100% renewables

Western Sydney University

Sustainable Energy Strategy

FINAL REPORT – EXECUTIVE SUMMARY

Date: 27 April 2020

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1 Executive Summary

100% Renewables was commissioned by Western Sydney University to develop a Sustainable Energy Strategy (SES) for WSU's operations. There are a number of drivers for the university to develop an overarching approach to how it manages energy resources in future, including:

- Responding to global concerns over climate change by taking action at all levels of society to reduce greenhouse gas emissions in line with the goals of the Paris Agreement, Sustainable Development Goals (SDGs), and related IPCC recommendations,
- Responding to tertiary sector leadership in Australia on climate action, which includes goals for net-zero emissions, 100% renewables, Green Star buildings and SDG commitments,
- Building on its leading performance in efficiency, Green Star Buildings and SDGs, and ensuring that WSU's Western Growth Strategy leads to long-term, low-cost, sustainable buildings

A Sustainable Energy Strategy is intended to put a comprehensive framework around all aspects of WSU's energy and climate change plans and actions, encompassing operations, procurement and capital works processes, and to establish good governance arrangements that will ensure WSU's actions are planned, coordinated, funded and supported over the long term.

1.1 Recommended emissions reduction and renewable energy targets and timeframes

Based on an assessment of responses to climate change, it is recommended is that WSU consider the adoption of the following targets:

- **100% renewable energy for its operations as soon as practicable, including 100% renewable energy for electricity by 2025, and**
- **Net-zero GHG emissions target by 2030, including upstream and downstream emissions (aligned with the *Climate Active*[1] standard), and energy-related emissions currently reported under the mandated National Greenhouse and Energy Reporting (NGER) Act**

These recommended targets for WSU to reduce its carbon footprint and increase renewable energy are informed by global and national policy, as well as tertiary education sector approaches, which for leading universities are ahead of the science-based requirement.

There are many pathways for how these targets could be met. It is recommended that WSU develop implementation strategies and plans that evaluate and balance the risks, costs and benefits of the levers it has to reduce emissions. These include energy procurement, onsite solar panels, energy efficiency, fleet electrification, waste reduction, sustainable procurement, supply chain optimisation and purchasing of carbon offsets. Grid decarbonisation is a factor in the scale and timing of WSU's responses to reduce its emissions, but WSU cannot directly influence this aspect of its emissions.

This Strategy assesses and presents possible implementation pathways in order to illustrate the potential relative scale and timing of these various levers, and to evidence that such ambitious goals are feasible with current and emerging technologies. The detail, scale, cost and timing of WSU's preferred implementation pathway will emerge from WSU's further analysis, subject to adoption of these or similar targets.

[1] Climate Active is a government-backed program. Climate Active and the Climate Active Carbon Neutral Standard support and guide businesses as they account for and reduce carbon emissions. See: https://www.environment.gov.au/climate-change/government/climate-active

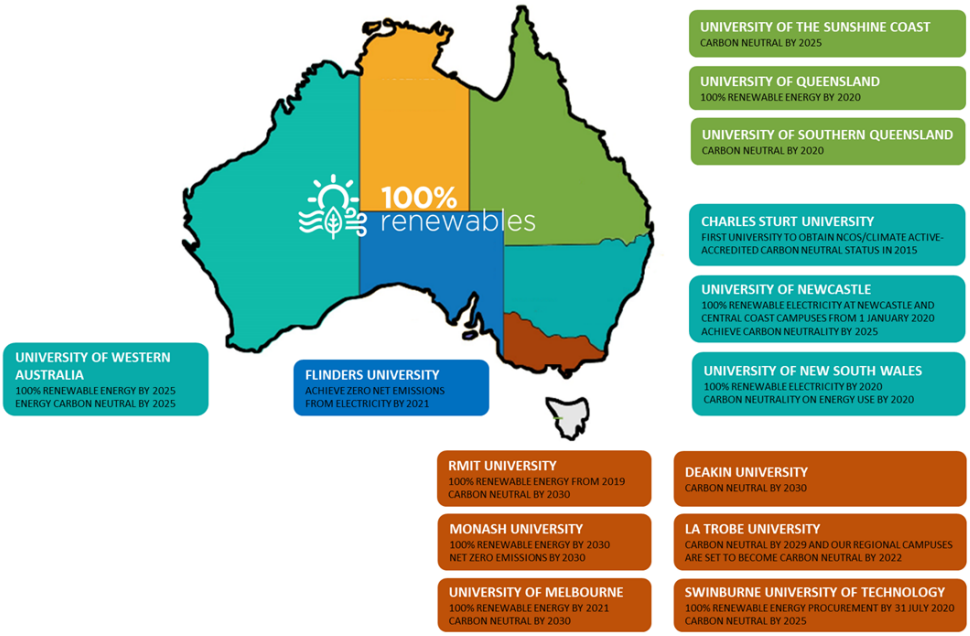

FIGURE 1: AMBITIOUS RENEWABLE ENERGY AND CARBON REDUCTION COMMITMENTS BY UNIVERSITIES

1.2 Approach to developing recommended targets and scenarios

A structured approach was adopted to develop and assess potential emissions reduction and renewable energy targets, and potential implementation pathways that illustrate how this might be achieved. The approach is summarised in the sub-sections below, and includes:

