Opportunities for Australian solar neighbourhood planning following COVID-19

Source: Randy L. Martin

Introduction

The COVID-19 pandemic has initiated an accelerated realisation of the importance of how we source and consume energy in our daily lives. Widespread household lockdowns have placed an abrupt pause on travel, economic activity, employment certainty and social interactions that has impacted energy usage patterns and initiated environmental flow on effects. A sudden change in urban behaviour has allowed us to better understand local and global impacts and the gaps and vulnerabilities of existing energy systems.

This paper provides an Australian perspective of urban energy usage within the global context and explores the role solar neighbourhood planning has in driving resilience and stimulating economic recovery towards safeguarding societal values and needs we often take for granted.

About the Australian PV Institute (APVI)

The Australian PV Institute (APVI) is a not-for profit, member-based organisation providing data analysis, reliable and objective information, and collaborative research to support the uptake of solar photovoltaics and related technologies. APVI promotes PV through its live solar mapping platform (http://pv-map.apvi.org.au), organises Australia's national solar research conference, and coordinates Australia's participation in two International Energy Agency programs Photovoltaic Power Systems (PVPS) and Solar Heating and Cooling (SHC).

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Energy and Cities – the pandemic wakeup call

When we think about energy and cities, there are a range of factors and approaches that help us understand what is happening across the world. On the one hand, cities characterise the urban concentration of world population and economic growth and on the other, they epitomise the insatiable demand for resources and societal needs to live prosperous lives. With this comes expectations of having access to essential services, housing and employment opportunities, all requiring an abundance of reliable and affordable energy.

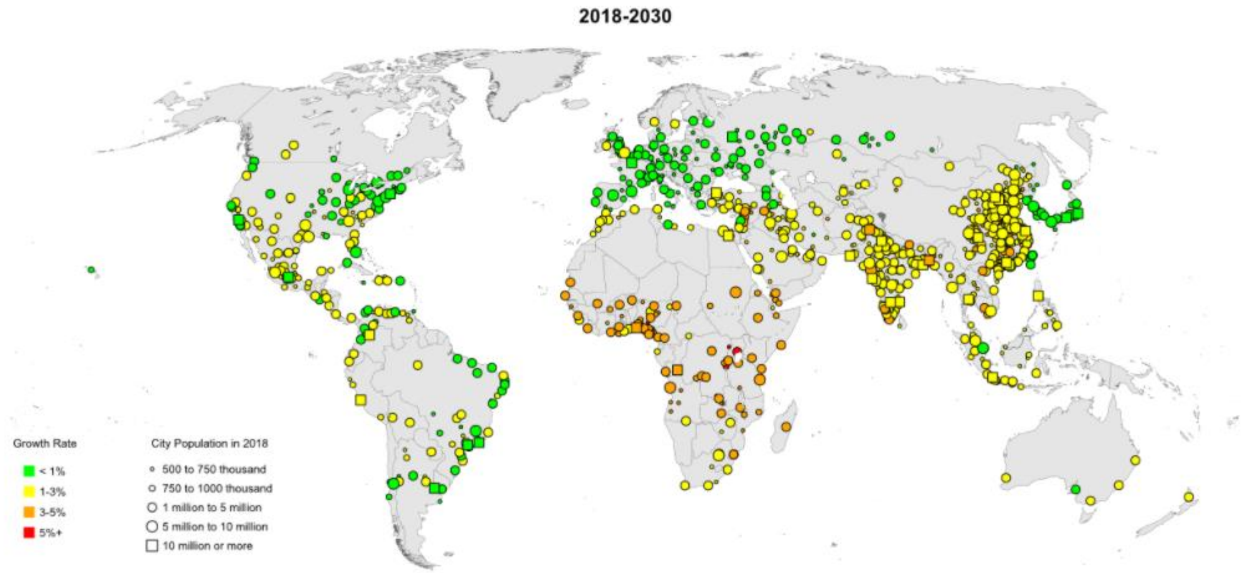
Over 40 years ago, a pioneering UNESCO Man and the Biosphere study of Hong Kong (Boyden et al 1981) made one of the first comprehensive strides to understand the quantum and impact of energy flows in cities (extrasomatic energy distinct from somatic energy[1]). More recent work, with cities looking to set and track renewable targets, have undertaken measurable energy planning activities at an urban scale (Thellufsen et al, 2020; REN21, 2021; ICLEI, 2021; Energy Cities, 2021, C40 Cities, Rockefeller 100 Resilient Cities). These efforts are all intrinsically linked in order to achieve sustainable development goals (SDGs) as defined by the United Nations (https://sdgs.un.org/goals) particularly through the use of affordable, clean energy (SDG7) and initiatives that promote sustainable cities and communities (SDG11).

The advent of the COVID-19 pandemic has compelled us to think about the way we live, what we often take for granted, what we now consider as important and how actions now can mitigate risks and challenges associated with the security, reliability and affordability of energy and how this will impact our quality of life into the future.

Global context

As of 2018, 55% of the total global population, which equates to around 4.2 billion people, were living in urban areas, up from 30% (751 million people) in 1950. By 2050, the United Nations (UN) predict 68% of the world's population will reside in urban areas. This is around 6.7 billion urban inhabitants, an increase of 2.5 billion people (UN DESA, 2018).

Global city population growth projections from 2018 to 2030



Source: World Urbanisation Prospects: The 2018 revision, United Nations, DESA, Population Division https://population.un.org/wup/Maps

