Electricity

Climate Action Monaro

September 2021

A background report from:

Zero SE

A Beyond Zero Future for South East NSW

www.zerose.space

Electricity Report

Contents

Key Points

Across the country and the globe, the world is stepping up to the challenge of transitioning from fossil fuel generated energy to a low carbon economy powered by renewable and clean energy sources. This is a once in a generation change and it presents a huge opportunity for local communities to benefit economically.

The transition from horse to cars in the early 1900s happened in a short time, despite the lack of paved roads and infrastructure for fuel refining and petrol stations at the start. With the forecast retirement of our coal fired generator fleet over the coming 15 to 20 years, the transition to fully renewable electricity is likely to be just as swift. The question is how can we maximise the benefit at a local level and make the transition as smooth as possible?

This report outlines the targets for a low carbon local economy at the local level for electricity generation and storage. The emphasis is on what this might look like in relation to distributed renewable energy - primarily solar photovoltaics (PV). We estimate the savings on energy bills for residential and business, and point out what is needed from community, business and government leaders to help pave the way.

The proposition is that local initiatives will ensure the best outcomes for our regional communities.

- **Councils** who are electricity users, have regulatory and direct influence over ratepayers and others, obtain relevant funding and can seek grants and lobby State and Federal Government and can and do facilitate community activities are in a unique position to drive the actions necessary to deliver optimal clean and local renewable energy.
- **Community energy groups** (CEGs) such as Climate Action Monaro, Southcoast Health and Sustainability Alliance, Clean Energy for Eternity, Repower Shoalhaven are already active across the ZeroSE region with a range of renewable power, emission reduction, reforestation, soil carbon, etc initiatives and they have strong networks but could benefit from a ground-swell of local participants including Councils, citizens, business and researchers - this report identifies opportunities, existing electricity projects and links to successful community energy groups.
- **Business and business groups** can join with Councils and CEGs to undertake energy efficiency, renewable power switching, solar farm participation etc whilst reaping operational savings and reputational benefits.
- **Consumers** can build into new or existing homes energy and money saving devices or purchase renewable power which reduces carbon emissions and can add to property values.

What is the Target and Why?

Under the 2015 Paris Agreement, Australia's target for greenhouse gas emissions reduction is 26 to 28% below 2005 levels by 2030. Beyond this, the goal is to be net zero by 2050.

In addition to the Paris Agreement goal, the Intergovernmental Panel on Climate Change (IPCC) says we need to cut world emissions to 45% of 2010 levels by 2030 and achieve net-zero in 2050 to keep the world average temperature increase to 1.5 degrees Celsius.

For this report, the focus is at the Local Government Area (LGA) level in South East NSW. Emissions data from 2005 at the LGA level was not readily available for this analysis. Instead the study refers to the 2019 emissions data from the Snapshot website that has been made available by Beyond Zero Emissions and Ironbark Sustainability.[1] To achieve the IPCC reduction target by 2030 we have estimated that this will require a year-on-year reduction in emissions per year from 2020 until 2030 of 3.6% per year of the 2019 value.

For the purpose of this analysis, a more ambitious target is assumed for the electricity sector. The renewable electricity transition is well underway and industry predictions indicate 40 to 50% renewables in the grid by 2030. A target of 50% reduction of 2010 emissions from electricity by 2030 will be used. **This equates to a year-on-year reduction in emissions per year from 2020 until 2030 of 4.55% per year of the 2019 value.** This is illustrated in the Table 1 below.

Table 1. Emissions and 2030 target emissions by LGA, 2018/19

LGA	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Tonnes CO2e from electricity use in 2019	209,000	177,300	57,900	477,500	256,900	259,000	135,400	721,600
Target Emissions reduction per year (2020 to 2030)	9,500	8,059	2,632	21,705	11,677	11,773	6,155	32,800
Target Tonnes CO2e from electricity use in 2030 (t CO2e)	104,500	88,650	28,950	238,750	128,450	129,500	67,700	360,800

Source: Snapshot 2018/19 emissions

Where Are We Now?

Emissions and Energy Use - Bigger Picture

For the whole of Australia, 187.5 Mt CO2-e (or 35% of the total emissions) were produced by fuel combustion to make electricity in the 12 months to December 2019[2].

The National Electricity Market (NEM) includes the eastern states from Queensland to Tasmania. Table 2 below shows a comparison of electricity produced, generation type and CO2 emissions at the state level within the NEM in 2019.

[1] https://snapshotclimate.com.au
[2] https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook45p/EmissionsReduction

Table 2. Electricity generation and C02 emissions by NEM state, 2019

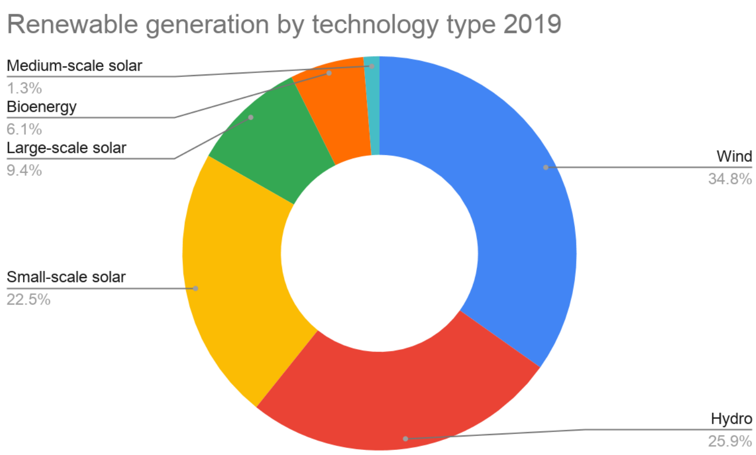
	Queensland	NSW & ACT	Victoria	South Aust	Tasmania
Electricity generated GWh	70,964	73,532	47,235	15,400	10,801
Tonnes CO2e	54,867,532	58,097,108	43,554,044	4,778,865	381,961
Renewable share	13%	10%	21%	50%	94%

Source: https://www.energy.gov.au

Renewable technologies include wind, hydro, solar and bioenergy. The breakdown of renewables by technology type varies by state, depending on the natural resource available. For example, Tasmania's renewable generation is 81% Hydro.

At a national level, renewables contributed 24% of electricity generation in 2019. The breakdown of renewable generation by technology type is illustrated in Figure 1 below.

Figure 1. Renewable generation by technology type, 2019



Note:

- Small scale (< 100kW): includes residential and commercial & industrial
- Large scale solar: Grid scale wind and solar farms typically > 30MW
- Medium scale solar: (100kW to 30MW), incl. Community energy

Source: Clean Energy Council – Clean Energy Australia 2020 Fact Sheet

Emissions and Energy Use - Local Level

At a more local level, the emissions profile of South East NSW is summarised by Local Government Area (LGA) in Table 3 below. These emissions profiles are based on the financial year 2018/19. This data is provided by the Snapshot community climate tool that has been led by Beyond Zero Emissions and Ironbark Sustainability [2].

Table 3. CO2 emissions in South East NSW by LGA, 2018/19

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Total LGA emissions tCO2e	737,700	596,200	431,000	988,600	596,700	519,200	281,000	1,495,500
Electricity	**28%**	**30%**	**13%**	**48%**	**43%**	**50%**	**48%**	**48%**
Gas	1%	0%	4%	7%	2%	0%	7%	9%
Transport	20%	19%	25%	32%	35%	42%	39%	36%
Waste	1%	1%	1%	2%	2%	2%	2%	2%
Agriculture	50%	51%	56%	11%	18%	6%	3%	5%

Source; https://snapshotclimate.com.au

Electricity is one of the main sources of emissions across all LGAs. Phasing out coal from the electricity sector is one of the most tangible and achievable steps to get towards our carbon reduction goals.