- A review of sector, global and national responses to climate change, to inform potential targets for consideration by WSU,
- Analysis of WSU's current energy characteristics, energy and carbon footprint, and projections informed by the Western Growth Strategy,
- Identification of the levers available to WSU to de-carbonise its operations and supply chain, and collation of past and current work by WSU to reduce its energy costs and emissions, including assessments of the capacity for abatement by these levers where available,
- Development of possible implementation scenarios to reach net zero emissions and 100% renewables, using these levers.
    - For this work a focus was placed on the implementation of measures – such as onsite solar panels and energy efficiency – that can provide a good return on investment to WSU, that balances risks that may be associated with other strategies such as renewable energy procurement and vehicle electrification, and minimises the requirement to purchase carbon offsets that offer no return to WSU.
    - Potential costs and benefits of using each abatement lever were estimated for these scenarios to provide WSU with an indication of the possible scale of investment and returns.
    - These scenarios are presented as possible pathways, and are intended to inform WSU's further, more detailed analysis of its abatement options, capital and other financing options, and risk.

1.3 Sector and other approaches

Figure 1 (above) illustrates the scale of ambition made by the tertiary education sector in Australia to increase its supply of renewable energy and to reduce its emissions. Within the tertiary education sector, a range of other commitments and actions are also relevant and inform the approaches being taken by the sector. These include:

Sustainable Development Goals	**Green Star Buildings**	**TEFMA benchmarking**
In Australia, there are fifteen universities that are signatories to University Commitment to the SDGs, including WSU.	WSU is ranked third of Australia's universities with eight Green Star certifications, including one design and as-built 6-star rating and five 5-star ratings.	TEFMA conducts annual benchmarking of its member, including energy intensity measured on a per-EFTSL and a per-GFA basis.

At the national level, Australia's emissions reduction targets remain at 26-28% below 2005 levels by 2030, and the Commonwealth Government remains committed to the overarching Paris Agreement goal of decarbonising by mid-century, though this is not legislated.

At a State level NSW is committed to a net zero target by 2050, and has committed to an interim target of reducing the State's total emissions by 35% by 2030, with an accompanying Plan to get there. Other States and Territories also have ambitious targets, legislated in the case of Victoria and the ACT.

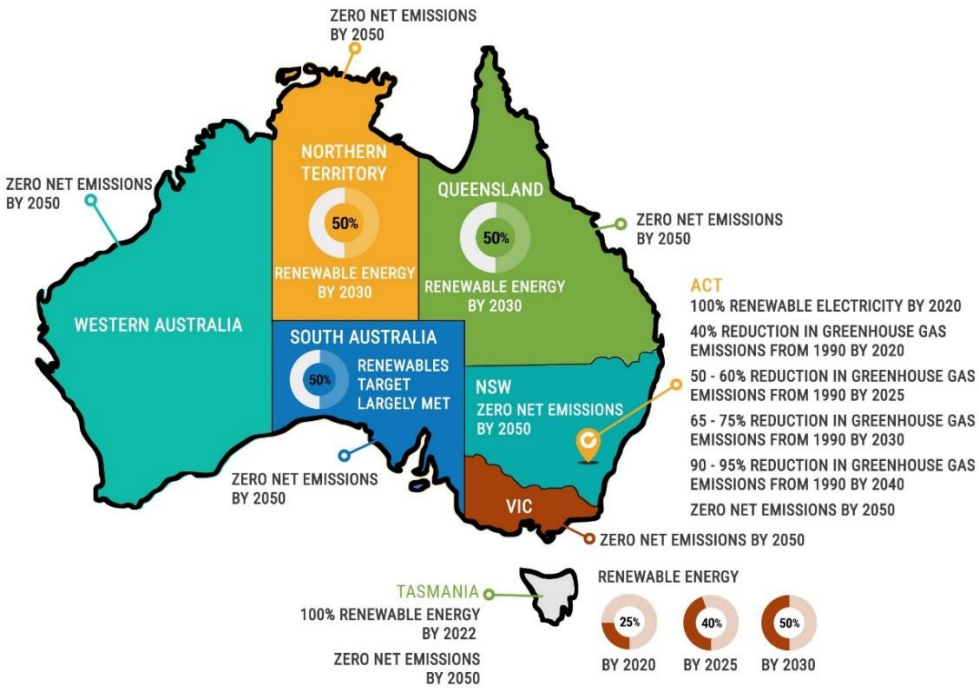

FIGURE 2: AUSTRALIA'S RENEWABLE ENERGY AND CARBON GOALS – STATE & TERRITORY LEVEL

1.4 WSU's energy & carbon footprint and energy characteristics

WSU's operations are spread across 13 campuses, predominantly in Western Sydney with small operations in some regional NSW locations. The university has close to 50,000 students as well as nearly 3,500 academic and administration staff. While total student numbers are growing, WSU's Western Growth Strategy is seeing more energy-efficient and sustainable Green Star-rated vertical CBD campuses built close to public transport hubs, with the result that overall energy consumption is forecast to decrease. To date vertical CBD campuses have been built at Liverpool and Parramatta, with a further vertical campus being developed in Bankstown.

In 2018-19 Western Sydney University consumed more than 265 TJ of energy, with the majority (70%) of this being electricity for all of its campuses. Natural gas (23%) was the next most significant source of energy consumption, followed by fuel use for vehicles (6%). WSU reports this energy use and associated scope 1 and scope 2 emissions[2] publicly each year, as required under the *National Greenhouse and Energy Reporting (NGER) Act*.

