Carbon Management Report

November 2021

Engineering Services | Corporate Services

Griffith UNIVERSITY
Queensland, Australia

Executive Summary

The annual Carbon Performance report reflects on our progress in managing the carbon footprint of the University, with a focus on electricity, waste and air travel. It notes our targets, outlines our carbon emissions for the year ended 30 June 2021 and compares our performance to the baseline, the previous year and the higher education sector TEFMA benchmarks.

Overall, the total carbon emissions for the 2020/21 year were 53,545 tonnes of carbon dioxide equivalent (t $CO_{2\text{-}e}$). 2020/21 emissions were 37% below the 2010/11 baseline and 27% lower than the prior year. There was a 95% reduction in airline travel compared to the 2010/11 baseline resulting from the ongoing pandemic border restrictions. Electricity emissions reduced by 14% from 2019/20 levels, partly associated with the reduced campus activity aspect of the pandemic response.

Performance of scope 1, 2, and 3 emissions for 2020/21 can be summarised as follows:

- Scope 1 emissions relate to the direct consumption of fossil fuels. Scope 1 only accounts for 1.4% of the total carbon emissions for the year. 2020/21 scope 1 emissions were 1,008 tonnes of $CO_{2\text{-}e}$, a 37% decrease on 2019/20 and a 52% decrease on 2010/11. The primary driver of the reduction was a reduction in unplanned refrigerant releases from chiller plant (as a result of replacing aged plant), and a 30% reduction in fuel consumption (compared to the previous year) resulting from continued reduced activity in the University car fleet.
- Scope 2 emissions are the emissions associated with the consumption of electricity generated off campus. These account for 80% of the total Carbon footprint for the year. 2020/21 scope 2 emissions were 42,629 tonnes of $CO_{2\text{-}e}$, a 14 % decrease on 2019/20 and 19% below 2010/11 levels. Contributions to the reduction in Scope 2 emissions included:
    - ongoing reduction in campus activity due to reduced student load, working from home and building closures.
    - Decommissioning old chiller plant including replacements at Queensland Conservatorium (S01), Psychology (M24) and GRIDD I (N27) and removing chiller plant at Graduate Centre (S07) (providing chilled water from existing plant at the adjacent Webb Centre (S02))
    - Building tuning and controls improvements including reducing plant run times over holidays and weekends and more energy efficient mould reduction programmes
- Scope 3 emissions, the emissions as a direct consequence of the University's goods or services e.g. waste, paper, flights and distribution losses from the electricity counted under Scope 2. These form the remaining 18.5% of our emissions with total 2020/21 emissions being 9,896 tonnes $CO_{2\text{-}e}$, a 57% decrease on 2019/20 and a 68% decrease on 2010/11. This was mostly due to the reductions in flights and electricity related emissions supported by some savings in IT equipment and waste.

Since 2010/11 the University has successfully mitigated the additional emissions that come with student load, staff and campus expansion. The 2020/21 emissions levels show a 37% reduction on the baseline, following a 2019/20 total 14% below the reference year with both years reflecting the reduction in activity due to the pandemic to some extent. To achieve its strategic objectives, as normal activity resumes, the University will need to focus on how it uses energy and how regularly staff choose to travel. This year's results again demonstrate that reducing campus activity, air and road travel contributes directly to reducing emissions.

The final section of the report focuses on reducing our emissions and sets out our pathway to achieve the strategic goal of halving 2010 net emissions by 2030 and net zero emissions by 2050. This includes detail on the projects proposed and in progress for completion in 2022.

Introduction

In 2012 the University developed its first Carbon Management Plan, as part of its broader commitment to sustainability. This plan was updated in 2016 to align with the University's objectives and targets with the government's revised commitment to reduce carbon pollution. Since then, we have committed to aligning Griffith with the Intergovernmental Panel on Climate Change by halving carbon emissions from 2010 levels by 2030 and reducing them to zero by 2050. This report provides an update of our progress on reducing emissions and compares our overall emissions with the higher education sector.