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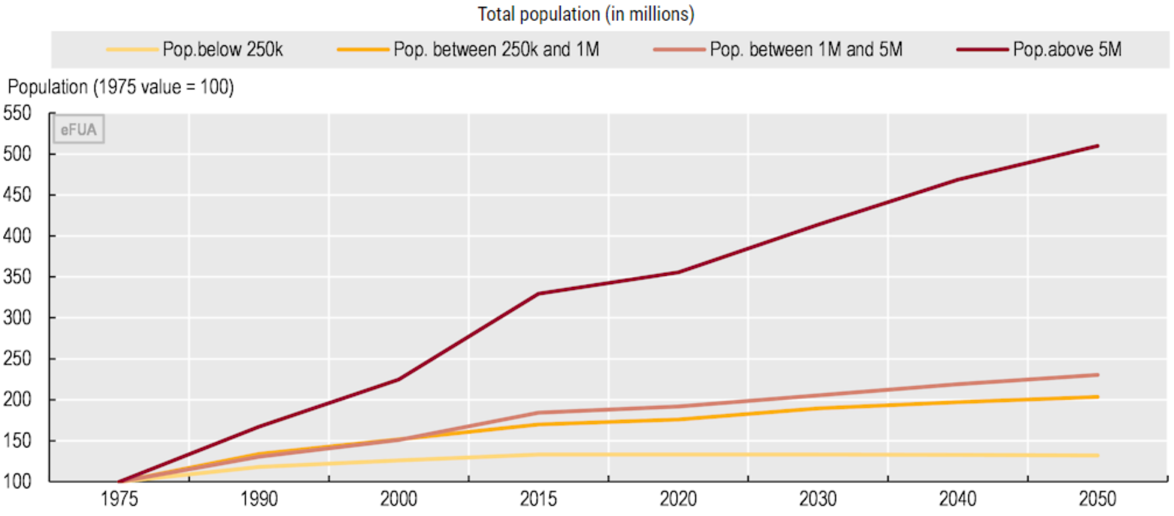
[1] With the progression of civilization, technological innovation and living standard expectations, the energy demands of cities have risen exponentially over recent decades. Boyden (1987) aptly described the last 8 generations (200 years) as the high-energy phase of human existence with the transition from somatic energy (coming from food used in the human body) to extrasomatic energy (outside of human bodies via fossil fuels used to drive machines for performing various kinds of physical work).

These are staggering numbers with projections expecting significant growth in Asia and Africa as displayed in the map above. Currently, the most urbanised regions include Northern America (with 82% of its population living in urban areas in 2018), Latin America and the Caribbean (81%), Europe (74%) and Oceania (68%). The level of urbanisation in Asia is now approximating 50%. In contrast, Africa remains mostly rural, with 43% of its population living in urban areas.

The Organisation for Economic Cooperation and Development (OECD) has tracked since 1975 population numbers in functional urban areas (FUAs)[2]. This is helpful to understand where anticipated growth is predicted to occur. Numbers for FUAs provided in the graph below between 1 and 5 million inhabitants is estimated to increase by over 45% over the next 30 years, reaching 1.5 billion by 2050. This has significant planning implications with continued densification of existing large cities but also further development pressure at the periphery of metropolitan areas and commuter corridors.

Changes in global population in FUAs, 1975-2050



Source: OECD (2020), World Cities Tool (database), OECD, Paris, http://www.worldcitiestool.org

Recent Global Energy impacts from COVID-19

According to latest International Energy Agency (IEA) data (IEA, 2021) the COVID-19 pandemic has resulted in the most substantial decline in global emissions since the second world war. Primary energy demand decreased by 4% in 2020 with substantial reductions in oil demand (8.6%) and coal (4%) accounting for the majority of energy related global CO_2 emissions dropping by 5.8%. This is equivalent to removing all of the European Union's emissions from the global total in one go.

By contrast, the global electricity generation mix over the last 10 years has seen the share in renewables increase from 20% in 2010 to 29% in 2020, an increase of 2% compared to 2019. Despite the shock of the pandemic, renewables accelerated their expansion in 2020, with a 50% increase in their contribution to lowering power sector emissions relative to 2019.

In terms of energy consumption, commercial energy demand has declined proportionate to lockdown stringency, with an uptrend in residential energy demand following working from home requirements. As demonstrated by McWilliams and Zachmann (2020) and Menezes, et.al (2021), electricity consumption data can provide useful real-time insights on the economic impact of the pandemic. According to Farrow (2020) residential electricity demand in Australia during the lockdown in March 2020 increased 14%

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[2] Functional urban areas (FUAs) are composed of a city and its commuting zone and encompass the economic and functional extent of cities based on daily people's movements (Dijkstra et al., 2019).

compared to that in pre-lockdown. Jiang, *et. al*. (2021) provide a comprehensive review of research findings on the impacts of COVID-19 on energy demand and consumption with the following relevant observations:

- shifts have occurred to peak time electricity demand with households using more electricity during the beginning of the week with demand for regular morning peak periods declining
- energy supply from fossil fuel energy decreased but renewable energy consumption increased
- energy poverty and household pressures from increased residential energy bills have been exacerbated by the pandemic
- energy consumption behaviours correlate to measures to control the pandemic, with demand returning to previous levels around 3 months after relaxing lockdown measures
- private car usage initially increases higher than expected after lifting of lockdown following reduced confidence in using public transport
- significant reduction in energy demand in localised areas threatens the stability of existing electricity networks and requires a fundamental rethink on how energy systems should be structured into the future.

From an urban perspective, the pandemic lockdowns and travel restrictions ushered in a short period of clear skies for city inhabitants not seen in China since industrial production was halted during the Beijing Summer Olympic games in 2008. Recent research from the World Bank (2020a) and Chossière *et. al*. (2021) has predominantly highlighted a marked drop in nitrous dioxides of more than 40% linked predominately from primary pollutants (transport pollution being a major contributor) and localised reductions on secondary pollutants such as fine particulate matter ($PM_{2.5}$) and ozone in areas of higher lockdown stringency.

As reported by IQAir (2020), cities with typically higher average $PM_{2.5}$ levels and denser populations tended to observe the most significant $PM_{2.5}$ reductions from COVID-19 lockdown measures. Delhi (-60%), Seoul (-54%) and Wuhan (-44%), for example, all observed substantial drops during their respective lockdown periods as compared to the same time frame in 2019. Los Angeles experienced a $PM_{2.5}$ reduction of -31% during its lockdown period as well as a record-breaking stretch of air quality that met WHO air quality guidelines ($< 10\ \mu g/m^3$).

The World Bank (2020b) identified a number of opportunities to build back sustainable and healthier cities as a consequence of COVID-19. More broadly, findings have shown the pandemic requires new and innovative planning to protect and manage the flow of people in public spaces, a reassessment of how urban neighbourhood density is considered to reduce concentration of floor space and overcrowding and a shift to smart energy approaches that builds energy supply resiliency and investments that deliver healthy and more liveable urban neighbourhoods.