In addition to energy consumption and related emissions, WSU is also responsible for, or has the ability to influence emissions in its supply chain. These include upstream scope 3 emissions[3] to produce and distribute energy to WSU facilities and vehicles, waste sent to landfill, and emissions associated with the supply of goods and services to WSU. The potential scope of emissions sources that WSU would consider are illustrated below in Figure 3 below.

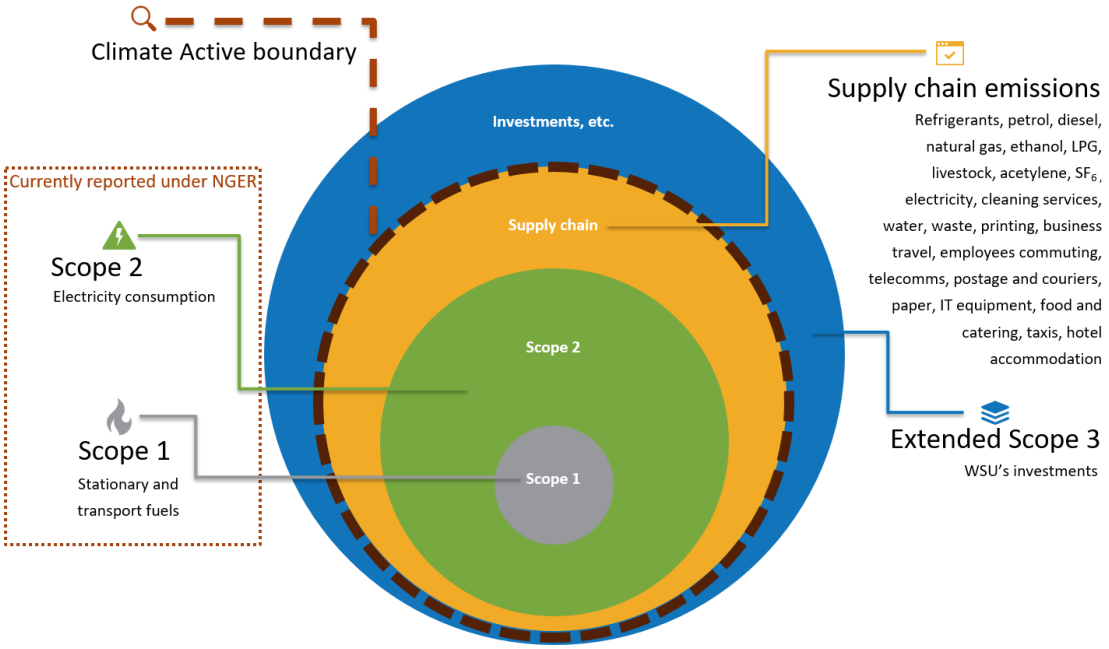

FIGURE 3: POTENTIAL WSU CARBON FOOTPRINT BOUNDARY

[2] GHG emissions are arranged into scopes, including Scope 1 (direct emissions such as from fuel burning), Scope 2 (indirect emissions such as from the consumption of electricity), and Scope 3 (upstream and downstream emissions associated with the production and distribution of energy, and associated with the production of goods and services supplied to an organisation)

[3] ibid

Based on known energy use and related GHG emissions, and estimated scope 3 emissions for waste and goods and services supplied to WSU, a carbon footprint was developed for WSU for FY2018-19. This estimates that WSU's carbon footprint for this year was 56,872 t CO_2-e. This is presented below.

TABLE 1: ENERGY AND CARBON FOOTPRINT FOR WSU

	EMISSION SOURCE	ACTIVITY IN GJ	ACTIVITY DATA	UNITS	SCOPE 1	SCOPE 2	SCOPE 3	TOTAL T CO2-E	%
	Diesel for fleet	8,457 GJ	219.1	kL	596 t CO2-e		30 t CO2-e	627 t CO2-e	1.1%
	Petrol for fleet	8,482 GJ	248.0	kL	574 t CO2-e		31 t CO2-e	604 t CO2-e	1.1%
	Ethanol for fleet	4 GJ	0.2	kL	0 t CO2-e		0 t CO2-e	0 t CO2-e	0.0%
	Natural Gas	60,880 GJ	60,880	GJ	3,137 t CO2-e		828 t CO2-e	3,965 t CO2-e	7.0%
	Electricity used by WSU	185,926 GJ	51,646,109	kWh		42,350 t CO2-e	5,165 t CO2-e	47,514 t CO2-e	83.5%
	Solar PV used by WSU	1,384 GJ	384,548	kWh		0 t CO2-e	0 t CO2-e	0 t CO2-e	0.0%
	Waste to landfill		169	t			203 t CO2-e	203 t CO2-e	0.4%
	Green waste		244	t			5 t CO2-e	5 t CO2-e	0.0%
	Other scope 3 emissions						3,953 t CO2-e	3,953 t CO2-e	7.0%
	TOTAL:	**265,134 GJ**			**4,307 t CO2-e**	**42,350 t CO2-e**	**10,215 t CO2-e**	**56,872 t CO2-e**	**100.0%**

Electricity demand for the whole of WSU is characterised below in Figure 4. The load profiles show that the largest demand for power occurs in the daytime during summer, attributed to higher air conditioning (cooling) demand. This is ideal for solar PV systems which operate during the day and have their highest yield in summer.