Our carbon footprint

In 2021, Pangolin Associates were appointed again to calculate the University's total carbon emissions. These emissions cover activities over which the University has direct control, together with those generated beyond our direct control. This methodology enables us to report on our overall emissions and monitor our progress against our emissions reduction target.

Table 1: Griffith Carbon Footprint - Emissions t $CO_{2\text{-}e}$ from Baseline 2010/11 to present

Year	Scope 1	Scope 2	Scope 3	Total
2020/21	1,008.3	42,629.8	9,896.3	53,534.5
2019/20	1,592.5	48,499.1	23,214.6	73,306.2
2018/19	2,627.8	52,775.1	31,148.9	86,551.8
2017/18	2,588.9	53,880.1	24,585.2	81,054.2
2016/17	1,739.8	55,624	29,020.9	86,384.7
2015/16	2,274.7	55,440.4	31,835.4	89,550.5
2014/15	1,813.4	53,840.2	32,318.2	87,971.8
2013/14	2,124.8	52,604.7	36,459.6	91,189.1
2012/13	2,637.1	52,281.1	35,912.2	90,830.4
2011/12	2,115.7	55,431.1	31,456.9	89,003.6
2010/11	2,114.6	52,694.3	30,535.5	85,344.4

Categories of carbon emissions

Scope 1
Emissions on our campuses, or associated with the University's business, generated through the combustion of fossil fuels in University owned vehicles, natural gas and LPG use as well as refrigerant gas leakage.

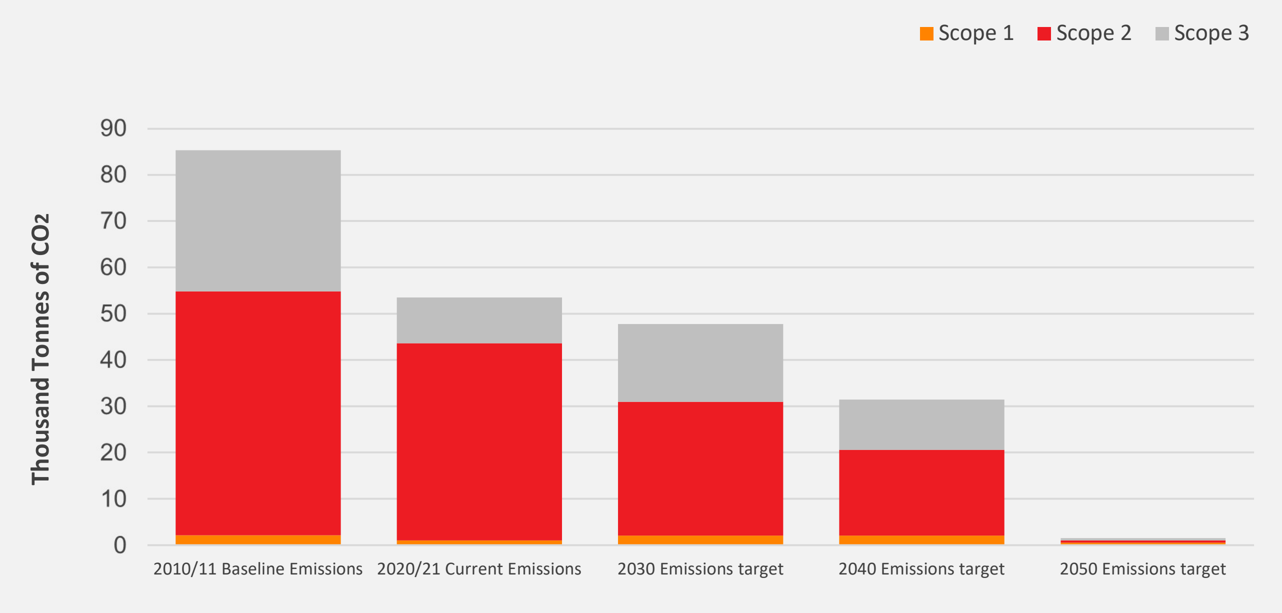
Scope 2
Emissions associated with the use of electricity imported from the grid or from a third-party supplier of energy in the form of heat or electricity.