Pathway to Net Zero Energy by 2050

Considering the global climate imperative to pursue Net Zero Energy by 2050, this will require global energy demand in 2050 to be around 8% smaller than today but for it to serve an economy that is more than twice as big, catering for an additional 2 billion urban inhabitants. The IEA (2021a, 2021b) has set a well-defined and measurable roadmap for the global energy sector requiring:

- a major push to increase energy efficiency and zero-carbon-ready buildings[3]
- scaling up renewable energy generation to power buildings and transportation

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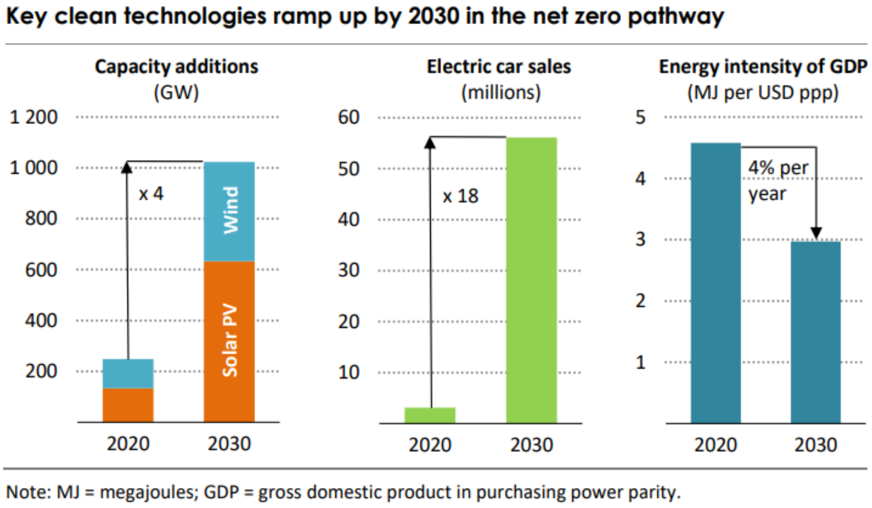
[3] A zero-carbon-ready building is highly energy efficient and either uses renewable energy directly, or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heat. This means that a zero-carbon-ready building will become a zero-carbon building by 2050, without any further changes to the building or its equipment (IEA, 2021b, p143).

- rapid transition to electric transportation.

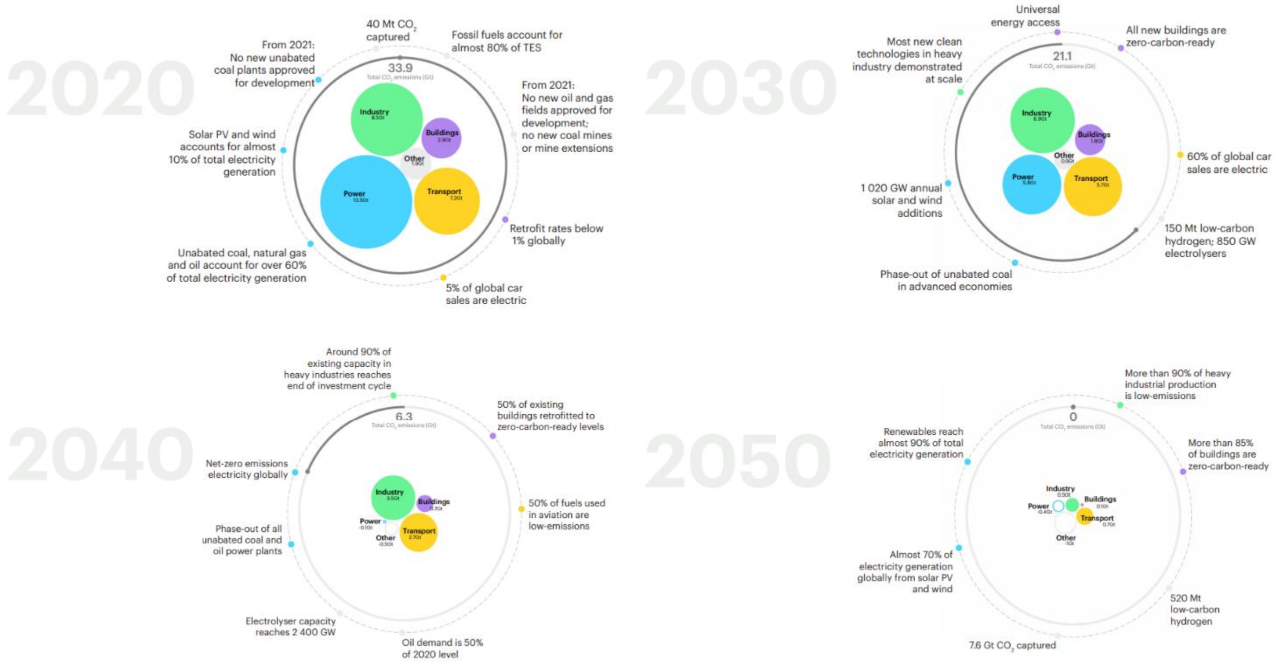
The graph below illustrates the global energy sector effort and ramp up of key clean technologies required by 2030 to support a world economy some 40% larger than today using 7% less energy.



Note: MJ = megajoules; GDP = gross domestic product in purchasing power parity.

Source: IEA (2021b), p15

For each decade, the representation below presents milestone requirements to achieve net zero energy by 2050. This will result in electricity accounting for almost 50% of total energy consumption and a 20-fold increase in Solar-PV capacity by 2050.



Source: Net Zero Emissions by 2050 Interactive www.iea.org/reports/net-zero-by-2050 (TES = Total Energy Supply)

The role solar neighbourhoods play will have a major bearing on reaching this goal. It is abundantly clear from recent Climate Economics Index reporting from one of the largest reinsurance company Swiss RE, the consequences of not addressing climate change and meeting net zero energy targets could slice around 11-14% off global economic output by 2050 - amounting to as much as US$23 trillion in reduced annual global economic output worldwide as a result of climate change (SwissRe, 2021).