Demand on days when the university is not open for regular tuition (i.e. January – but may be open for staff, researchers, etc) remains at similar levels to normal teaching days. On public holidays and Sundays however, maximum demand is lower, which indicates that air conditioning plant has '365-day' control functionality. Night profiles indicate a high 'fixed' demand which may include ICT equipment, external lighting, and equipment that run 24/7, such as onsite servers. This demand, if taken to run all the time, accounts for 60% of all WSU's electricity use.

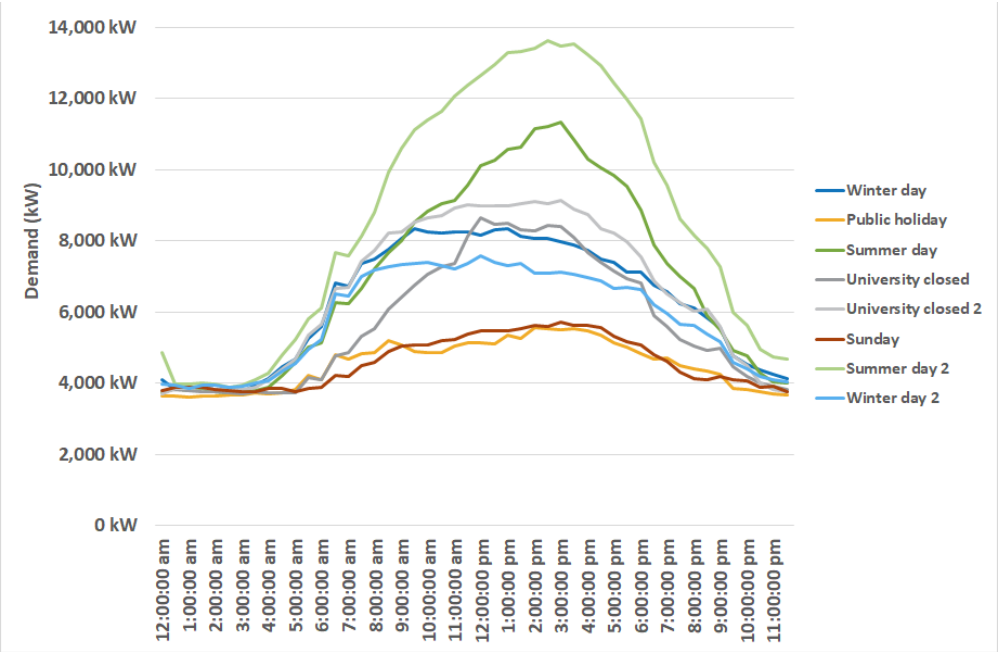

FIGURE 4: LOAD PROFILES FOR THE WHOLE OF WSU

Taking into account WSU's energy and carbon footprint, the potential impact of the Western Sydney Growth strategy, as well as likely 'decarbonisation' of the NSW electricity grid as older coal-fired power stations are retired and potentially replaced with renewable energy sources, a *business-as-usual* (BAU) forecast of energy consumption and emissions to 2030 was developed, illustrated below.

