-16. These reports provide data on total annual emissions from all individual power stations. Multiplying emissions intensity by the quantity generated by each power station to obtain total emissions by each station, then summing all, gives total emissions by the NSW NEM generation system. This total is then divided by total electricity sent out by all fossil fuel generators, i.e. total generated minus auxiliary load, to give the emissions intensity of NSW fossil fuel generation. Data on the individual output of each power station is obtained from AEMO operational data, as sourced through *NEM Review*. It is assumed that the future emissions intensity of NSW fossil fuel generation will be equal to the intensity in 2015-16. This assumption implies that the mix of electricity supplied by coal and gas fuelled generators will remain roughly constant, although two closures have in fact already been announced – Smithfield (160 MW gas) in July 2017 and Liddell (2,000 MW coal) in March 2022.

Up until March 2017 a significant quantity of electricity available in NSW has been imported from Victoria and Queensland. Much smaller quantities of NSW generated electricity are exported to each of these states. AEMO data on imports to and exports from NSW from and to the other two states, through the various interconnectors, is obtained through *NEM Review*. For all past years, up to and including 2015-16, the emissions intensity of NSW fossil fuel electricity has been calculated as the net volume weighted average emissions intensity of electricity generated in NSW, and of electricity imported from Victoria and Queensland. This value, for each year, has been used to calculate annual ACT greenhouse gas emissions. The very high emissions intensity of Victorian electricity, generated from brown coal, and the relatively large share of imports from Victoria in total NSW supply, contribute to make the historic weighted average emissions intensity of NSW electricity significantly higher than the average emissions intensity of fossil fuel electricity generated in NSW.

However, on 31 March 2017, the last of the eight turbo-alternators at Hazelwood power station in Victoria will be permanently shut down. This will reduce total electricity generated in Victoria by about 18%. The almost certain outcome is that electricity exports from Victoria to NSW will almost cease and may, indeed, reverse. In addition, electricity consumption in Queensland has increased considerably, because of the large quantities used to drive compressors and pumps in the coal seams gasfields. The result has been a large reduction of electricity exports from Queensland to NSW. Fossil fuel generated electricity in Queensland is, on average, slightly less emissions intensive than corresponding NSW electricity, because the Queensland coal fired power stations are, on average, more modern, and there is a larger share of gas generation in Queensland.

These considerations lead to the conclusion that, from April 2017 on, residual supply of fossil fuel electricity to the ACT will be ultimately sourced from NSW fossil fuel fired generators, with the corresponding average emissions intensity. It has been assumed that the average emissions intensity of NSW fossil fuel fired electricity will equal the value in 2015-16, which was 0.908 t CO_2-e/MWh sent out.

2.2 Results

Table 2 shows the quantities of electricity supplied each year from 2012-13 to 2024-25 from the various sources supplying through the network, i.e. excluding behind the meter consumption, under the assumptions set out above. All these results are shown graphically in Figures 4, 5 and 6 for the period from 2013-14 to 2024-25. It can be seen that the major change occurs between 2016-17 and 2018-19, as a large volume of new wind generation is expected to be built and brought on-line, under contract to the ACT government, following the second and third wind auctions.

Table 2 also shows the resultant weighted average emissions intensity of electricity supplied in each year, assuming that there is no growth in behind the meter consumption, which is also shown graphically in Figure 6. Unsurprisingly, the trend of emissions intensity has a shape which is the inverse of the trend of non-renewable electricity in total supply.

Table 3 shows the effect of including the projected growth in consumption of behind the meter PV. This consumption displaces residual fossil fuel NEM supply, meaning that the renewable share of total electricity consumed is slightly higher, and the emissions intensity slightly lower. In this case, which we consider to be a more likely future, the renewable share reaches 100%, and the emissions intensity falls to zero, between 2019-20 and 2020-21.

The 2016 report noted that projected emissions intensity values for NSW fossil fuel generation assumed no closure of old coal fired power stations in the relevant states, and pointed out that this was an improbable assumption. That has come to pass, even sooner than might have been expected. It has been announced that Liddell power station, the oldest in NSW, will close in March 2022. Closure of Liddell would reduce the emissions intensity of NSW electricity by a small amount; this effect will be far smaller than the effect on emissions intensity of the Hazelwood closure.

Although future demand estimated for this electricity emissions intensity report is slightly higher than the level estimated for the 2016 report, the emissions intensity values reported here for the later years of the projection period are lower than those contained in the 2016 report. The difference is largely attributable to an increase in the volume of contracted wind generated supply, with a higher share of LRET generation also contributing. The anticipated faster growth of rooftop PV and explicit treatment of behind the meter consumption has also made a difference.