An indication of electricity use per LGA is provided below. This data is calculated from the Snapshot emissions data and using the Carbon Dioxide Equivalent Intensity Index (CDEII) for the NSW grid in 2019 (0.79)

Table 4. South East indicative annual electricity use and CO2 emissions by LGA, 2018/19

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Population	*20,218*	*14,395*	*16,142*	*56,027*	*33,253*	*37,232*	*21,464*	*99,650*
Residential (MWh)	103,418	40,506	28,354	248,861	135,823	135,823	115,063	323,797
Commercial (MWh)	64,684	27,848	21,646	86,835	76,076	84,684	37,848	231,519
Industrial (MWh)	96,456	156,076	23,291	268,734	113,291	107,342	18,481	358,101
Total MWh / year	**264,557**	**224,430**	**73,291**	**604,430**	**325,190**	**327,848**	**171,392**	**913,418**
Tonnes CO2e	**209,000**	**177,300**	**57,900**	**477,500**	**256,900**	**259,000**	**135,400**	**721,600**

Source:2016 Census; Snapshot FY2019

Renewable Generation and Storage

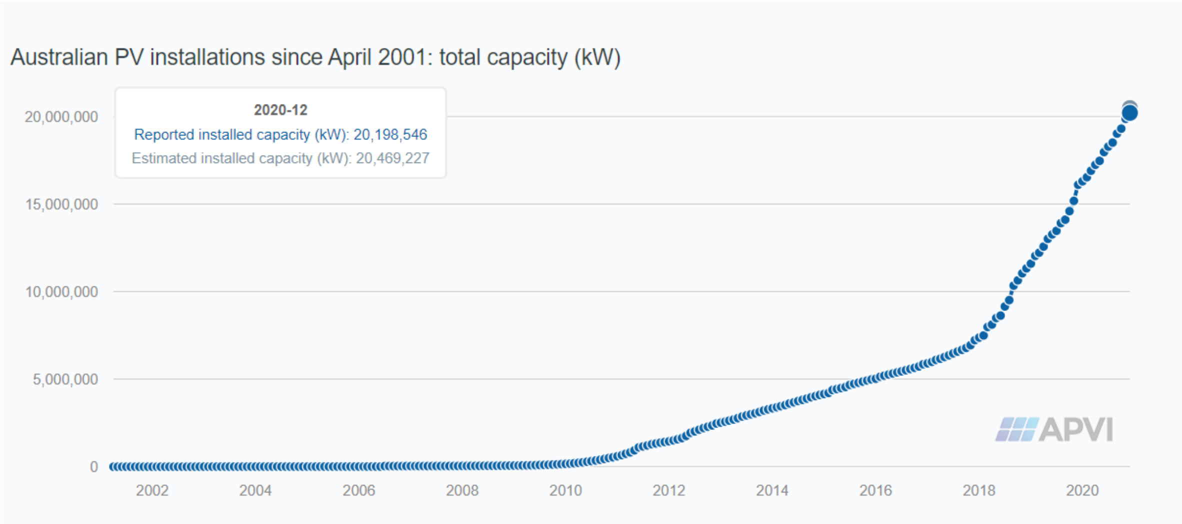
The opportunity to build renewable energy generation and storage at our local level falls into three main categories

- Small scale:
  - includes residential (<10kW)
  - commercial & industrial (< 100kW)
- Medium scale solar: (100kW to 30MW), includes Community energy projects
- Large scale solar: Grid scale wind and solar farms typically > 30MW

Australia has been leading the world in the uptake of small-scale photovoltaics (PV). At a national level, PV installation rates have increased in recent years. As of 31 December 2020 there are over 2.66 million PV installations in Australia with a combined capacity of 20.2 gigawatts.

The chart below shows the dramatic increase in the rate of PV installation in recent years. As can be seen, the rate of installation has accelerated significantly since 2011.

Figure 2. Australian PV installations since 2001



Source: Australian Photovoltaic Institute

Residential

The table below shows the density of installed residential rooftop PV in the South East and the total capacity up to the end of 2020.

Table 5. Residential rooftop PV installations in South East NSW, 2001 – 2020

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Dwellings[3]	*11842*	*6783*	*6876*	*25646*	*18022*	*24244*	*9580*	*56927*
Installs 2001-2018	1775	1513	1460	1901	3981	4627	1774	8312
# Installs 2019	274	235	277	325	488	758	420	2030
# Installs 2020	306	232	280	340	570	767	435	2026
Total no. dwellings with PV (<10kW) at 31 Dec 2020	2335	1955	1996	2532	5011	6080	2589	12172
% of dwellings with PV(<10kW at 31 Dec 2020	20%	29%	29%	10%	28%	25%	27%	21%
Total kW installed (<10kW) at 31 Dec 2020	12152	10282	11858	13314	20416	27654	12458	57154

Source: Australian Photovoltaic Institute https://pv-map.apvi.org.au/

[3] Dwellings include all private dwellings, based on past Census data extrapolated to 2020.

Business and Community

A lot of work has been done in the past by Community Energy Groups in the South East to initiate PV installation on community buildings, public buildings and commercial and industrial buildings. Groups such as Repower Shoalhaven, Clean Energy for Eternity and SHASA have enabled PV installations across the South East on public buildings, small and medium sized businesses, Rural Fire Service sheds, community halls, churches and sporting clubs. These systems typically in the range of 10 to 100kW are represented in the table below.

Table 6. Commercial and industrial size PV installations to 2020

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Total no.installations (10 - 100kW) at 31 Dec 2020	204	147	304	629	208	232	146	671
Total kW installed (10 - 100kW) at 31 Dec 2020	3679	2918	4498	11288	4336	5372	2660	12506

Source: Australian Photovoltaic Institute https://pv-map.apvi.org.au/

In recent years, large business chains such as Woolworths, Bunnings, Aldi and Coles have been recognising the opportunity of energy cost savings and reduced environmental footprint from installing rooftop PV systems. The numbers of these larger systems are small but starting to grow. The existing sites in this range (>100kW) include:

Table 7. Medium size PV installations to 2020

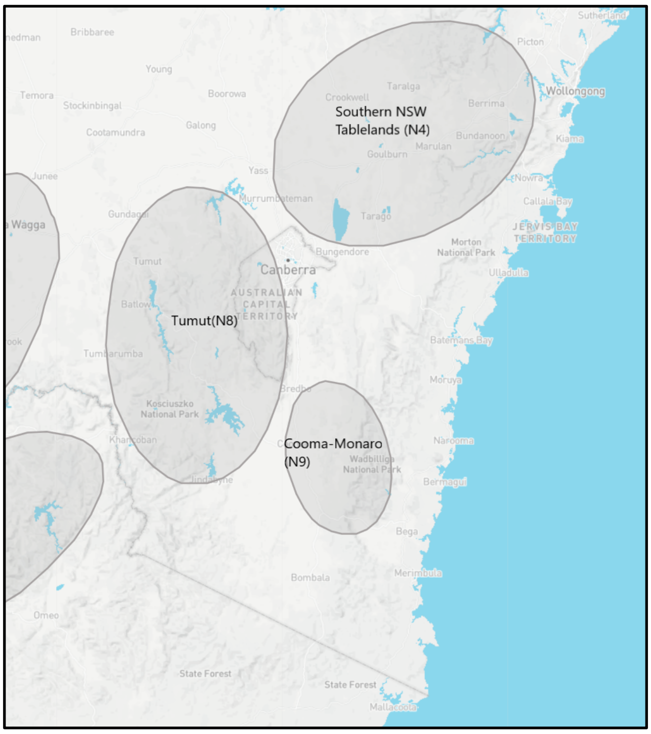
	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Total no.installations (>100kW) at 31 Dec 2020	0	0	0	4	1	2	1	4
Total kW installed (>100kW) at 31 Dec 2020	0	0	0	1512	259	425	169	1023

Source: Australian Photovoltaic Institute https://pv-map.apvi.org.au/

Grid Scale Systems

The large "grid scale" systems are typically located in Renewable Energy Zones, where the necessary transmission line infrastructure is available. The REZ's that have been defined by the Australian Energy Market Operator (AEMO) are illustrated below. It should be noted that these zones are not part of the current NSW Government REZ program which is focussed on Central West and New England areas. Development of these zones is not anticipated until after 2030.