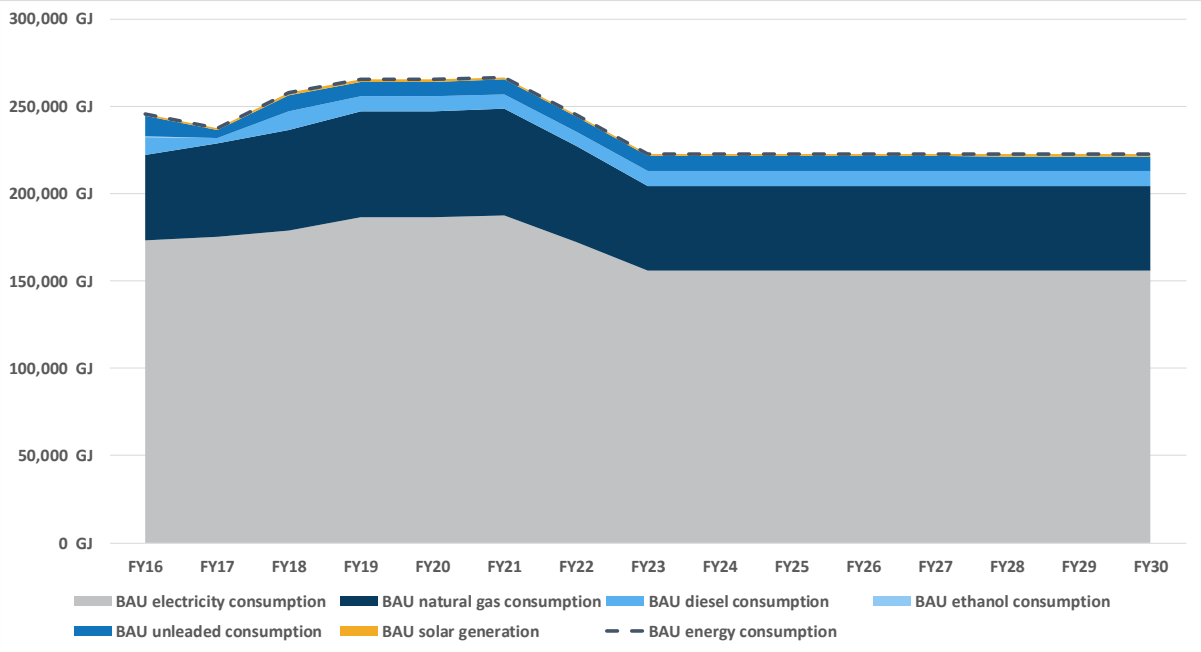

FIGURE 5: WSU BAU ENERGY CONSUMPTION PROJECTION TO 2030

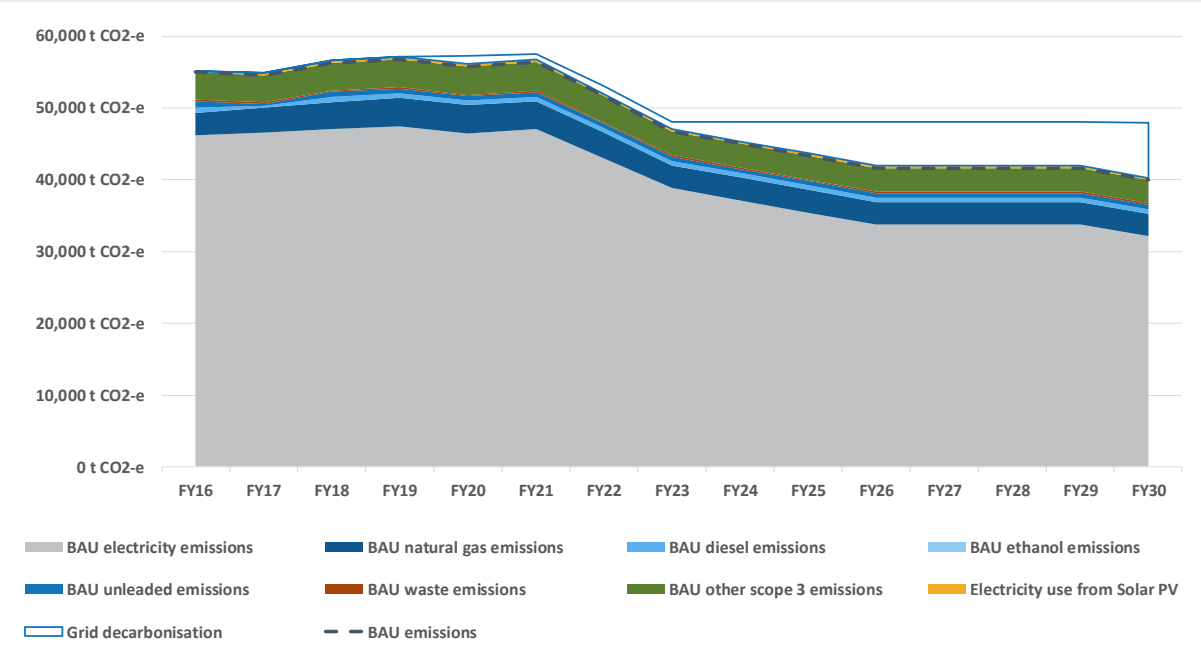

FIGURE 6: WSU BAU SCOPE 1, 2 AND 3 GHG EMISSIONS PROJECTION TO 2030

1.5 Summary of a potential implementation pathway for WSU

To inform WSU's decision-making relating to targets, as well as future more detailed assessments of its abatement options, costs, risks and its preferred implementation pathway, two abatement scenarios were assessed in this work. These include:

- A science-aligned target to limit global warming to 'no more than 1.5 degrees C' and reach net-zero emissions by mid-century (**1.5C**), and
- As recommended for WSU, a more ***rapid renewable energy and emissions reduction pathway that would see WSU achieve 100% renewable energy and net-zero emissions by 2030 (NZ30)***.

For these scenarios abatement effort required was assessed against the following levers.

1. Energy efficiency
2. Waste management
3. Behind-the-meter solar (e.g. onsite solar)
4. Supply chain management
5. Buying clean energy (e.g. via a renewable energy power purchase agreement)
6. Grid decarbonisation
7. Sustainable transport
8. Carbon neutral strategy (i.e. for residual emissions)

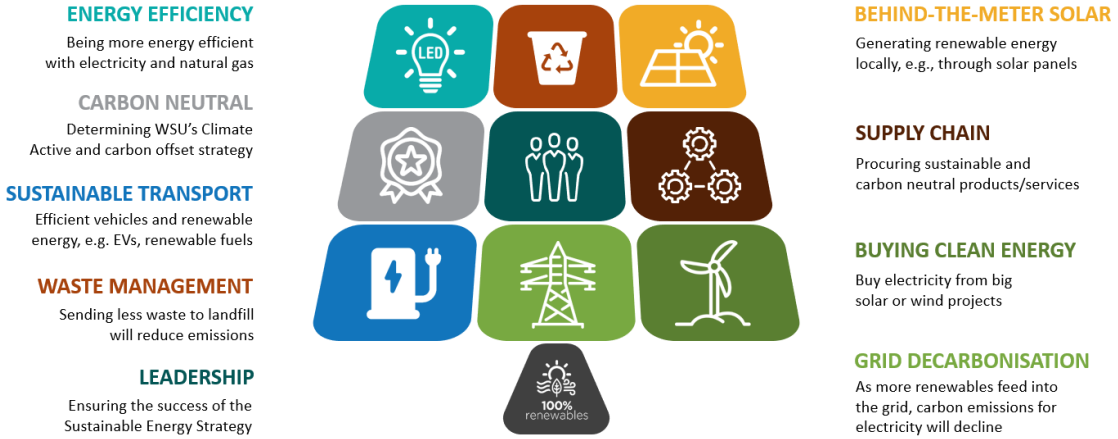

FIGURE 7: NINE ABATEMENT LEVERS FOR WSU

1.5.1 Net-zero emissions by 2030 (NZ30)

A potential pathway based on reaching net-zero emissions by 2030 through a program of work that draws on all of the abatement levers is summarised below. The intent is to help WSU see the potential relative scale and timing of each abatement option, and more detailed assessment will determine WSU's preferences if this or similar targets are adopted.