It is important to appreciate that the estimates presented here are necessarily uncertain. Future demand for electricity is probably the largest source of uncertainty. Future levels of rooftop PV installation, particularly on commercial buildings, are also highly uncertain.

Figure 3: Weighted average emissions intensity and renewable share of electricity supply to the ACT, assuming no growth in behind the meter PV consumption

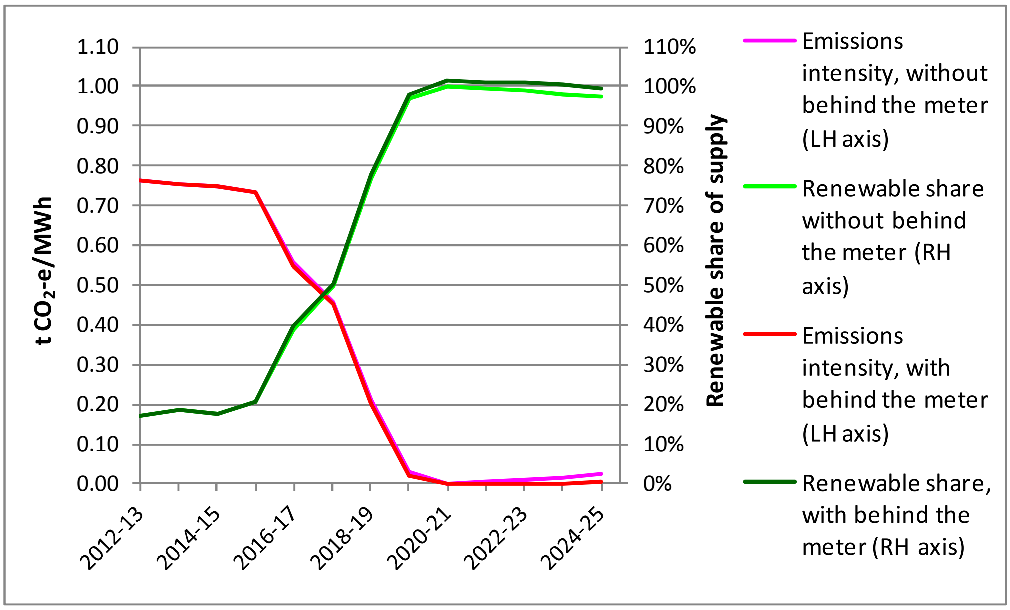


Figure 4: Components of total electricity supply to the ACT: renewable and non-renewable