Figure 3. NSW Renewable Energy Zones identified for South East NSW



Source: https://www.aemo.com.au/aemo/apps/visualisations/map.html

The two main Renewable Energy Zones for South East NSW are the Tumut (N8) and Cooma Monaro (N9). The table below lists the existing and proposed new projects in these areas:

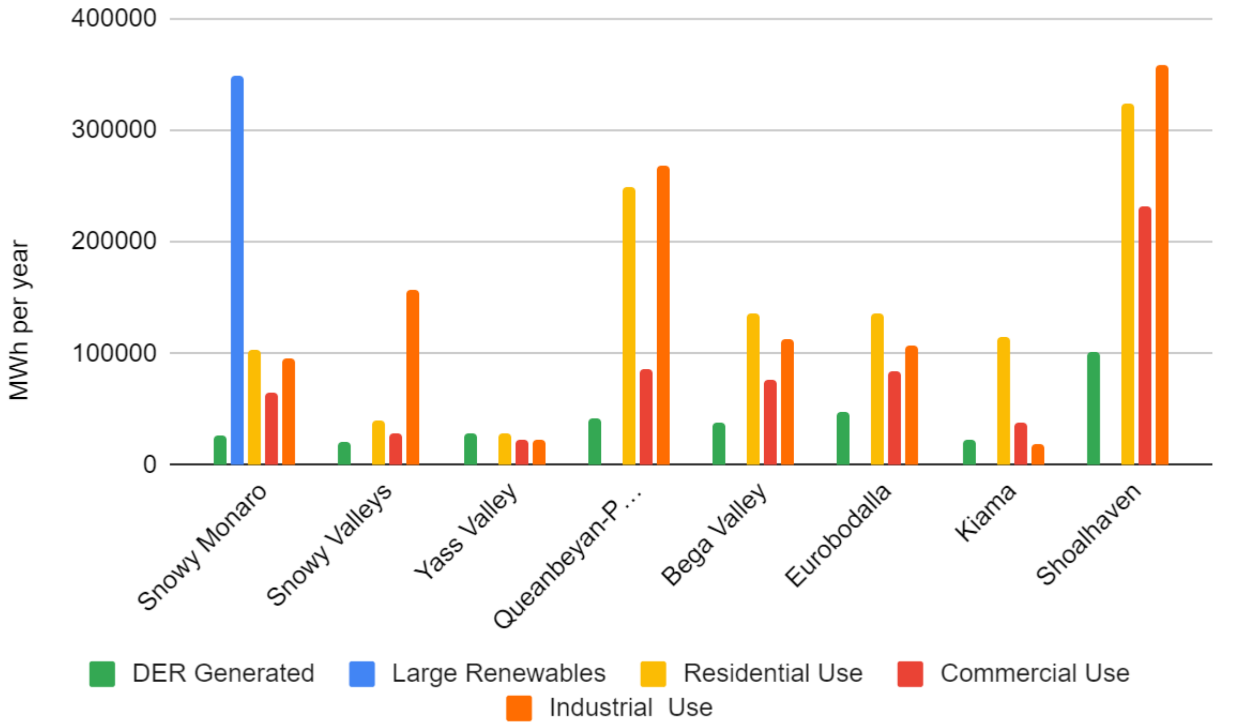
Table 8. Tumut (N8) and Comma-Monaro (N9) projects

Project	Energy Type	Capacity (MW)	Year opened/ Planned	LGA
Boco Rock	Wind	113	2014	Snowy Monaro
Bango	Wind	236?	Under construction	Yass Valley
Boco Rock Stage 2	Wind	113	tba	Snowy Monaro
Monaro	Solar PV	70	tba	Snowy Monaro
Snowy Mountains Scheme	Hydro Electric	3800	constructed between 1949 and 1974	Snowy Valleys and Snowy Monaro
Snowy 2.0	Pumped Storage Hydro	2000	2025	Snowy Monaro

To illustrate the magnitude of local electricity use compared with current levels of renewable generation, Figure 4 below shows the amount of energy generated from renewables each year compared with electricity use by residential, commercial and industrial use. The chart excludes generation from the Snowy Hydro Scheme but includes the new renewables where applicable. This indicates that there is significant scope to create local generation and storage to replace imported generation and build system resilience.

The wind farm in Snowy Monaro produces significantly more energy than the local consumption. The rooftop PV is typically 9 to 15% of local consumption, with the exception of Yass Valley which is at 37% and Queanbeyan-Palerang at 7%.

Figure 4. Renewable generation bs electricity use by LGA, 2020



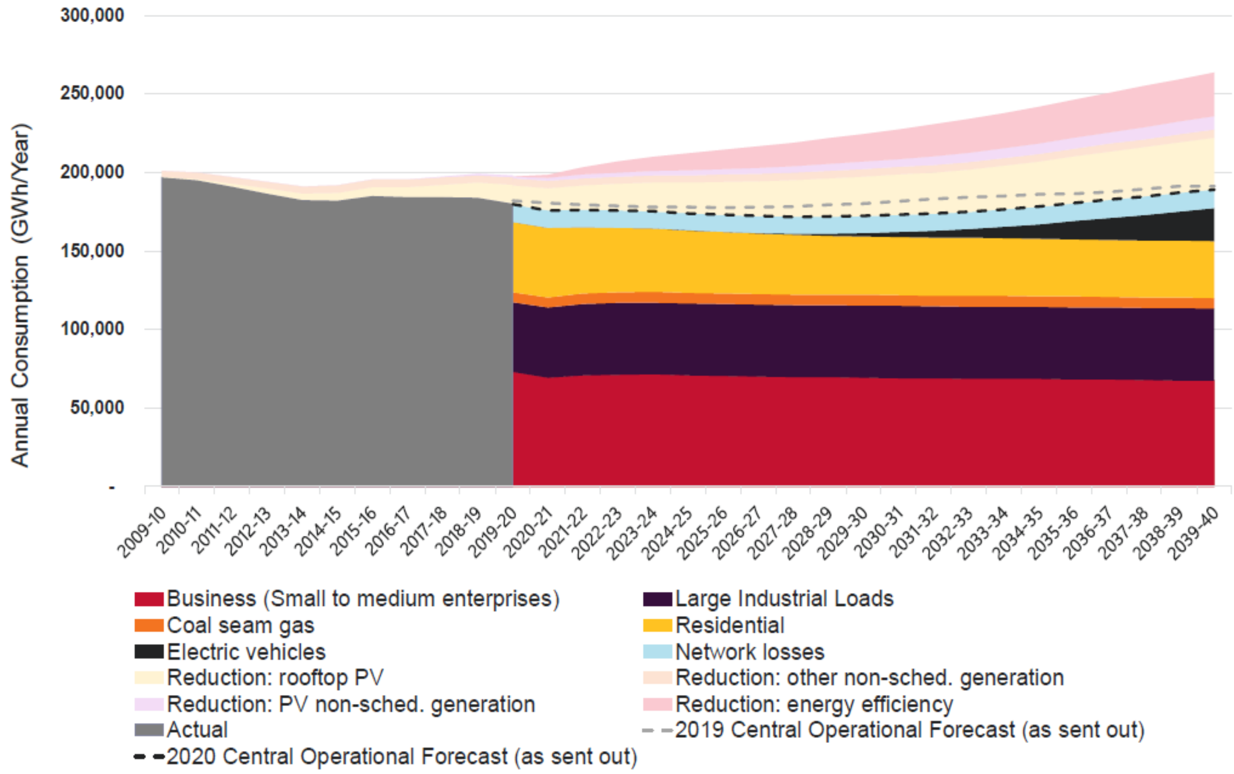
Source: estimated based on installation data from [Australian PV Institute] and generic utilisation factors. DER = Distributed Energy Resources

Future Projections

National Electricity Market

National Electricity Market (NEM) actual electricity consumption has been trending down in recent years. This has been largely due to the uptake of renewables including roof top PV and improving energy efficiency. The figure below from the Australian Energy Market Operator (AEMO) shows the actual and forecast annual energy consumption for the NEM in their “central scenario”.

Figure 5. NEM electricity consumption, 2009-10 & 2039-40, central scenario



Source: AEMO Electricity Statement of Opportunities, August 2020

The power system in Australia is already in a transition from mainly coal to renewables and storage. Currently renewables contribute about 33% of generation capacity. The Australian Energy Market Operator (AEMO) estimates that this could increase to 46% in 2030 and 73% in 2040 [3].

Australia is leading the world in uptake of rooftop solar. According to data from the Clean Energy Regulator (CER), 2.6 gigawatts (333,978 installations) of rooftop solar was added in Australia in 2020. This is about 18% higher than what was added in 2019[4].

The AEMO Integrated System Plan suggests that distributed generation (such as rooftop PV) could provide 13% to 22% of the total underlying annual NEM energy consumption by 2040.

Thermal coal fired generation retirement from the National Energy Market is creating a need for 40gigawatts + of new build by 2040.

The technology exists to meet this demand with renewables backed by storage. Households and businesses can contribute a significant portion of this new clean energy with rooftop PV, batteries and participation in community renewable projects, eg solar farms, and at the same time save on their power bills, create local jobs and keep money in the local economy.