Scope 3
Emissions as a direct consequence of the use of goods or services provided to the University to enable it to conduct its business. Sources include waste disposal, cleaning services, food and beverage services, IT and other equipment, paper and flights transmission and distribution losses from electricity.

Our carbon emissions target

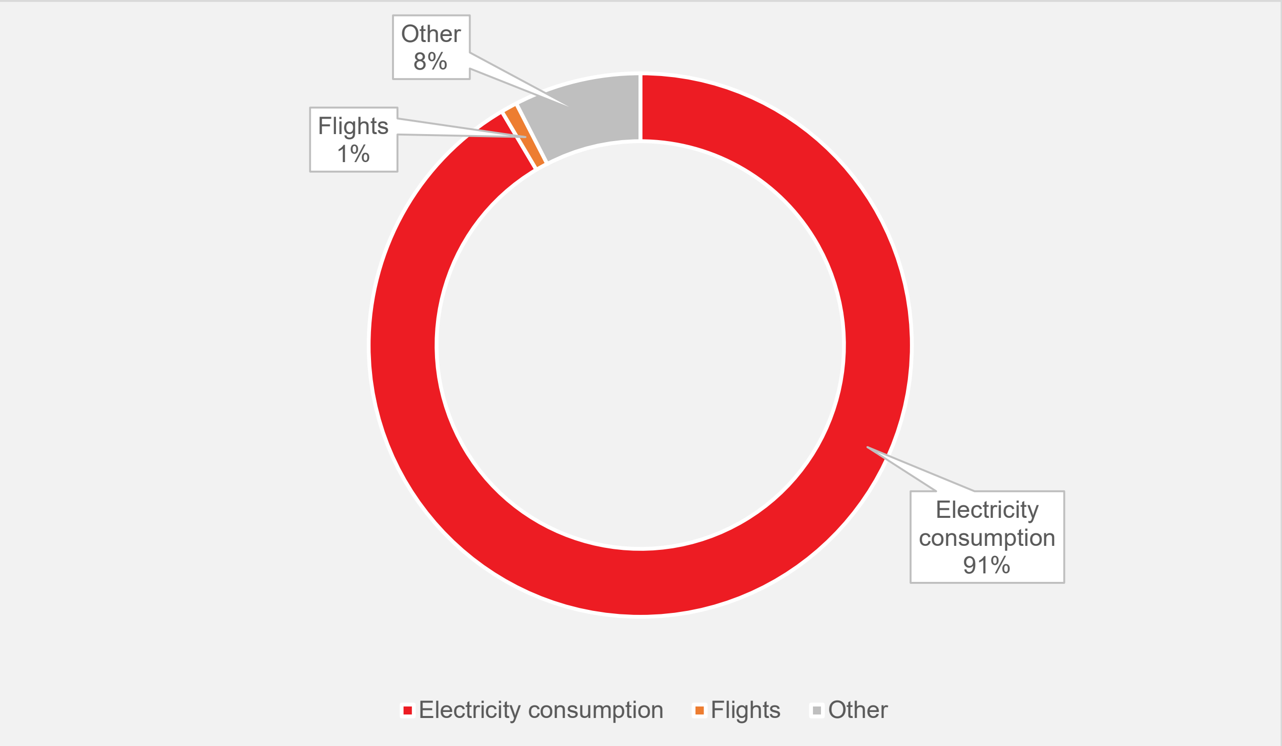
The University Strategy 2020 – 2025 “Creating a future for all” commits to developing an action plan to align Griffith with the recommendations of the Intergovernmental Panel on Climate Change by halving carbon emissions by 2030 from 2010 levels and reducing them to net zero by 2050. The Net Zero Carbon Emissions Report outlines the plan and was endorsed by Council in December 2019.

Comparison of 2010/11 baseline emissions, current emissions and targets to meet the IPCC targets.