Furthermore, an interactive flood zone map produced by Climate Central presents a sobering visualisation of the threats posed by sea level rise by showing land projected to be below annual flood levels in 2050. Of note, C40 Cities predict in 30 years' time, over 570 low-lying coastal cities could face projected sea level rise by at least 0.5 metres putting over 800 million inhabitants at risk. A recent US study by Buchanan *et.al.*, 2020 estimate more than 24,000 affordable housing units in the United States could be flooded at least once a year in 2050 compared to around 8,000 in 2000.

Solar neighbourhood planning

Neighbourhood planning or neighbourhood development planning is a consultative process that sets out the vision and policies for the use and development of a locally defined area. It often is part of a wider Local, City or Regional Plan that allocates sites or land use zones for different development or redevelopment purposes and specifies planning guidance and controls in accordance with legislative requirements.

A neighbourhood can be defined as a group of buildings or urban precinct/district with a spatially identifiable area often including different types of buildings and functions, open space and infrastructure. Its size is typically associated with a community of inhabitants who have a logical spatial interaction or geo-cultural identity. In city planning, these are often characterised as, for example, suburbs, industrial estates, business centres, campuses and precincts.

Solar neighbourhood planning focuses on creating environments which maximise energy (resource) self-sufficiency through urban design that:

- embraces appropriate levels of **passive solar gain** (heating and lighting) and
- protects adequate **solar access**
- encourages **natural ventilation and urban cooling** (smart urban form that uses water, vegetation cover and low emissivity building materials)
- sets high standards in building **energy efficiency and energy demand management**
- enables the increased use of **onsite renewable energy sources** as balanced power generation to meet local transportation and neighbourhood energy needs
- plans sufficient **energy system integration of battery storage infrastructure** (smart microgrids).

These considerations are core to a recently commenced International Energy Agency (IEA) Solar Heating and Cooling (SHC) work programme Task 63 on Solar Neighbourhood Planning as represented in the illustration below.

Six different ways to use an urban surface to provide sustainability across cities

Source: IEA SHC Task 63 (2020) highlights contributed as an extension of work from Croce and Vettorato (2019)

Task 63 work activities are aimed at supporting developers, property owners, architects, urban planners, municipalities and other key players achieve solar neighbourhoods as a core contribution to sustainable and healthy environments. These include four main topics of focus, being:

A. Solar planning strategies and concepts for achieving net zero energy/emission neighbourhoods
B. Economic strategies, including added values and stakeholder engagement
C. Solar planning tools for new and existing neighbourhoods
D. Case studies and stories for wider dissemination in consultation with key stakeholders.

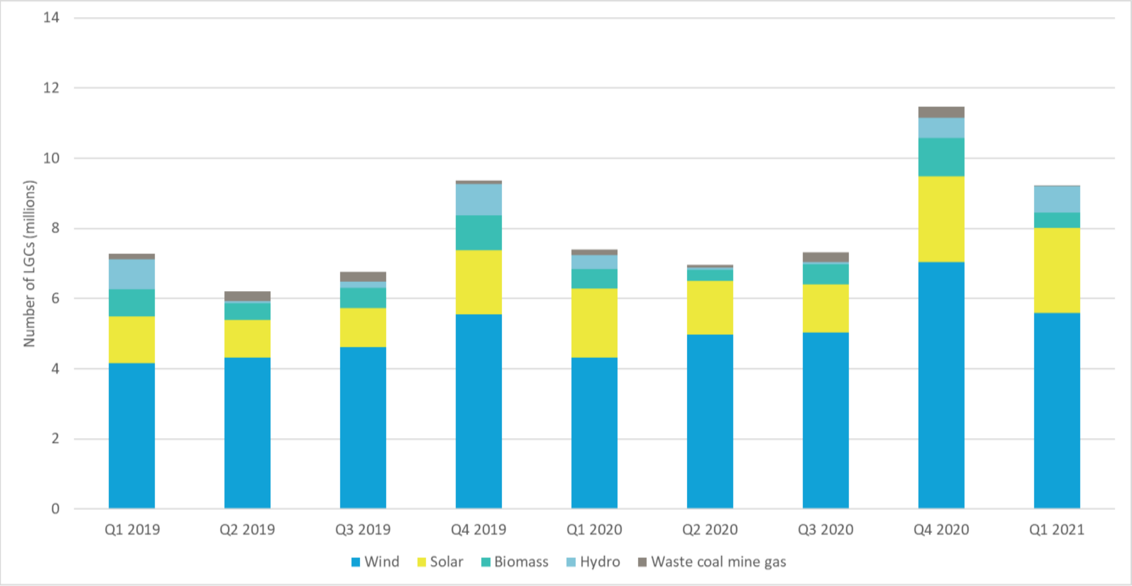
Australian renewables, solar market penetration and present challenges

Large Scale renewables

With an abundance of natural renewable and non-renewable energy resources, Australia is both resource rich but also highly exposed to extreme climate change impacts. Given more than a decade of federal politics infighting, national Australian energy policy indecision and consequently market uncertainty, much of the heavy lifting in meeting emissions targets has fallen at the feet of Australian households and businesses with support from the Renewable Energy Target (RET) established in 2001.

The RET has two main schemes, one being the Large-scale Renewable Energy Target (LRET) where high-energy users surrender a fixed proportion of their electricity from renewable sources in the form of large-scale generation certificates (LGCs) or are liable to financial penalties after a 3-year period.

LGCs validated by technology type, Q1 2019 to Q1 2021



Quarter	Wind	Solar	Biomass	Hydro	Waste coal mine gas
Q1 2019	4,163,383	1,325,825	784,269	839,688	169,615
Q2 2019	4,310,490	1,070,199	478,893	57,938	284,535
Q3 2019	4,608,738	1,114,407	586,299	170,849	278,078
Q4 2019	5,555,545	1,818,946	1,001,089	879,547	117,768
Q1 2020	4,313,812	1,973,944	545,611	403,025	161,286
Q2 2020	4,974,714	1,526,406	327,152	57,458	82,299
Q3 2020	5,023,838	1,387,380	562,685	58,210	290,632
Q4 2020	7,038,530	2,447,583	1,092,288	581,376	304,751
Q1 2021	5,585,594	2,424,731	432,716	751,496	11,028

Source: Clean Energy Regulator (CER) Quarterly Carbon Market Report - March 2021 (CER, 2021, p21)

The above table provides a quarterly view of LGCs by technology type showing a continued growth in solar compared to previous quarters with annual increases of around 35% from solar LGCs (systems sized upwards of 100 kW) and 15% from wind technology sources. Each LGC equates to 1 megawatt hour (MWh) of eligible generated electricity.