Local Potential for Distributed Energy Resource (DER)

If we use the AEMO projections outlined in the previous section as a guide - with some conservative pessimism built in - to estimate the state of transition of the grid to renewables by 2030, we can expect that the National Energy Market will be in the order of 45% renewables.

To meet our local emission reduction targets for 2030, with grid energy that is 45% renewable would require that 36% of local energy demand is met by locally generated distributed energy resources (DER). This combination of grid and locally supplied energy would support the target to reduce emissions to 50% of 2010 levels by 2030.

Locally produced distributed energy can be grouped into the following four categories:

- Residential
- Commercial
- Industrial
- Community scale

While wind, hydro and biomass generation can all contribute to the goal, it is solar PV that is the most established option and is the focus of this study.

The table below shows an example of the number of systems that would be required to achieve the target emissions reduction, assuming 1% p.a. growth in demand. This amount of locally produced renewable energy would provide around one third of local energy demand. The rest of the energy demand would be sourced from the grid, which is assumed to be 45% renewable by 2030.

Table 9. Number of installed systems by 2030 to meet local emissions reduction target

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
Residential	6971	5775	1735	15905	9282	10448	4531	28722
Commercial	468	271	140	903	542	461	355	1363
Industrial	114	128	40	360	128	107	59	329
Community	4	5	1	5	4	4	3	5

For comparison, the table below shows the number of systems installed in 2020.

Table 10. Number of systems installed as of 2020

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
# installations (<10kw) Residential	2335	1955	1996	2532	5011	6080	2589	12172
# installations (10 to 100kw) Commercial & Industrial	204	147	304	629	208	232	146	671
# installations (>100kw) Community scale	0	0	0	4	1	2	1	4

Source: Australian Photovoltaic Institute https://pv-map.apvi.org.au/

As can be seen from these tables, reaching our emissions reduction goals can be achieved if we:

- Double the current level of residential rooftop solar
- 4 to 5 fold increase in the quantity of commercial and industrial PV installations
- Development of community scale renewable energy projects

These goals appear to be achievable, but will require considerable investment and an appropriate level of leadership, incentive and support from Government. Governments play a critical role in setting strategic direction and can build momentum through government purchasing policy and providing incentives and market signals to encourage private investment.

Both small and mid sized distributed energy resources can play an important part in the generation mix of the future renewable grid. With the right incentive structure and network infrastructure planning, they can provide greater resilience and also provide an opportunity for consumer savings that can be redirected from power bills back into the local economy.

Building local renewable energy generation will support a more resilient power system, create local jobs, reduce energy costs for consumers and provide other benefits to our local economies that will be outlined later in this report.

The data for these estimates have been taken from the following key sources:

- Snapshot Climate website carbon dioxide emissions data was used to derive electricity use
- AEMO website for Carbon Dioxide Equivalent Intensity Index data
- Australian Bureau of Statistics ABS.Stat website (for 2019 industry data)
- Australian Bureau of Statistics Census QuickStats (for population and dwelling data)
- Clean Energy Regulator website for postcode Photovoltaic (PV) installation data[4]
- Australian PV institute website for PV installation data

The calculations are based on some simplifying assumptions:

- Photovoltaic systems sized < 10 kW are residential
- Photovoltaic systems sized 10 to 100 kW are commercial and industrial
- New residential PV system average size is 5 kW
- New commercial PV system average size is 30 kW
- New industrial PV system average size is 100 kW
- New Community scale PV system average size is 1000 kW
- Growth in demand for electricity use from 2019 to 2030 is 1% p.a.
- Growth in residential dwellings is extrapolated from past Census data
- The required % number of rooftops for residential and commercial & industrial is the same

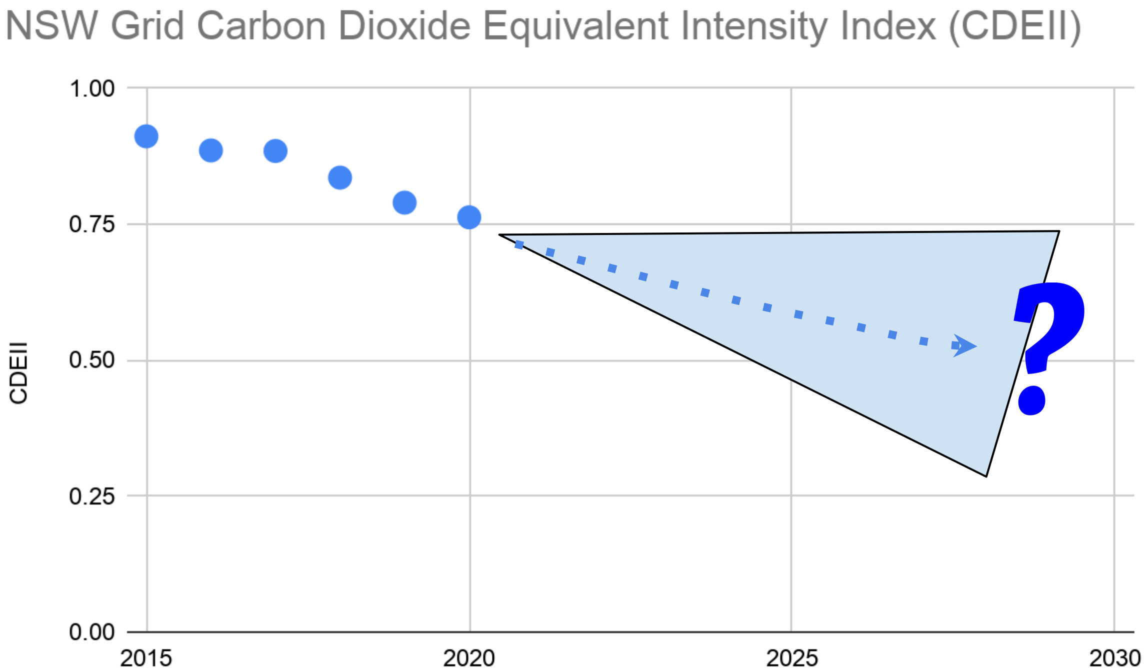
Grid Scale Systems

The decarbonisation of the national grid has been taking place for the past decade or so.

The Carbon Dioxide Equivalent Intensity Index (CDEII) is a formal measure of the carbon footprint of the electricity grid produced power. The measure is published weekly on the Australian Energy Market Operator (AEMO) web site. The CDEII represents the tonnes of CO2 emissions per MWh of electricity produced. As renewable generators replace fossil fuel stations, the CDEII reduces. The number has been steadily reducing over the last decade as is illustrated in the chart below.

[4] Data sourced from Clean Energy Regulator website postcode data. A source of error exists were post code data doesn't align with LGA boundaries.

Figure 6. NSW Grid Carbon Dioxide Equivalent Intensity Index (CDEII), 2015-2030



Source: [AEMO website]

A key driver has been Australia's Renewable Energy Target (RET). The RET is a Federal Government policy designed to ensure that at least 33,000 gigawatt-hours (GWh) of Australia's electricity comes from renewable sources by 2020. The policy has effectively achieved its goal. This means that it will have less and less impact in the future. It is vital that new policy drivers are developed to ensure we maintain the transition rate at the required level to achieve the goals of emission reduction.

Large scale wind and solar farm projects will be a vital component of the future renewable energy system. These projects will be required to replace the coal fired power stations that are reaching end of life and will be decommissioned over the coming two decades.

The Snowy 2.0 pumped hydro station will be a vital component of the future renewable grid. This station when completed post 2025 will have a capacity of 2000 MW and able to generate continuously for 174 hours. This will provide critical storage to complement the variable renewables.

In addition to Snowy 2.0 other sources of energy storage will need to be built. Storage in the form of batteries and other pumped hydro projects are likely to be part of the mix. The ANU has mapped potential pumped hydro sites and there are battery projects being discussed.

There is a lot more that needs to happen in this space and a clear national plan will be required.

What is Needed to Achieve Our Goals

State Level

Legislation, incentive schemes and leadership are demonstrating that the NSW Government is fully committed to achieving the goal.