The approach highlighted in this particular scenario is also one that could deliver WSU a good return on investment for measures such as onsite solar panels and energy efficiency, while achieving sizeable cuts to WSU's emissions. This approach could balance the risks associated with other measures and lower the requirement to purchase carbon offsets.

For this scenario the following pathway to net-zero emissions was modelled for WSU, to be achieved by 2030.

TABLE 2: WSU POSSIBLE EMISSIONS PATHWAY – NZ30

	Abatement area	Emissions Pathway
	Grid decarbonisation	The grid is assumed to decarbonise according to the current schedule for coal-fired power station closures, replaced with renewables
	Buying clean energy	It is assumed that WSU will enter into a 50% renewable energy PPA from 2021, rising to a 100% renewable energy PPA from 2025
	Local generation (renewable energy)	12 MW of solar PV could be implemented over a five-year period in even increments. Years are 2021, 2022, 2023, 2024 and 2025
	Energy efficiency	WSU will aim for 2% year-on-year reduction in electricity from BAU. Gas will be upgraded to electric technologies by 2030, starting in 2026.
	Sustainable transport	WSU will move towards hybrid and electric vehicles, reaching 75% of vehicles by 2025. From then full EVs will be achieved by 2030.
	Waste management	A circular business would see zero waste to landfill. From current levels, this is assumed to occur in increments over a ten-year period.
	Supply chain	A 1% year-on-year reduction in electricity is assumed to be feasible, compared with BAU.
	Carbon offsets	The balance of scope 3 GHG emissions will be offset in 2030.

The chart below captures this scenario and shows the emissions reduction pathway that would result for scope 1, 2, and 3 emissions. Since there are some residual scope 3 emissions at 2030 under this scenario, these are assumed to be offset at this time.

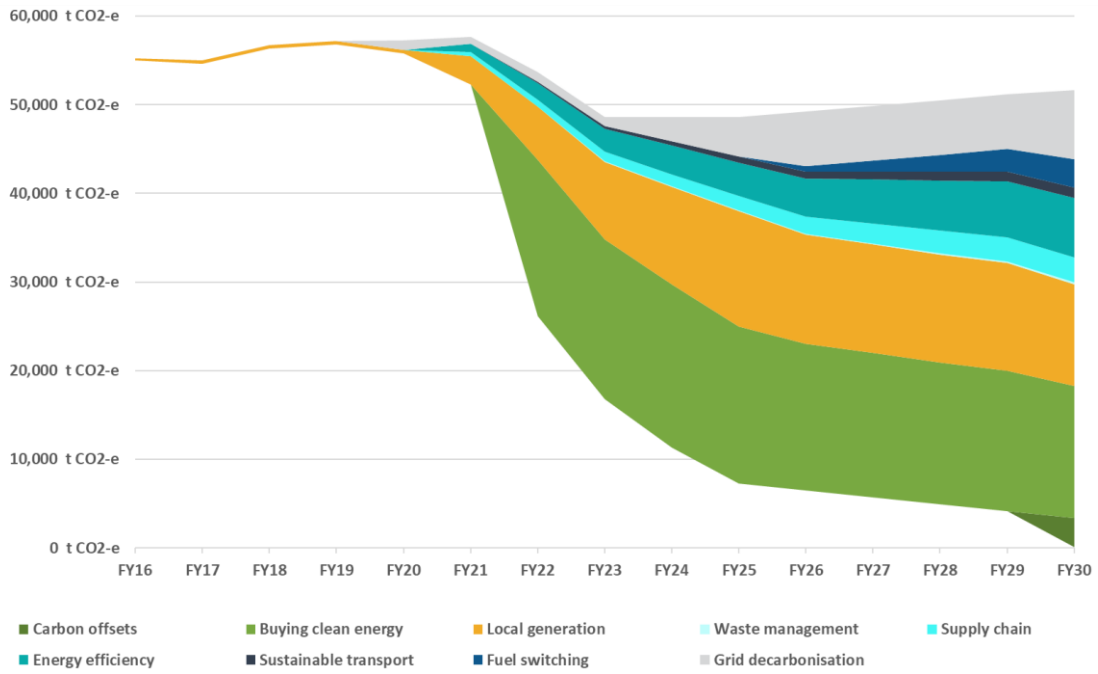

FIGURE 8: PATHWAY TO 2030 UNDER NET-ZERO EMISSIONS BY 2030 (NZ30) – SCOPE 1, 2 AND 3 EMISSIONS

Drawing on the available information, and the development of possible scenarios for WSU, the following plan outlines the scope, WSU objectives, potential abatement and potential costs and benefits for each of the abatement areas, intended to inform further, more detailed investigations of WSU's net zero pathway.