From an urban neighbourhood perspective, a number of Australian local jurisdictions have entered into long term Power Purchase Agreements (PPA) with a renewable energy supplier. Good examples of this include the University of NSW (UNSW) in 2018 entering into a 15-year Solar PV Corporate PPA agreement with a large scale 255MW solar farm near Balranald in south-western NSW sourcing 125 GWh of renewable energy per annum from 52MW of single axis tracking solar power since it was connected in November 2020. A 3-year retail firming contract was also negotiated with a utility to manage solar production intermittency and allow UNSW to become fully energy carbon neutral with 100% of its energy needs supplied by solar PV.

Also, City of Melbourne as part of its Climate Active Emissions Reduction Plan teamed up in 2020 with large energy consumers to source 110 GWh per annum of wind power under the Melbourne Renewable Energy Project (MREP 2) initiative. This provides electricity price certainty over a 10-year period with the renewable energy used to power 14 shopping centres, 9 office buildings, 7 city-based educational campuses and 4 manufacturing facilities across greater Melbourne.

These initiatives are currently benefiting from the LGC scheme which has reached its June 2015 reduced federal government target of 33,000 GWh, with LGC prices likely to fall significantly by the time the RET expires in 2030 as new capacity is added to the scheme. Unfortunately, headwinds through long network connection delays have also become commonplace for largescale renewable projects as the electricity network plays catch up in managing grid congestion and setting reasonable connection requirement conditions. This uncertainty creates barriers to market investment and legal disputes as to who takes the cost burden for commissioning delays.

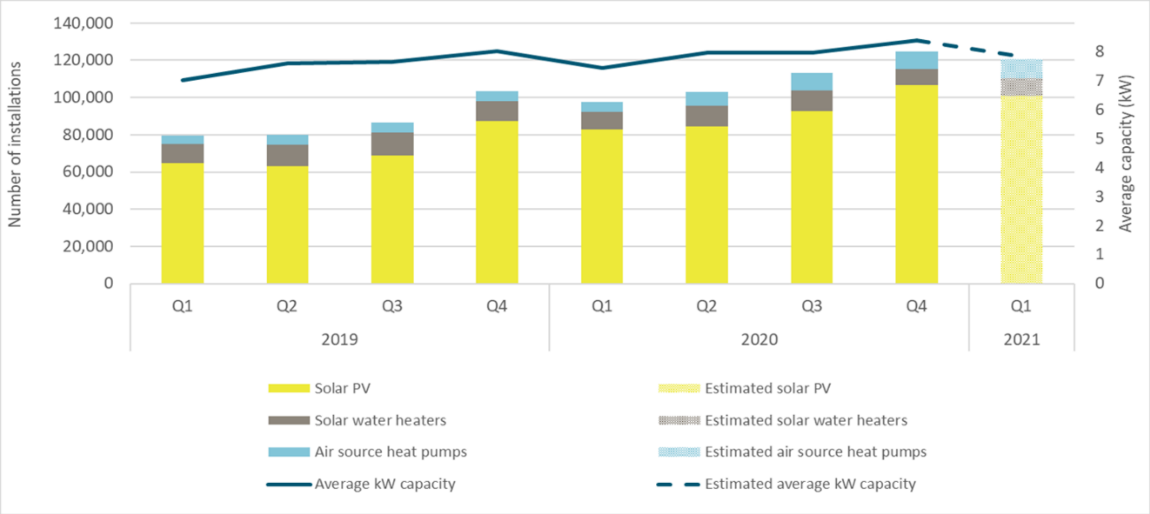
More recently, at Deakin University's Waurn Ponds Campus in Geelong, an onsite microgrid comprising a ground mounted 7 MW single axis tracking solar farm has been constructed on 14.5 hectares at the rear of campus combined with a behind the meter 2 MWh lithium iron phosphate battery storage, 250 kW of distributed rooftop solar on university buildings as well as a series of smaller battery systems with a collective capacity of 30 kWh. This will directly supply around 54% of the Waurn Ponds Campus' current power consumption and is a long-term investment in power generation assets the university will own outright. Numerous other universities and local governments are following similar microgrid paths, including ramping up onsite power generation and battery storage systems, thereby maximising their landuse assets and reducing reliance on centralised energy generation and high voltage network infrastructure.

Small-scale systems

The other RET scheme is the Small-scale Renewable Energy Scheme (SRES) providing financial incentives which reduce each year up until 2030 for individuals and businesses to install SRES such as rooftop solar, solar water heaters and air sourced heat pumps. Small-scale technology certificates (STCs) are created on the date of installation based on expected output determined by the system size and geographical climate zone location.

The below bar graph represents the number of SRES installations and average system size for PV systems below 100kW, solar water heaters and air sourced heat pumps and an estimate for the first quarter of 2021. At the beginning of the year there is typically a drop in the upward trajectory as consumers bring forward their purchase decisions before the deeming period drops each year from 1 January.