The NSW Government is providing strong leadership in the task of reaching net zero emissions by 2050. The *Net Zero Plan Stage 1:2020-2030* shows the intention to "fast track emissions reduction" for the next decade and prepare the State to take further action in the decades to follow"[5]

The Plan's priorities are:

1. Drive the uptake of proven emissions reduction technologies
2. Empower consumers and businesses to make sustainable choices
3. Invest in the next wave of emission reduction innovation
4. Ensure the NSW government leads by example.

Some of the key initiatives being introduced for the electricity sector as part of the plan include:

- $450 million Emissions Intensity Reduction Fund to support small business transition their plant, equipment and processes to low emissions alternatives.
- Fast track the delivery of key NSW Renewable Energy Zones. These will involve expanding transmission infrastructure to improve access for new solar and wind farms. The initial focus will not include the South East Region. However, this will be an important initiative to help drive the continued reduction of emissions from the Grid produced electricity.
- Energy Security Safeguard - ensuring that the new energy system is cheaper and more reliable into the future. This will include incentives for energy saving and demand shifting so that people are using electricity at the cheapest time of the day when it is most abundant
- The Energy Efficiency program will include initiatives to reduce bills and support vulnerable households and small business. The Empowering Homes program is an example of a pilot project currently underway in the Hunter Region to install solar battery systems by providing interest free loans. Once developed, this program will support 300,000 NSW households.
- Electric Vehicle Infrastructure and model availability - Aimed at growing the EV market and providing the necessary charging infrastructure to support the transition away from internal combustion engine transport.

NSW Government is providing great leadership in improving energy efficiency and reducing carbon pollution. We need alignment at the Federal and Local Government Levels as well to drive the attention and focus that this problem demands.

[5] Ministers message, Net Zero Plan Stage 1: 2020–2030

LGA Level

Residential Electricity Generation

The table below shows the installation rates required each year until 2030 to reach the emission reduction target set in this report of 50% of 2010 levels. In many of our LGAs these are similar to the rates of installation seen over the past two year. The table also shows the estimated percentage of residential and business rooftops that are required to meet the target. With this level of local rooftop PV generation, locally generated renewable electricity would meet approximately one third of local energy demand.

This estimate assumes that the electricity grid as a whole, can reduce its carbon dioxide emission intensity index (CDEII) from the current level of 0.79 down to 0.55 by 2030. This assumption is in line with government projections.[6]

Assumed system capacities for this estimate are:

- Residential - 5kW
- Commercial - 30kW
- Industrial - 100kW
- Community - 1000kW

Table 11. Solar PV installations needed per year to reach emissions reduction target

	Snowy Monaro	Snowy Valleys	Yass Valley	Queanbeyan-Palerang	Bega Valley	Eurobodalla	Kiama	Shoalhaven
% Residential dwellings with PV @ 2020	20%	29%	29%	10%	28%	25%	27%	21%
Installations achieved in 2020	306	232	280	340	570	767	435	2026
Installations per year required to reach emission reduction target by 2030	460	390	See footnote[7]	1050	450	520	210	1700
% Residential and business with PV in 2030 to meet emission target.	56%	81%	26%	59%	49%	41%	45%	48%

Commercial and Industrial Electricity Generation

In addition to residential PV, greater rates of commercial and industrial generation and mid-sized community energy systems also need to be built.

[6] Australia's emissions projections 2020. Australian Government Dept. Industry, Science, Energy & Resource
[7] The method used for this estimate suggests Yass Valley already has sufficient rooftop PV installed to meet 2030 targets. This may be due to the simplifying assumptions used for this relatively small LGA. Further investigation is required to confirm that this is the case.

Commercial and industrial business are an ideal fit for PV systems because most of the power use is during the day, when the sun is shining. Unfortunately, commercial and Industrial uptake of rooftop PV to date has been limited to date. Reasons for the low rates of historical take up include:

- The high proportion of commercial and industrial buildings that are tenanted. If the owner of the building and the building occupant are different, then the financial benefit for the owner of installing rooftop PV is not as clear as is the case for a residential homeowner.
- The costs to upgrade roof structural support for the weight of the PV panels further increases the upfront cost and financial payback period.
- Greater challenges than residential in relation to: building ownership, financing, power purchase and network connection.

This category represents a major opportunity because of the currently low rates of installation. There is a lot that can be done to enable this scale of system development and there is considerable potential to be unlocked.

We need government legislation and incentives to encourage commercial and industrial businesses to install rooftop PV. This is the biggest growth opportunity in each of the LGAs in the South East. Coming from a low base, we will need to increase the C&I uptake of PV significantly to achieve our goals for local distributed renewable energy.

Schools, hospitals and other public and community buildings are other facilities that could benefit from solar systems in this size range. A future of microgrids within towns and villages will provide significant benefits to communities simply by lower power bills over the decades of longevity in public hands of these community buildings. For example, it is not uncommon for a school to remain on the same site for 100 years.

Additionally, having the power produced locally will contribute to lower cost energy and more resilient networks. Having schools, hospitals and other public and community buildings fitted with rooftop solar can provide a foundation and core generating assets for community microgrids of the future. Some case study examples are provided later in this report.

Community Scale Electricity Generation

Community scale solar and wind farms can also be a significant part of the solution. Projects of this size can realistically be identified and developed and built by local communities. This could be by Councils, volunteer community energy groups or private developers or partnerships of the same. Solar farms of the scale of 1 MW will have a footprint of approximately 2 to 3 hectares. The cost of these projects is in the order of $1.4 to $2 million and is within the capability of local community groups to champion, fundraise and sponsor. There are many viable sites for projects of this size in our region and communities can take a lead in developing these shared local resources.

Households with shaded roofs, renters or people living in apartment blocks are not able to directly own a rooftop solar system. Community solar farms can provide the opportunity for these households to invest in and benefit from locally produced renewable energy.

Community engagement is going to be vital in order to achieve the carbon reduction goals and maximise the benefits of the energy transition at the local level. The concept of community energy can be empowering. The chance for everyday people to own, develop or receive tangible benefits from renewable energy projects can be a huge catalyst for the transition to the new energy future.

Without the local focus, opportunities will be missed for local jobs and skills development, profits will go to energy companies and not local communities and the chance to build energy resilience and self-reliance will be lost.

There are many great ideas being promoted and tried in different parts of the country. Some great examples are listed below:

- Enova community battery
- Solar our Schools
- Haystacks Solar Garden
- Totally Renewable Yackandandah
- Solar Share ACT
- Melbourne solar sponge
- Hepburn wind farm

Community Scale Microgrids

Community scale microgrids can be an important part of the energy system. There are well known challenges being presented by the rapid take-up of behind the meter distributed energy. Distribution networks are facing challenges as the number of installed rooftop systems increase. The variability of these non-dispatchable energy sources create headaches for network and market operators in balancing demand and system security. This often results in suboptimal outcomes for consumers and owners of rooftop solar systems.

Community energy grids can manage these issues at a local level by increasing or delivering energy efficiency and demand management. In addition, promotion of community energy helps engage the wider community on the key challenges of the energy transition and wider climate change. Community Energy provides local communities with opportunities for more resilient networks, ownership of generation assets and savings in energy costs that would otherwise leave the local area.

Community energy is a new and emerging area that is generating a lot of interest. There are a number of communities that are trying new things and showing what can be done.

Community Energy Groups

Within the South East area, there are a number of active Community Energy Groups that are working for change and showing what can be done to empower and Repower communities with local renewable energy. Volunteer community energy groups are a growing force across the country and can be a vital hub for the development of coordinated local action. Key roles for these groups can include:

- Engage with local Councils to set targets
- Build awareness
- Implement programs
- Seek government funding and develop plans and proposals to attract large and mid-scale solar farms with the focus on local usage and investment / job opportunities
- Lobby Councils to mandate that all new developments require solar PV or equivalent permanent renewable energy usage

- Lobby Councils to mandate that all building additions/refurbishments requiring a DA include solar PV or equivalent permanent renewable energy usage
- Engage with NSW Sustainable Schools

The community energy groups that have been directly involved with the ZeroSE project are RePower Shoalhaven, Southcoast Health and Sustainability Alliance and Climate Action Monaro. You can get more information about their initiatives and how to get involved via the website links below:

https://www.repower.net.au/

https://shasa.com.au/

http://www.climateactionmonaro.org.au/

Community energy groups are supported by not-for-profit groups such as the Community Power Agency (https://cpagency.org.au/). Established in 2011, the Community Power Agency provides expert advice and support for the development of community energy. It has supported more than 50 community energy groups to develop and deliver their own clean energy projects. CPA is behind the #RepowerOurCommunities Campaign to lobby politicians to create community awareness of the opportunities and amplify regional voices for local power.