TABLE 3: RENEWABLE ENERGY AND GHG EMISSIONS REDUCTION OPPORTUNITIES AND PLAN FOR WSU

Opportunity	Description	WSU's objective	Abatement	Potential Cost
Leadership	Executive leadership and commitment to ambitious renewable energy and/or deep decarbonisation goals is required if WSU's Sustainable Energy Strategy is to be successful. The implementation of management and governance systems for the strategy, and commitment and authority to act at relevant levels to reduce emissions, is also key for success to be achieved.	To set achievable carbon reduction targets that are sector-aligned, to apply governance and management processes that are effective and sustained, and to invest in people, technologies and services that achieve WSU's targets and improve its bottom line.	NA	The main cost will be the allocation of staff time to establish, govern and implement WSU's Sustainable Energy Strategy.
Grid decarbonisation	In NSW there are currently five coal-fired power stations with combined 10,240 MW capacity that supply most of the State's electricity and make up the vast majority of electricity sector emissions in the state. As more coal-fired power stations approach the end of their life they are most likely to be replaced with renewable energy. This is most likely to be from wind and solar PV, firmed with pumped hydro and batteries.	To keep abreast of changing trends, lobby effectively and use trends to inform future revisions to the Sustainable Energy Strategy and related plans. Grid decarbonization is critical to any goal to reach net zero emissions, so WSU's role here, by itself and in collaboration with others, is important to the achievement of WSU's goals.	The above potential change to the NSW grid carbon intensity would have a significant impact on GHG emissions for WSU, although the majority of this impact would not be seen until the late-2030s and in to the 2040s'.	There is no direct cost to WSU associated with decarbonisation of the electricity grid, excepting impacts on energy pricing in future years.
Buying clean energy	Electricity consumption accounts for more than 80% of WSU's carbon footprint, and the single biggest opportunity to reduce emissions is to purchase renewable energy and/or renewable energy offsets via WSU's electricity procurement	To source electricity for WSU campuses from clean renewable energy sources via market-based methods aligned with WSU's current	Purchasing 100% renewables would lead to abatement of 47,514 t CO_2-e, and 50% renewables would lead to	The costs or benefits of a renewable energy PPA are assessable via comparison of PPA offer pricing with

Opportunity	Description	WSU's objective	Abatement	Potential Cost
	process. Unlike other abatement options, this does not require WSU to physically implement change, only to stipulate that renewables be purchased to meet part or all of WSU's electricity needs.	electricity procurement, subject to assessed risks and costs to WSU compared with 'traditional' energy procurement.	abatement of 23,757 t CO_2-e per year. If vehicles and gas were also electrified then added abatement of 5,196 t CO_2-e per year would result.	forecast regular power pricing. In the current market (2020) WSU could expect to pay a small premium for renewable supply.
Behind-the-meter solar	A WSU-commissioned study indicated potential for 9.3 MW of solar PV across WSU campuses, including roof systems, carport solar and ground-mounted systems. WSU plans for around 8 MW of solar PV have been developed. Modelling the potential for solar at selected large WSU campuses in this study suggests that up to 12 MW may be feasible. Battery storage will help in future to maximise this potential.	To implement approximately 8 MW to 12 MW of solar PV at WSU campuses, including demonstration of a range of models including roof-mounted, ground-mounted, carports, as well as integration with battery storage.	Implementation of 8 MW to 12 MW of solar PV across WSU campuses, will deliver abatement of 7,000 to 10,500 t CO_2-e.	The cost for 8 MW to 12 MW of solar may be $11 - $15.6 million. WSU should see a payback of 6 years from annual cost savings of $1.83 million (8 MW) to $2.6 million (12 MW).
Energy efficiency	Energy efficiency remains the cheapest form of greenhouse gas abatement in many situations and will continue to be a key focus area for WSU, with efficiency gains to come from action on several fronts, including Green Star Buildings, efficient refurbishments and major plant upgrades, equipment retrofits, building management systems, fuel switching, sustainable procurement, IT systems upgrades, as well as education. Efficiency plans will be informed by regular auditing of facilities and equipment, metering and monitoring, and engagement with energy users.	To build on past and ongoing energy efficiency work and implement cost-effective energy-efficient decisions and measures across WSU's activities, so that WSU's demand for energy is continually reduced while services and facilities are improved.	An aggressive program of energy efficiency could see WSU aim for say 2% year-on-year improvement. To 2030 this would equate to abatement of close to 9,000 t CO_2-e of scope 1 and 2 emissions.	Assuming a payback on the cost (full or marginal) of efficiency initiatives of 6 to 8 years, this level of savings would cost in the range $7m to over $10m over the long term.