SRES installations and average kW capacity from Q1 2019 to Q1 2021

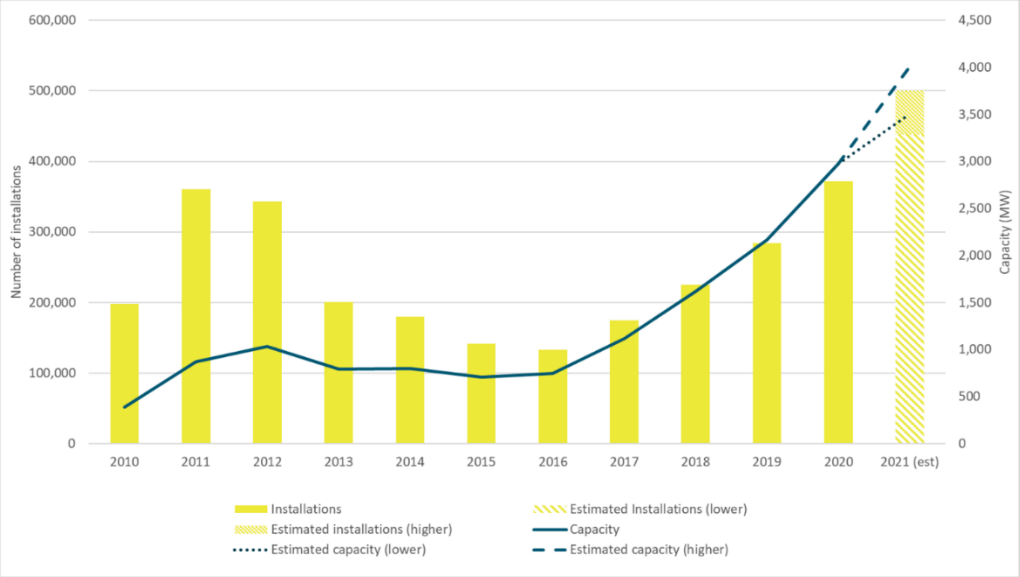


	2019				2020				2021
No. of SRES Installations	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1 (estimate)
Solar PV (No.)	64,839	62,895	69,036	87,224	83,002	84,550	92,868	106,642	101,078
Solar Water Heaters	9,968	11,655	11,943	10,706	9,306	10,884	10,807	8,823	9,328
Air Source Heat Pumps	4,819	5,521	5,345	5,400	5,215	7,644	9,586	9,178	10,037
Average kW capacity	7.0	7.6	7.7	8.0	7.5	8.0	8.0	8.4	7.8

Source: Clean Energy Regulator (CER) Quarterly Carbon Market Report - March 2021 (CER, 2021 p35)

Despite reduced activity during the lockdown periods, solar installations nationally continue to increase on year on year as presented in the graph below.

Small-scale solar PV installations and capacity (MW), 2010 to 2021



Installation year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 (Lower est)	2021 (Higher est)
Installations (No.)	198,208	360,745	343,320	200,407	180,139	141,500	132,696	174,941	224,850	283,994	372,061	437,350	499,850
Capacity (MW)	390	872	1,036	792	800	706	748	1,119	1,617	2,165	2,977	3,500	4,000

Source: Clean Energy Regulator (CER) Quarterly Carbon Market Report - March 2021 (CER, 2021 p34)

This is also reflected in the growth of renewables as percentage of primary fuel source and reduction of electricity generation emissions as shown in the table below.

Electricity generation by primary fuel source (Grid-connected designated generation facilities[4])

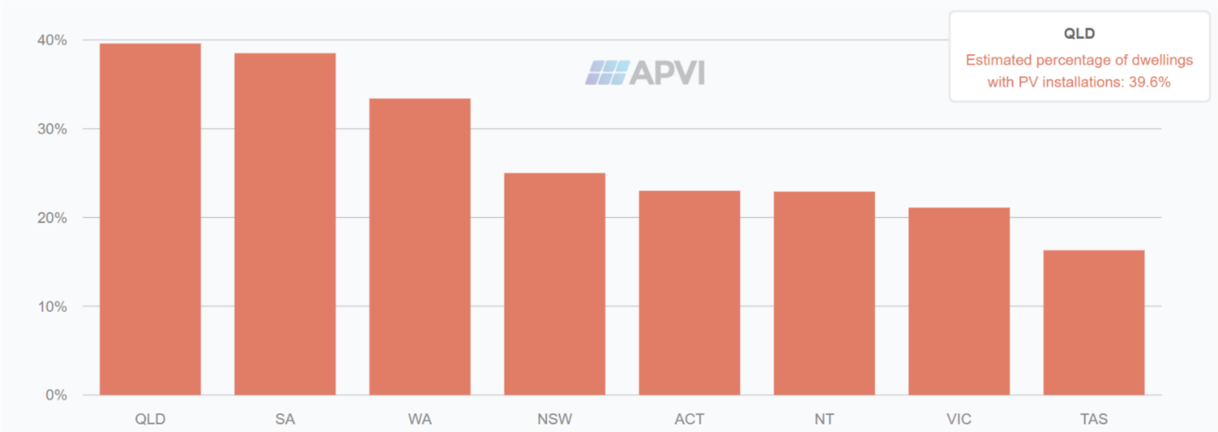
Reporting Year	Total Emissions (CO_2 Mt)	Electricity Generation Emissions % of Total Scope 1 Emissions[5]	Electricity Production (MWh)	Primary fuel source (%)			
				Renewables	Gas	Brown Coal	Black Coal
2014-15	176,183	55.3%	220,028	11.1%	13.8%	23.2%	51.9%
2015-16	179,099	54.3%	225,891	13.4%	12.7%	21.8%	52.1%
2016-17*	174,176	52.4%	224,190	14.2%	12.7%	19.2%	53.9%
2017-18	167,215	50.3.%	223,690	14.8%	14.9%	16.1%	54.2%
2018-19	162,491	48.8%	221,983	16.8%	14.2%	15.5%	53.5%
2019-20	155,025	47.9%	218,713	19.1%	14.9%	15.4%	50.6%

** Values have been estimated for 2016-17 from CER graph representation of changes in the national energy mix. For other years, CER provided percentages as part of NGER data highlights.*

Source: National Greenhouse and Energy Reporting (NGER) Electricity sector emissions and generation data 2014-2020

As of 31 March 2021, there are over 2.77 million PV installations in Australia, with a combined capacity of over 21.4 gigawatts (GW). Installations continued to grow throughout the pandemic period at record levels of around 4.6 GW/year over the last 2 years. The below table uses most recently available Clean Energy Regulator (CER) data and reflects the high percentage of PV dwelling penetration levels especially in Queensland and South Australia. Further local government and postcode level data can be accessed through the APVI's solar maps https://pv-map.apvi.org.au.