More support is needed to empower and enable local initiatives in community energy. Federal member for Indi, Independent MP Dr Helen Haines has been leading the way in providing this support at the Federal Level. In February 2021, Dr Haines introduced her Australian Local Power Agency Bill to Federal Parliament. This bill is based on the Local Power Plan, developed with a panel of local community energy leaders through a national community co-design process in 2020. It draws together much of the knowledge and experience of the pioneering groups that have been at the forefront of community energy development. The Bill is currently the subject of an inquiry by a parliamentary committee.

The Australian Local Power Agency proposed in the bill would work in conjunction with and will support Local Community energy in the following key areas:

- Support communities to develop their own energy projects by attracting investment capital and establishing knowledge hubs to provide local technical expertise
- The Underwriting New Community Investment scheme to underwrite locally-owned mid-scale projects
- The Community Renewable Investment Scheme to enable local communities to coinvest in new large-scale projects

The support provided in this proposed bill will provide much needed support for enabling community energy in a way that empowers local communities and helps the renewable energy transition happen for local communities and not to them

Local Government Leadership

Local government has a huge role to play in moving towards a low carbon local economy. Our councils can set an example for the community through their own initiatives as they also make it easier for local business and residents to make the transition from fossil fuel generated energy.

A really important step we should demand of our local councils is to make a commitment to Zero carbon. By setting goals around energy efficiency, renewable energy and broader sustainability, local councils can lead by example and set a local agenda for change.

The Cities Power Partnership is a network established by the Climate Council. The network already includes around 140 councils and represents almost 11 million Australians. The key aim of The Cities Power Partnership is to connect councils for sharing of information and access to a knowledge hub that provides tools and information to help councils set goals and manage their progress. In the South East; Bega Valley, Eurobodalla and Shoalhaven councils have made a commitment to switching to non-polluting energy and reducing emissions in their communities by joining the Cities Power Partnership. Some examples of their initiatives include:

- Install renewable energy (solar PV and battery storage) on Council buildings
- Support community energy projects
- Ensure Council fleet purchases meet strict greenhouse gas emissions requirements and support the uptake of electric vehicles.
- Power council operations by renewables, directly (with solar PV or wind), or by purchasing Greenpower
- Adopt best practice energy efficiency measures across all council buildings, and support community facilities to adopt these measures.

We should urge all our local councils to get on board and tap into the support provided by the Cities Power Partnership.

Another important area where local governments can enable the clean energy transition is in relation to greater support and prioritisation for development of new renewable energy projects. Community scale solar and wind farms as well as the large utility scale projects. There are several ways this can be achieved, including:

- Boost rooftop PV penetration of their sites.
- Underwrite through purchasing generation and/or invest in solar farms ideally with Community Energy Groups.
- Issue Requests for Tender or similar expressions of intent to attract renewable energy projects (having packaged up suitable land site, DA, lease and approval processes that provide a fast-track, de-risked project), ideally with significant local outcomes such as local usage, developer financial contributions to community activities.

Energy Consumption

The two key aspects of energy use that will support the transition to renewable energy and enable lower costs and improved reliability are:

- Greater efficiency
- Demand shifting

Electrifying our energy use in the key areas of heating and cooking will switch energy use from fossil fuels to an increasingly renewable energy grid. Reverse cycle air conditioners and electric heat pump hot waters systems are widely recognised as the most energy efficient options for heating. By powering these systems from behind the meter rooftop solar makes the household and businesses more self-sufficient and over time saves money by reduced energy bills.

Building new homes that are energy efficient or by retrofitting existing homes. The energy required for heating and cooling can be significantly reduced. ZeroSE has studied the options and financial benefits of household retrofitting for energy efficiency and has shown that significant financial savings can be achieved while reducing carbon footprint up to 65%.[8]

Technology is available to manage household appliances and ensure that they are used at the cheapest time of the day. By providing monitoring and control functions, Home Energy Management systems can help consumers use less energy and also shape energy use to align with times when power is more abundant and cheaper. Another important feature of Energy Management Systems will be the ability to interact with others to enable sharing of community resources such as batteries, buying and selling power from others in your local community and enabling pooling of resources in Virtual Power Plants for getting additional benefits and value opportunities from providing network services.

Electric vehicles may well be a very big and exciting part of the solution. EV charging is estimated to add a significant demand to the electricity network. This will increase as the uptake of EVs increases. Therefore, more generation is going to need to be added to the system to support this additional load. However, EVs can have great utility. EVs can provide grid services and are a source of stored energy that can supplement home and office electricity supply from the grid.

Consumers need to envisage that EV uptake is going to increase rapidly in the coming years. Ultimately all vehicles are likely to be electric. Having an EV and thinking of it as an energy asset as well as being a transportation asset, will greatly enhance recognition of its value and utility. One clear benefit will be the cost savings to households and businesses in fuel cost alone when switching from internal combustion engine to battery powered vehicles which can be charged for free behind the meter from rooftop PV. Further to this obvious benefit, the EV battery can be used to supplement power to the house or business premises or even generate revenue as part of a larger virtual power plant. To illustrate the potential of EVs for the energy future, energy companies such as Origin Energy are starting to develop products and offerings in the area of EV fleet management for their business customers.

Economic Benefits

Low Cost Energy - Residential

Solar is an excellent investment for almost all Australian households, but there are a wide range of savings, depending on the characteristics of household electricity consumption, retail tariffs and roof characteristics. Nevertheless, the majority of households installing a wide range of PV system sizes under different types of tariffs can expect a payback of between 3-7 years.[9] This is illustrated in the chart below. The time to payback the initial cost of installation is shown for different cases of self-consumption of the rooftop generated electricity. These indicative values are based on the average electricity consumption data per LGA and assume a 5.5kW system, installed at a cost of $5,500. The assumed electricity use tariff is 30 cents and the export tariff is 6 cents.

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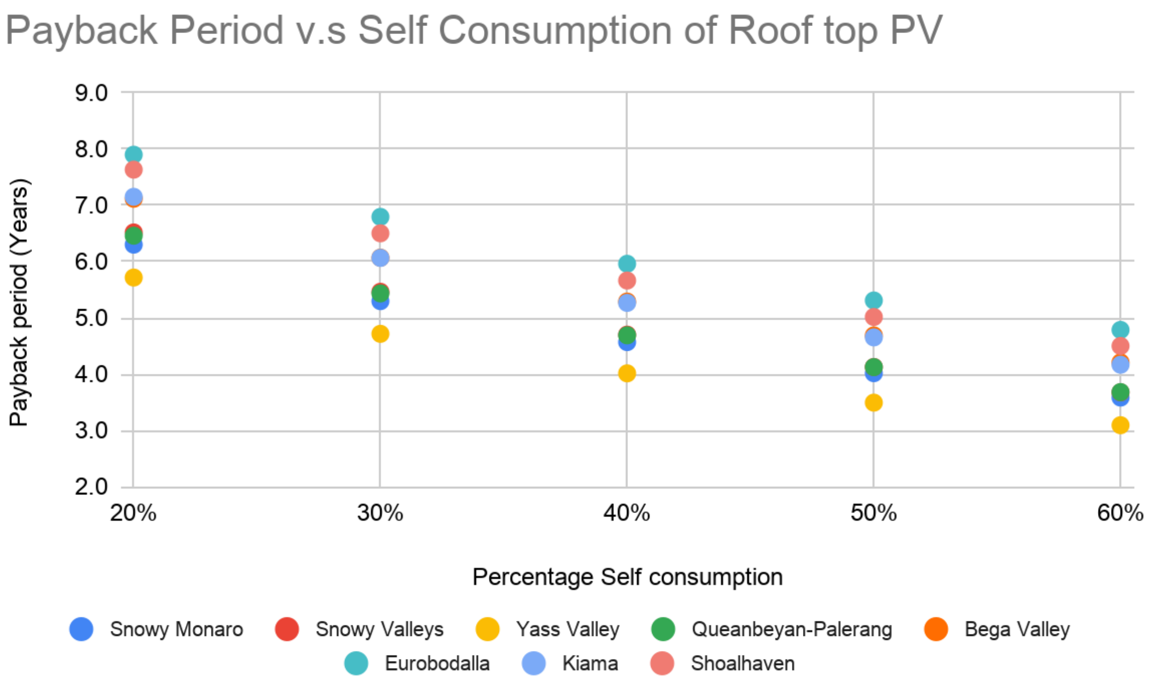
[8] See ZeroSE *Retrofits* report.