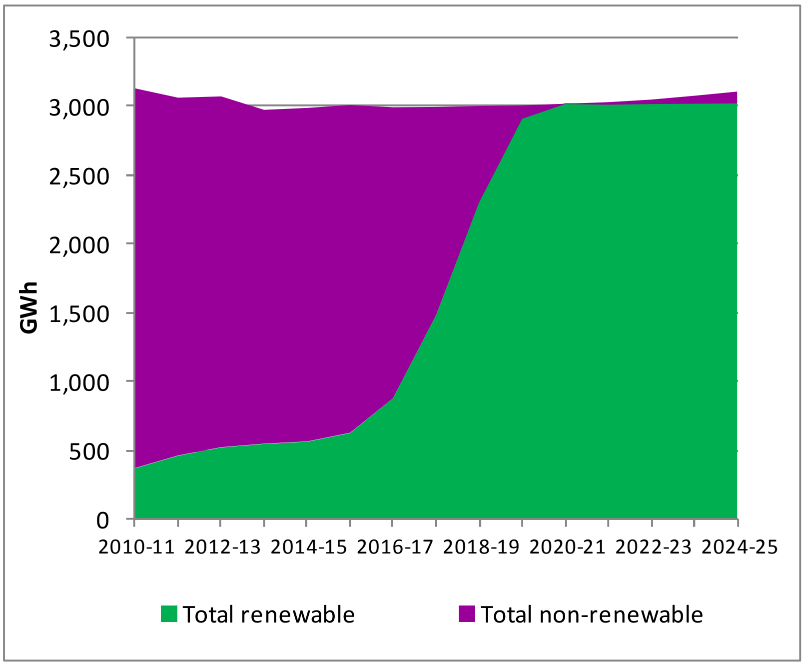


Figure 5: Components of renewable electricity supply to the ACT

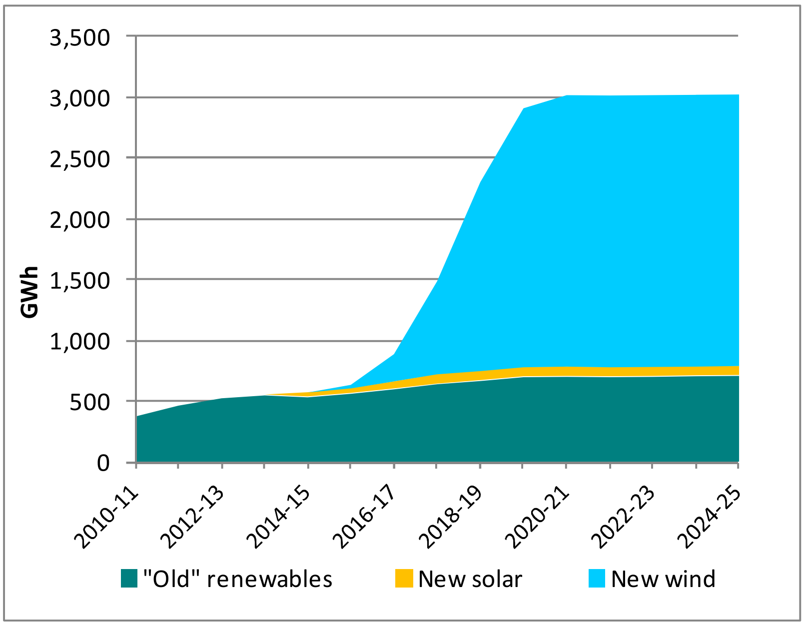


Figure 6: Components of "old" renewable electricity supply to the ACT

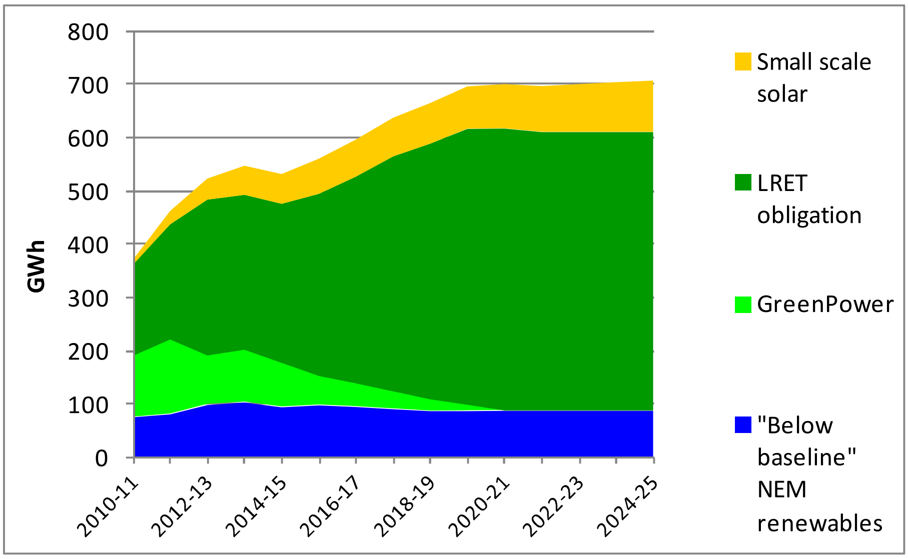


Table 2: Quantities of electricity supplied from each component of total supply, and share of renewable in total consumption, assuming no growth in behind the meter PV, 2014-15 to 2024-25, GWh

Financial year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Electricity consumption	2,988	3,009	2,994	2,995	3,003	3,009	3,019	3,031	3,050	3,076	3,107
LRET obligation	300	343	389	442	481	520	531	524	524	524	524
GreenPower	83	55	44	33	22	11	0	0	0	0	0
Small scale solar	56	66	69	73	76	79	83	86	90	93	96
"Below baseline"	94	98	95	91	87	87	87	87	87	87	87
Total "old" renewables	533	561	597	638	666	697	701	698	701	705	708
New solar	33	38	59	77	77	76	76	75	75	75	74
New wind		27	224	768	1,559	2,136	2,240	2,240	2,240	2,240	2,240
Total "new" renewables	33	66	565	845	1,635	2,212	2,316	2,315	2,315	2,314	2,314
Total renewable supply	566	627	1,163	1,483	2,301	2,910	3,017	3,013	3,016	3,019	3,022
Total renewable share of consumption	17.8%	20.8%	38.8%	49.5%	76.6%	96.7%	99.9%	99.4%	98.9%	98.1%	97.3%
Weighted average emissions intensity (t CO_2-e/ MWh)	0.748	0.732	0.555	0.458	0.212	0.030	0.001	0.005	0.010	0.017	0.025

Table 3: Total quantity of renewable electricity in consumption, assuming growth in behind the meter PV, 2014-15 to 2024-25, GWh