Percentage of dwellings with a PV system by State/Territory



Source: Australian PV Institute (APVI) Solar Map, funded by ARENA, accessed from www.pv-map.apvi.org.au on 20 June 2021

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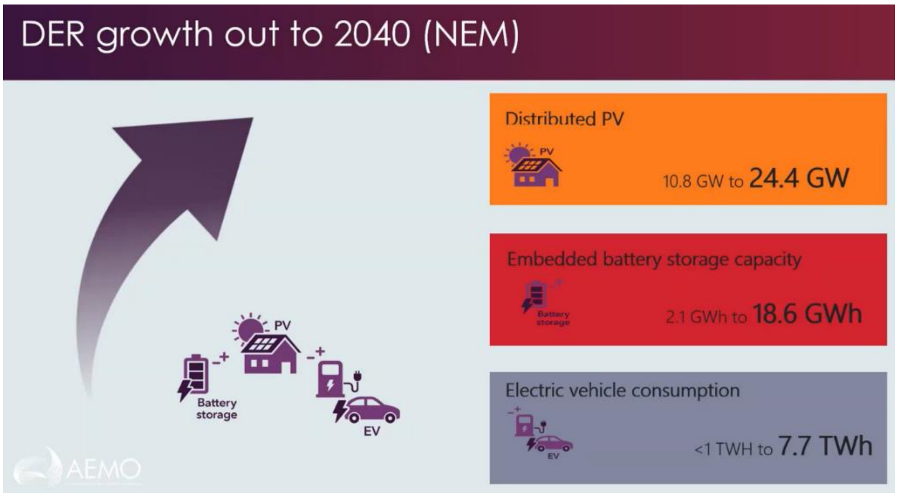
[4] Grid-connected refers to connection to a designated electricity network, which comprise Australia's five main electricity grids: the National Electricity Market (NEM), the South-West interconnected system (SWIS), the North West interconnected system (NWIS), the Darwin to Katherine network and the Mount Isa-Cloncurry supply network for the purposes of an electricity safeguard mechanism.

[5] Scope 1 greenhouse gas emissions (refer to CER scope definitions) as specified under the National Greenhouse and Energy Reporting Act 2007 (NGER Act) are the emissions released to the atmosphere as a direct result of an activity, or series of activities at a facility level.

Distributed Energy Resource (DER) Opportunities

The increase in solar system penetration in urban areas, particularly for residential households has brought about a range of activities and recently funded ARENA projects on distributed energy resources (DER) to manage the generation and storage of energy within the local electricity network. This presents exciting opportunities as part of solar neighbourhood planning but also challenges in the extent to which legacy centralised energy system thinking and network regulations are transformed to accommodate a new way of sourcing and managing energy in urban areas whilst maintaining stability, reliability of supply and affordability.

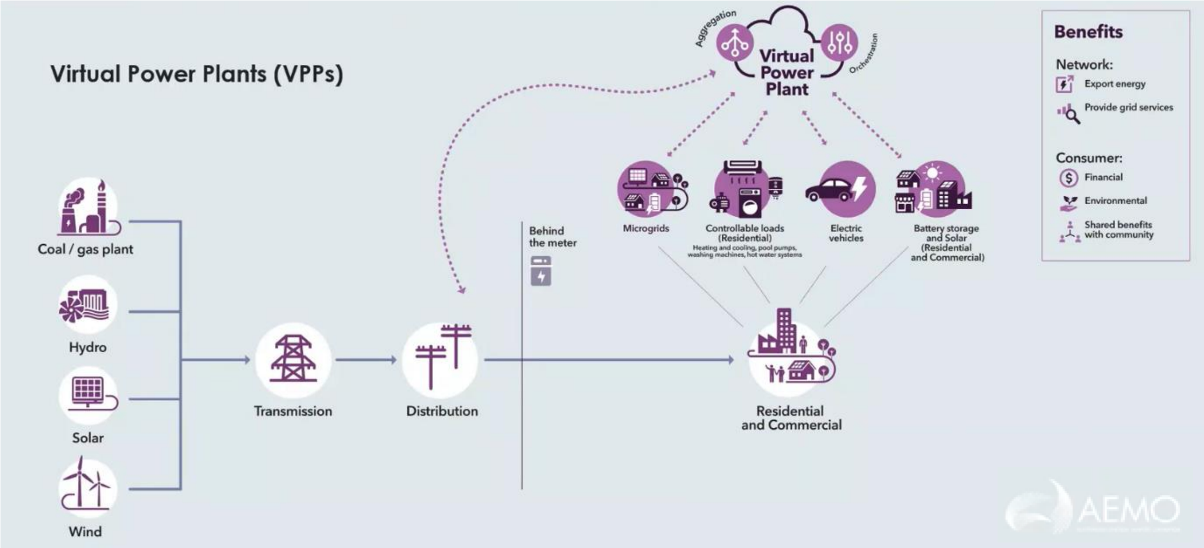
Estimated DER growth by 2040 of distributed PV, embedded storage and electric vehicle consumption



Source: AEMO (2020)

The Australian Energy Market Operator (AEMO) released a Renewable Integration Study stage 1 report in April 2020 (AEMO, 2021) confirming the technical capability is already there to safely operate the National Electricity Market (NEM) with up to 75% renewable electricity supply penetration rates of renewable energy by 2025. What is required to make this possible is a significant change in regulatory arrangements to ensure that voltage, system strength and inertia are maintained.

AEMO representation of Virtual Power Plans (VPPs)



Source: AEMO (2020)

Through trialling of virtual power plants (VPPs), AEMO is being proactive in working with key stakeholders to better understand smart grid/microgrid opportunities given their scalability, supply flexibility and cost benefits. It also recognises the significant contribution renewable energy generation and storage has in firming up electricity supply during unexpected outages often caused by extreme weather events.

South Australia has recently trialled the successful VPP rollout of 20MW of rooftop solar energy and 54MWh of combined battery storage to act as a single power plant. This includes solar and battery storage installations for over 4,000 public housing properties and further incentives are being provided in collaboration with energy utilities to bring storage solutions to households that have returns on investments of less than 5 years. Whilst the technology is there, including using household electric vehicles as mobile energy storage systems that can be plugged in to provide power to residential and commercial buildings, the current market mechanisms and network controls are struggling to keep apace with DER innovation.

AEMO has been making great strides in mapping the make-up of DER assets installed on residences and businesses across Australia through a DER data dashboard and register. AEMO led VPP demonstrations through ARENA's Advancing Renewables Program funding and detailed sharing of findings (AEMO, 2021) have shown what is possible and what regulatory changes are creating barriers to achieving positive outcomes. The work shares insights into how VPPs can contribute to frequency balancing between supply and demand through contingency Frequency Control Ancillary Services (FCAS) markets. Of particular interest are the structural VPP approaches that can be used in urban neighbourhood settings and the role aggregators can play as a third-party interface between rooftop owners and the electricity market.