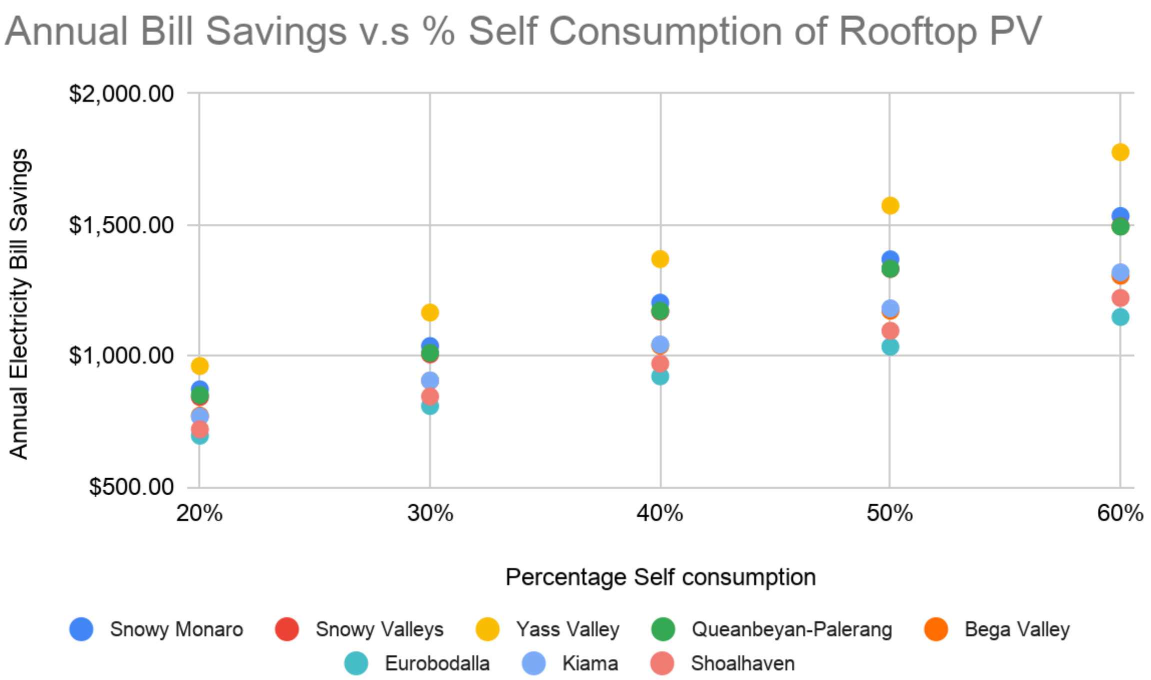
[9] UNSW adn APVI Report, Solar Trends Report for Solar Citizens. Authors: Mike Roberts, Jessie Copper, Anna Bruce, Tyce Barton, Navid Haghdadi and Rebecca Hu

Figure 7. Rooftop PV: payback period vs self-consumption



The life of a quality PV system could be expected to be 25 years. While the system may require one or two inverter replacements during its lifetime, the financial value is compelling, with annual savings in the range of $700 to $1700 per year, depending on how much is used behind the meter. This is illustrated in the chart below for a 5.5kW system.

Figure 8. Rooftop PV: annual bill savings vs self-consumption



As consumers become more aware - enabled by smarter technology and better monitoring - the ability to self-consume rooftop solar energy can be increased within the household. Appliances can be scheduled to run during times when the rooftop power is available. Similarly, consumption can be curtailed or shifted when power needs to be drawn from the grid and prices are high.

It is important to note that energy from rooftop solar is only available during the daylight hours. At other times, energy needs to come from other sources. In the future clean energy grid, this could be from household battery, the Grid or community microgrid storage.

A key point of these household savings is that the money saved on energy bills can be redirected and spent locally in the community rather than going to the large energy companies. This compounds the benefit for the local community through the local multiplier effect that has been discussed previously.

Low Cost Energy - Commercial and Industrial

As has been stated previously, business installation of solar offers great potential because energy use is typically during the daylight hours. Because of this most of the power will be used behind the meter which maximises the energy bill savings.

Tenure is the biggest barrier to commercial rooftop solar. Rented premises generally do not have PV, because the building owner - who would typically make the investment - cannot easily capture the benefits of reduced electricity bills, which are the responsibility of the occupant.

New methods are required to share the benefits between tenant and landlord if this sector is to contribute to the required goals of emission reduction and benefit from the costs savings of behind the meter rooftop PV. Some of the key opportunities are described in the next section.

Local Jobs in Installation, Maintenance, Replacement of Small-Scale Generation

Transition to renewable energy will create new employment opportunities in the local region. Some of the opportunities directly associated with the installation of new generation and storage systems include:

- Small scale solar
- Medium scale wind and solar
- Grid scale wind and solar
- Battery system installation
- Pumped Hydro
- Building efficiency retrofits
- Education and training
- Small scale system maintenance and end of life replacement
- Large scale system maintenance

The tables below provide a basic illustration of the size of the small and medium scale construction sector that would be required to meet our minimum emission reduction goals over the next 9 years to 2030. Estimates show the number of jobs and the investment required to achieve our local contribution to the emissions reduction goals. These estimates do not include the larger grid scaled project construction, operation and maintenance or other supply chain roles. If the demand can be met by local business, this shows some of the additional value to the local economies in the South East.

Table 12. Number of PV installations per year to reach 2030 emissions reduction goal

No. Installs per year	**Snowy Monaro**	**Snowy Valleys**	**Yass Valley**[10]	**Queanbeyan-Palerang**	**Bega Valley**	**Eurobodalla**	**Kiama**	**Shoalhaven**
Residential	**464**	**382**		**1337**	**427**	**437**	**194**	**1655**
Commercial (assume 75% of C&I)	28	19		48	35	25	20	77
Industrial (assume 25% of C&I)	9	6		16	12	8	7	26
Community scale systems	0.4	0.5		0.5	0.4	0.4	0.3	0.5

Table 13. Number of PV installation jobs in reaching 2030 emissions reduction goal

Jobs	**Snowy Monaro**	**Snowy Valleys**	**Yass Valley**	**Queanbeyan-Palerang**	**Bega Valley**	**Eurobodalla**	**Kiama**	**Shoalhaven**
Residential (60% rooftops)	7	5		19	6	6	3	24
Commercial (assume 75% of C&I)	2	1		3	2	2	1	5
Industrial (assume 25% of C&I)	2	1		3	2	2	1	5
Community scale systems	1.2	1.5		1.5	1.2	1.2	0.9	1.5
Total # Jobs	12	9		27	12	11	6	35

Table 14. PV investment required per year to reach 2030 emissions reduction goal

Investment per year ($ million)	**Snowy Monaro**	**Snowy Valleys**	**Yass Valley**	**Queanbeyan-Palerang**	**Bega Valley**	**Eurobodalla**	**Kiama**	**Shoalhaven**
Residential (60% rooftops)	$2.55	$2.10		$7.36	$2.35	$2.40	$1.07	$9.10
Commercial (assume 75% of C&I)	$0.99	$0.66		$1.66	$1.21	$0.88	$0.70	$2.68
Industrial (assume 25% of C&I)	$1.13	$0.76		$1.90	$1.39	$1.01	$0.81	$3.06
Community scale systems	$0.72	$0.90		$0.90	$0.72	$0.72	$0.54	$0.90
Total Investment per year	$5.40	$4.42		$11.82	$5.67	$5.02	$3.12	$15.74

Local Benefits of Large-Scale Renewable Generation

At the local level, there is considerable benefit from having grid scale renewable projects being developed.

[10] The method used for this estimate suggests Yass Valley already has sufficient rooftop PV installed to meet 2030 targets. This may be due to the simplifying assumptions used for this relatively small LGA. Further investigation is required to confirm that this is the case.

The Boco Rock Stage 1 wind farm in Eden Monaro LGA has a capacity of 113MW produced by 67 turbines and has been operating since 2015. While the electricity produced by the wind farm is not necessarily used locally, for comparison purposes, the facility produces renewable energy equivalent to 1.3 x the total energy used in the Eden Monaro Shire.