Financial year	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**
Electricity consumption	2,988	3,009	2,994	2,995	3,003	3,009	3,019	3,031	3,050	3,076	3,107
Total renewable supply	566	627	1,163	1,483	2,301	2,910	3,017	3,013	3,016	3,019	3,022
Behind the meter PV consumption	6	14	21	27	34	40	47	54	60	67	73
Total renewable share of consumption	17.8%	20.8%	39.5%	50.4%	77.8%	98.1%	101.5%	101.2%	100.9%	100.3%	99.6%
Weighted average emissions intensity (t CO_2-e/ MWh)	0.748	0.732	0.549	0.450	0.202	0.018	0	0	0	0	0.003

Table 4: Emissions displaced by ACT purchases of contracted wind and solar electricity, 2014-15 to 2024-25, GWh

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Renewable electricity purchased, GWh	33	66	283	845	1,635	2,212	2,316	2,315	2,315	2,314	2,314
Emissions intensity of electricity displaced, t CO_2-e/ MWh	0.928	0.937	0.908	0.908	0.908	0.908	0.908	0.908	0.908	0.908	0.908
Emissions saved, kt CO_2-e	31	62	257	767	1,484	2,008	2,102	2,102	2,101	2,101	2,101

3. Emissions saved by ACT contracted renewable generation

The 2015 and 2016 emissions intensity reports contained extensive discussions of how the emissions intensity of displaced electricity should be calculated. The complexity revolved around uncertainty as to the marginal source of fossil fuel electricity supply in NSW, given the level of imports from both Victoria and Queensland up till now. However, as explained above, the closure of Hazelwood has removed that uncertainty. From now on, the mix of NSW fossil fuel generators will undoubtedly be the marginal source of supply to the ACT, making the calculation of displaced emissions very simple.

The only qualification to this conclusion would arise from an argument, examined in the 2016 report, that a NEM-wide perspective should be adopted. It is, however, difficult to reach any conclusion as to what difference this might back. The Ararat wind farm and the much smaller Coonoer Bridge are located in Victoria, where they would at almost all times displace brown coal generation. However, the largest provider of contracted renewable electricity is Hornsdale, located in South Australia. There will be many occasions when it displaces lower emission gas fired generation and other occasions when it displaces high emission brown coal generated electricity, imported from Victoria. The other two contracted wind farms are in NSW where they will, of course, displace mainly NSW fossil fuel generated electricity. Given these considerations, it is not obvious that taking a NEM-wide approach in this way would greatly change the average emission intensity of displaced electricity, even assuming it would be possible to undertake the relevant calculations with the required degree of certainty.

Accordingly, the results shown in Table 4 below assume that contracted renewable generation displaces NSW fossil fuel generated electricity. It is most important to appreciate that, as already noted, all these figures are based on the assumption that there will be no change in the mix of fossil fuel generators in the NEM, beyond plant closures already officially notified.

4. Conclusions

Estimates presented in this report of renewable electricity supplied over the years 2010-11 to 2014-15, and the resultant overall average emissions intensity of electricity supplied to ACT electricity consumers, differ slightly from those presented in the 2016 report. The differences arise from small revisions to some input data for the calculations. In 2015-16 the renewable share was 20.8% and the average emissions intensity of electricity supplied was 0.732 t CO_2-e/MWh.

For the projections out to 2024-25, the most important change in this report is use of a new projection of future electricity consumption by ACT consumers. For the year 2019-20, projected demand estimates used in this report are 44 MWh, equivalent to 1.5%, lower than in the 2016 report. Corresponding differences for the year 2024-25 are 64 GWh, equivalent to 2.1%. The new demand projections are those developed for the concurrent project examining future emissions from stationary energy use in the ACT, as part of the input to Blueprint for a net zero emissions Territory. The new figures include an expectation of a strong uptake of reverse cycle air conditioners in both new and retro-fitted housing, replacing gas for space heating. The figures also include a quantity of electricity required for use in electric vehicles. The previous demand modelling used a top-down approach, which made no explicit allowance for these and other important changes in trend, and little or no implicit allowance.

The other major change is that the total quantity of contracted new wind and solar generation in 2019-20 and subsequent years is higher than the corresponding figures used in the 2016 report. By contrast there is virtually no change in the estimates of electricity supplied from old renewable generation.

The overall outcome is that this report projects that the residual quantity of non-renewable electricity needed to supply consumption in the ACT will be less than the corresponding figure estimated for the 2016 report. Although non-renewable supply will not quite reach zero by 2019-20, it will do so by the following year. This projected average emissions intensity of electricity supplied is correspondingly lower than the 2016 value, and reaches zero in 2020-21.

Another factor which could reduce emissions in 2019-20 is more rapid uptake of rooftop PV. The projections of future uptake used for this report are deliberately rather conservative, i.e. low. Analysis undertaken for this report results in an estimate that rooftop solar generation, including behind the meter consumption, provided 2.6% of electricity consumed in the ACT in 2015-16. This is lower than the 5.6% share in SA and the 3.5% share in Queensland, but higher than the share in other NEM states.

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