Other initiatives of note include is:

- Project EDGE (Energy Demand and Generation Exchange) - a multi-year project to demonstrate an off-market, proof-of-concept Distributed Energy Resource (DER) Marketplace that efficiently operates DER to provide both wholesale and local network services within the constraints of the distribution network.
- University of Queensland (UQ) solar campus battery dashboard which monitors grid frequency to charge when prices are low and renewable energy is abundant, and then discharge when demand and prices are high.
- Project Symphony Marketplace and tariff pilot program as part of the Energy Transformation Taskforce (2020) DER roadmap to test and trial in Perth and the coastal Pilbara town of Onslow in northwest Western Australia how large numbers of batteries, rooftop solar panels and large appliances, such as air conditioners and electric hot water systems, can be coordinated into a hybrid microgrid virtual power plant solar plus storage microgrid.

Relevant solar neighbourhood planning information from these initiatives and other examples of onsite supply of power for multi-tenanted apartments and urban areas will be compiled into knowledge products as part of the IEA SHC Task 63 work activities. The work will also look to bring together solar planning tools, workflow examples and neighbourhood reporting approaches and datasets (such as 20-minute Neighbourhoods, National Cities Performance Framework Dashboard, CSIROs Australia's National Energy Analytics Research (NEAR) program as well as international solar neighbourhood case examples to share and disseminated through key stakeholders.

Opportunities for Australian solar neighbourhood planning

Work undertaken under IEA Task 51 Solar Energy in Urban Planning completed in 2019 set a foundation of understanding the art of the possible and the challenges and barriers to implementation. Shared international experiences and case study learnings have confirmed the complexity and breadth of considerations and stakeholder interactions that play out in urban planning processes (Lobaccaro, et.al. 2018), (Kanters and Wall, 2018).

The planning of neighbourhoods that address the generation of renewable energy on site will enable solar thermal technologies and photovoltaics to be implemented or prepared for, as well as creating daylight and sunlight access to achieve healthier urban environments. Solar neighbourhoods create the possibility of not just healthy environments but ones which are energy (resource) self-sufficient and resilient to energy price fluctuations or reliance on energy imports – helping future proof towns and cities.

Whilst Australia has similar challenges to many cities of the world, its geographic size and variety of climate zones requires consideration of local factors that have distinctly different design and construction requirements. This is also the case with solar access provisions to ensure urban form allows adequate access to daylighting. Australian legislative frameworks to protect and promote solar neighbourhoods, however, are often ad hoc and left to local government authorities to develop as part of individual building controls rather than at a broader urban neighbourhood level.

Progressive developments, such as One Central Park in Sydney designed by architect Jean Nouvel have overcome some of the daylighting constraints faced by high density urban areas using cantilevered heliostat mirrors to provide daylighting amenity on the south side of the precinct. It also includes covering around half of the building façade area with green plantings to act as a sun control device during changes in the seasons and reduce unwanted thermal gain. Learnings from such projects help to contextualise linkages between broader multi-faceted urban design considerations such as mobility, household affordability and water management and share different solar planning approaches and workflow experiences. This is a core focus for IEA Task 63 activities on Solar Neighbourhood Planning and includes investigating financial mechanisms to move from an energy market bias to realise added value services and co-benefits related to the hybrid or/and integrated use of urban surfaces beyond just solar energy production.

An example of innovative financing has recently occurred through Križevci Crowd investment initiative in Croatia. This is a citizen driven solar investment where the local municipality uses funds from individuals to install a PV system to cover public building electricity consumption and pays back the citizens through fixed interest micro loan agreements through monthly savings and revenue from surplus exported energy. The success of this approach has led to the establishment in March 2020 of a local energy cooperative called KLIK (Križevci Laboratory for Innovation in Climate) with new public-private projects in the pipeline.

Importantly, solar neighbourhoods shift the thinking from individual buildings to areas that include consideration of transport, infrastructure, landuse, waste management and materials/design to cool cities and combat urban heat island effects as identified in work completed by the Co-operative Research Centre for Low Carbon living which set the scene for this broader consideration and pathways to designing integrated low carbon precincts.

Australian cities are spoilt for solar energy resources with façade surfaces in Sydney often having similar performance outputs to optimally oriented surfaces in Northern Europe. City leadership is necessary to harness these opportunities and bring together:

- urban form that demands less energy to function whilst maintaining healthy societal interactions
- on site or close proximity renewable energy sources and storage to meet heating, cooling and power needs for buildings, open spaces and electric transportation
- flexible and responsive decentralised energy systems that enables energy independence and contributes to alleviating negative impacts from fuel poverty

- citizen lead participation in driving neighbourhood resilience and improvements
- legislative and regulatory frameworks that promote sustainable urban planning outcomes
- smart urban digital analytics and dashboard reporting to share and track neighbourhood level performance benchmarked against broader sustainability indictors and net zero energy targets.

Concluding remarks

This report has highlighted the critical role solar neighbourhood planning will play in achieving net zero energy by 2050 whilst meeting the population resource growth needs in urban areas. It has touched on a number of key initiatives currently being trialled and adopted in Australia and overseas whilst stepping through the acute challenge ahead and risk consequences from inaction. City leadership will be essential in driving citizen participation and creating the right framework for accelerated investment and transition to renewable powered living. This requires sharing global experiences, collaboration on best practice approaches and learnings and a belief in collective local action to make the fundamental change in how we treat our neighbourhoods and prioritise climate safe outcomes.

An essential component rests with the way in which urban jurisdictions map and track progress through live reporting and how their plans contribute to broader objectives and draw upon change opportunities to galvanise participation. Those that quickly embrace the challenge ahead will uplift resilience to increasingly unpredictable and undesirable threats to economic, social and environmental prosperity. This will require innovative thinking and committed planning approaches to significantly reduce our energy consumption needs, rapidly accelerate the use of sustainable energy generation sources and drastically transition to low emission transportation. Enabling frameworks set at a neighbourhood scale are essential if we are to deliver a no regrets pathway to 2050.

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