Large projects like the Boco Rock wind farm backed by storage such as the Snowy 2.0 pumped hydro station will replace NSW coal fired stations as they are retired.

As well as being vital for the clean energy transition, these projects can provide many benefits to the local communities where they are constructed. Some of the benefits include:

- Local landowners earn ongoing revenue from lease fees where wind turbines are located
- A Community Enhancement Fund providing hundreds of thousands of dollars each year for the life of the wind farm in grants for community groups to deliver improvements to community infrastructure and services, sustainability initiatives and opportunities for local economic and tourism development
- Ongoing jobs in the operation and maintenance of the wind farm.

Construction of wind farm projects typically takes 2 years and employs in the order of 200 workers. While many of the construction jobs are specialist trades that come from out of the area, there are flow on effects to the community from families moving to the area and from money spent on food, fuel, accommodation and recreation. The flow-on effect of these large projects means that there is a compounding effect. For every external dollar that comes into the local economy, a portion is spent and re-spent in the local area, effectively multiplying the value for the community.

Wind and solar farms have not always been popular with local residents. Local support is a key element in getting these projects approved. When communities see the economic benefit and the environmental drivers for moving from fossil fuel to renewable energy, there is greater likelihood of acceptance and positive outcomes for the community.

Another example of a vital component of the renewable energy grid being constructed in our region is the Snowy 2.0 pumped hydro project. This 2000MW station will provide a big portion of the necessary system storage to complement and firm the capacity of the new wind and solar renewables. The construction process is expected to extend to 2026. Some key figures illustrating the benefit to the local region from this project are listed below:

- Investment locally in the Snowy Mountains area (Snowy Mountains Regional Council and Snowy Valleys Council areas) by Snowy Hydro and the lead contractor; Future Generation is more than $35 million.
- Around 150 local businesses (ie SMRC and SVC) have been involved to date with both SHL, FG and Leed Engineering and Construction (which completed the Snowy 2.0 early works roads package July 2020).
- The project will generate about 4000 jobs over the life of the project (not including supply chain roles).
- Over 500 people are currently employed on Snowy 2.0 including site based roles at Lobs Hole, Tantangara and Polo Flat, plus office-based roles.
- Future Gen will be filling a minimum 300 more jobs by March 2021 (with others to follow).

Summary - What Can We Do?

Achieving the goal of decarbonising the electricity grid is in some ways the most straightforward opportunity that we have to reduce carbon emissions. We have the technology and some established momentum in the right direction. Switching to renewables is not only good for the environment but also can provide cost savings if done well.

This report has provided an illustration of what needs to be done at a local level to reach the goal of 50% of 2010 levels by 2030 by achieving a 4.55% reduction in CO2 emissions from electricity use per year.

Householders and Business:

Switch to Renewable Energy

- If you have the means and a suitable roof, installing rooftop Photovoltaic (PV) can save you money and contribute in a tangible way to the transition of the energy system from fossil fuel to renewables.
- If you can't install your own rooftop PV system, you can participate in other ways such as community solar gardens (e.g. Haystacks)
- Switching to "GreenPower Accredited" via your existing energy retailer will ensure that all your electricity from the Grid comes from Government accredited new renewable sources. GreenPower Accredited is a way to "vote with your wallet". It costs a bit more but helps reduce greenhouse gas emissions by ensuring your electricity use is matched with clean energy from renewable sources.

Reduce Energy Consumption

Reduced energy consumption is an important part of the solution to reducing carbon emissions. While some may be prepared to simplify their lifestyle to achieve this aim this is not the only way. Reduced consumption and cost savings can also be achieved by the improved awareness of energy waste and inefficient use that comes with having better access to data that usually accompanies installing rooftop PV. By being aware of when is the best time to use power demanding appliances at the lowest cost, can significantly reduce power use without a significant lifestyle change.

Local Government

Our local governments can provide visible leadership by prioritising sustainability and renewable energy projects for their own operations and also make it easier for local business and residents to make the transition from fossil fuel generated energy through development application and approval processes. Town planning can identify and zone suitable local land for renewable generation use.

As stated earlier, by setting zero emissions targets and joining networks such as the Cities Power Partnership, local councils can lead by example, become a knowledge hub for the community and set a local agenda for change.

Community Energy Groups

Volunteer community energy groups are a growing force across the country and can be a vital hub for the development of coordinated local action. Key roles for these groups can include engaging with local Councils to set targets, building community awareness and implementing projects and programs that help with the construction of more local distributed renewable energy.

Getting behind the #RePowerOurCommunities campaign to lobby politicians and create community awareness of the opportunities will amplify regional voices for local power.

Appendix 1: Method Used to Calculate the Future Solar Photovoltaic Installation Requirements for ZeroSE

Introduction

This is a description of the method used to estimate the future requirements for rooftop solar and community solar farms to meet the emission reduction targets outlined in the ZeroSE Electricity Report. This method was applied to the eight local government areas within the Gilmore and Eden Monaro Federal Electorate areas.

The key premise of the calculation is a requirement to meet the Intergovernmental Panel on Climate Change (IPCC) target to cut world emissions to 45% of 2010 levels by 2030 and achieve net-zero in 2050 to keep the world average temperature increase to 1.5 degrees Celsius. For the purpose of this analysis, a more ambitious target is assumed for the electricity sector. The renewable electricity transition is well underway and industry predictions indicate 40 to 50% renewables in the grid by 2030. A target of 50% reduction of 2010 emissions from electricity by 2030 will be used. This equates to a year-on-year reduction in emissions per year from 2020 until 2030 of 4.55% per year of the 2019 value.

The purpose of this estimate is to provide a general indication of the amount of locally generated renewable energy that would provide the required emissions reduction. From this an indication of the investment required to achieve this and the jobs that would be generated is determined. It is acknowledged that a significant increase in renewables at the large scale "Grid" level will also be required. For the purpose of the calculation in this report it is assumed that the Grid as a whole will have 45% of generation coming from renewable sources by 2030.

The estimate has been calculated in a Google Spreadsheet. The method of calculation is described below.

Method

1. Project the 2030 MWh use, based on 2019 MWh and a growth factor (1%)
2. Determine the Target CO2 emissions based on 2019 data and the required reduction pa (4.55%)
3. Based on the expected MWh consumption in 3030, empirically determine the % mix of local Distributed Energy Resource DER (100% renewable) and Grid Power (assumed 45% renewable). The required % of local DER is achieved when the resulting CO2 emission are less than or equal to the target value
4. Calculate required local DER MWh.
5. Empirically determine (by substitution) the required percentage of rooftops for residential and C&I + number of Community solar farms to deliver the required local MWh of renewable energy.
6. Subtract the existing number of installations in 2020 from the required no. installations in 2030 to determine the required rate of installations (row 65, 66, 67)
7. Calculate labour hours per year based on the number of installs
8. Calculate Jobs based on the required labour hours per year
9. Calculate annual investment based on the number of installs multiplied by the assumed system costs.

Simplifying Assumptions

The calculations are based on some simplifying assumptions:

1. Grid supplied energy is related to CO2 emissions by the Carbon Dioxide Equivalent Intensity Index (CDEII). e.g. 1 MWh of energy from the grid with CDEII 0.55 would produce 55 tonnes CO2
2. For existing installed system numbers provided on the Australian PV institute website:
    - Photovoltaic systems sized < 10 kW are residential
    - Photovoltaic systems sized 10 to 100 kW are commercial and industrial
3. Growth in demand for electricity use from 2019 to 2030 is 1% p.a.
4. Growth in residential dwellings is extrapolated from past Census data
5. The required % number of rooftops for residential and commercial & industrial is the same
6. Assumptions for New photovoltaic installations:

PV System	Size (kW)	System Cost ($)	Labour (hours)
Residential	5	5,500	25
Commercial	30	35,000	110
Industrial	100	120,000	350
Community	1000	1,800,00	5000

Data Sources

The data for these estimates have been taken from the following key sources:

1. Snapshot Climate website carbon dioxide emissions data was used to derive electricity use
2. AEMO website for Carbon Dioxide Equivalent Intensity Index data
3. Australian Bureau of Statistics ABS.Stat website (for 2019 industry data)
4. Australian Bureau of Statistics Census QuickStats (for population and dwelling data)
5. Clean Energy Regulator website for postcode Photovoltaic (PV) installation data[1]
6. Australian PV institute website for PV installation data