Opportunity	Description	WSU's objective	Abatement	Potential Cost
Sustainable transport	The primary medium and long-term goal for WSU's vehicle fleet could include the adoption of EVs that are powered initially with purchased renewable energy and later by a decarbonised electricity grid. Progress towards this goal may include purchasing and/or leasing low-emissions and hybrid as interim steps as the cost and availability of EVs improves over time. Continued growth in EV charging infrastructure will facilitate uptake of EVs, and WSU should consider the progressive installation of EV chargers that can allow both staff and students to charge their vehicles.	To align WSU's fleet strategy with its other areas of carbon abatement through the development of a fleet low or zero-emissions strategy and the implementation of measures to reduce fleet emissions over time, subject to assessed costs and risks to WSU.	The scope for emissions reduction for WSU overall from transport measures is small at just 1,231 t CO_2-e inclusive of both scope 1 and scope 3 emissions.	The capital and lease cost premium, and resale value for EVs and hybrid models will be assessed alongside savings in fuel, registration, insurance and maintenance. A cost-neutral approach would see low-emission vehicles have comparable total cost-of-ownership to current fleet.
Waste management	WSU has already diverted most of its waste from landfill. WSU will continue to develop initiatives that further reduce waste towards zero, and will work with on-campus lessees such as cafes / canteens to help them reduce waste and source more sustainable input materials.	To continue WSU's waste reduction, recycling and landfill diversion program, and to extend waste management efforts to reduce plastics consumption.	The scope for further abatement from waste management is small at just 208 t CO_2-e based on FY 2018-19.	The cost of any further waste treatment approach will be weighed up against savings through reduced collection and management fees.
Supply chain	WSU will evaluate opportunities to influence the carbon performance of supply chain providers. Omitted emissions sources from WSU's carbon footprint may include contractor energy and fuel use, embodied emissions and the like. WSU has the ability to influence positive climate outcomes through its specification for goods and services supplied to it by contractors. Implementation of sustainable procurement policies and practices for sourcing all goods and	To inform WSU's suppliers about WSU's objectives relating to emissions reduction, and to progressively align the suppliers of goods and services with these objectives where cost-effective.	The scope for abatement from sustainable procurement is sizeable, with incremental gains made via all purchased goods and services over the long term. WSU also has the capacity to influence emissions	A robust sustainable procurement approach would see sustainable services and goods sourced on a whole-of-life cost basis, which will tend to favour efficiency with lower lifetime cost. Similarly, contractors and suppliers who are

Opportunity	Description	WSU's objective	Abatement	Potential Cost
	services, and refinement of these to secure better environmental outcomes through a quadruple bottom line approach (economic, social, environmental and governance) is key to WSU achieving emissions savings through its supply chain.		reduction by its suppliers and contractors.	sustainable in their own operations are likely to have lower, not higher costs.
Carbon neutral	Any goal or target to be carbon neutral / net-zero emissions will consider the option to become accredited under the Commonwealth Government's Climate Active program, formerly the National Carbon Offset Standard (NCOS). In this event, from the year that WSU wants to be carbon neutral, the requirements of the Climate Active program would need to be met.	To develop a carbon neutral and carbon offset strategy aligned with WSU's targets.	For all remaining carbon emissions in each target year WSU will need to purchase offsets equivalent to its emissions. Under a Sustainable Energy Strategy that maximises abatement from renewables, efficiency and supply chain, offset purchases to be carbon neutral will be minimal.	Carbon offsets represent a cost to WSU, and should be purchased from sources that align with Climate Active / NCOS requirements. The cost of carbon offsets is minimised when other strategies to reduce emissions cost effectively are successful. WSU could expect to pay anywhere between \$9.5-\$20/t CO_2-e for Australian offsets, and \$1.5-\$15/t CO_2-e for international offsets in the current market.

1.5.2 Summary of potential costs and benefits of the indicative NZ30 scenario

For clarity, the potential costs and benefits to WSU from implementation of the NZ30 scenario outlined above are summarised below. It is noted that whereas some measures have quantifiable costs and savings, other measures are justified based on cost-of-ownership or life-cycle costs that represent the lowest among options available.

TABLE 4: SUMMARY OF POTENTIAL COSTS AND SAVINGS FOR INDICATIVE NET ZERO SCENARIO

Opportunity	Potential Cost	Potential Savings
Leadership	Allocation of staff time	NA
Grid decarbonisation	No direct cost to WSU, supply / demand and other factors will determine costs as well as any savings relative to current arrangements.	
Buying clean energy	In the current market (2020) WSU could expect to pay a small premium for renewable supply.	Many renewable energy PPAs are seeing lower costs to consumers, so a well-timed and informed approach to market is key.
Behind-the-meter solar	The cost for 8 MW to 12 MW of solar may be $11 - $15.6 million, with solar and battery costs continuing to decline.	Payback of 6 years from savings of $1.83 to $2.6 million.
Energy efficiency	Costs of a 2% year-on-year reduction in energy demand will be the full or marginal capital cost of energy efficient equipment. At a payback of 6 to 8 years, these costs may be $7m - >$10m.	Annual cost savings of $875,000 - $1.67 million based on the potential payback / cost range.
Sustainable transport	The capital and lease cost premium, and resale value for EVs and hybrid models will be assessed alongside savings in fuel, registration, insurance and maintenance. A cost-neutral approach would see low-emission vehicles have comparable total cost-of-ownership to current fleet.	
Waste management	The cost of any further waste treatment approach will be weighed up against savings through reduced collection and management fees.	
Supply chain	A robust sustainable procurement approach would see sustainable services and goods sourced on a whole-of-life cost basis, which will tend to favour efficiency and lower lifetime cost. Similarly, contractors and suppliers who are sustainable in their own operations are likely to have lower, not higher costs.	
Carbon neutral	Carbon offsets represent a cost to WSU, and should be purchased from sources that align with Climate Active / NCOS requirements. The cost of carbon offsets is minimised when other strategies to reduce emissions cost effectively are successful. WSU could expect to pay anywhere between $9.5-$20/t CO_2-e for Australian offsets, and $1.5-$15/t CO_2-e for international offsets in the current market.	NA

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