For the 2020/21 year, the carbon emissions breakdown by source is as follows

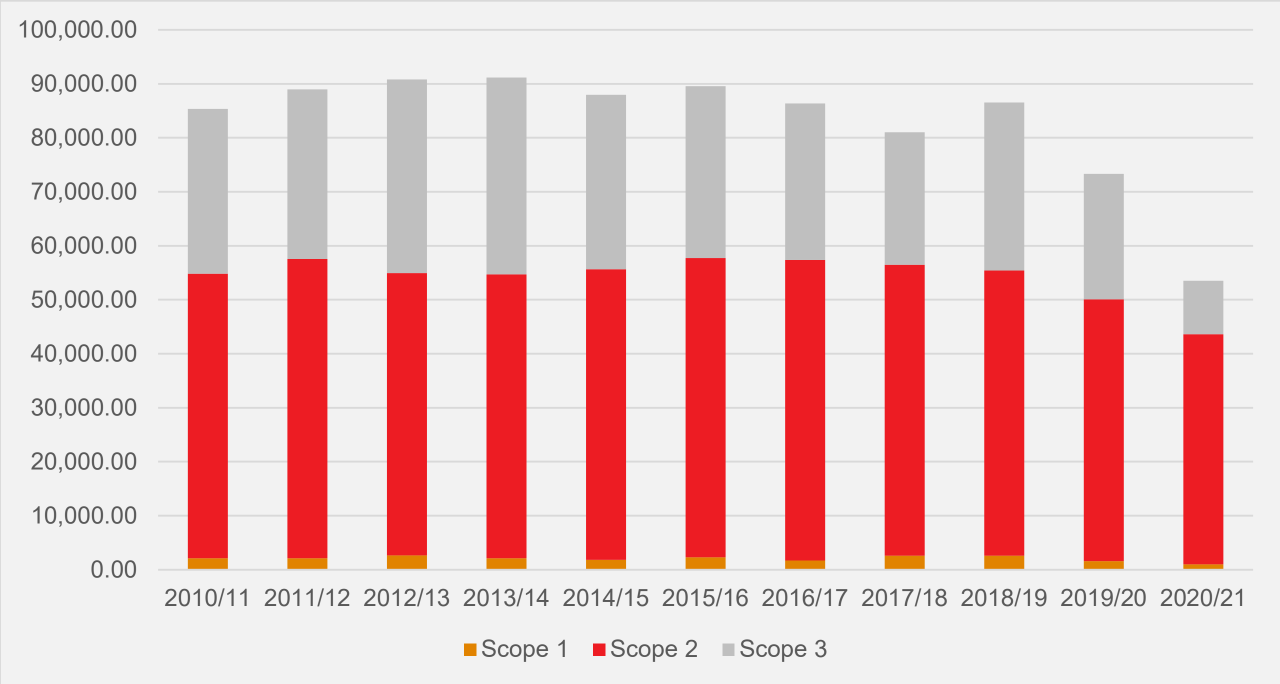
2020/21 carbon emissions breakdown



The above is reflective of the lack of air travel, expected to resume next year.

This report illustrates how Griffith compares against the sector on a scope 1 and 2 emissions, and electricity consumption basis; reviews scope 1, 2 and 3 emissions and projects to reduce each, and forecasts our 2030 emissions based on implementing further initiatives.

Scope 1, 2 and 3 emissions by year



2020/21 progress

Overall, the total carbon emissions for the 2020/21 year are 37 % below the 2010/11 baseline.

Comparing against the 2010/11 baseline:

- Scope 1 'direct emissions' are 52% lower due to reduced fuel consumption for vehicles and reduced replacement of refrigerant in aged chiller plant.
- Scope 2 'electricity (indirect) emissions' are 19% lower due to the progress with on-going energy efficiency projects and the reduced campus activity across all campuses.
- Scope 3 'other indirect emissions' are 68% lower with reduced flights, paper, waste, cleaning and food related emissions.

Comparing against the previous year (2019/20):

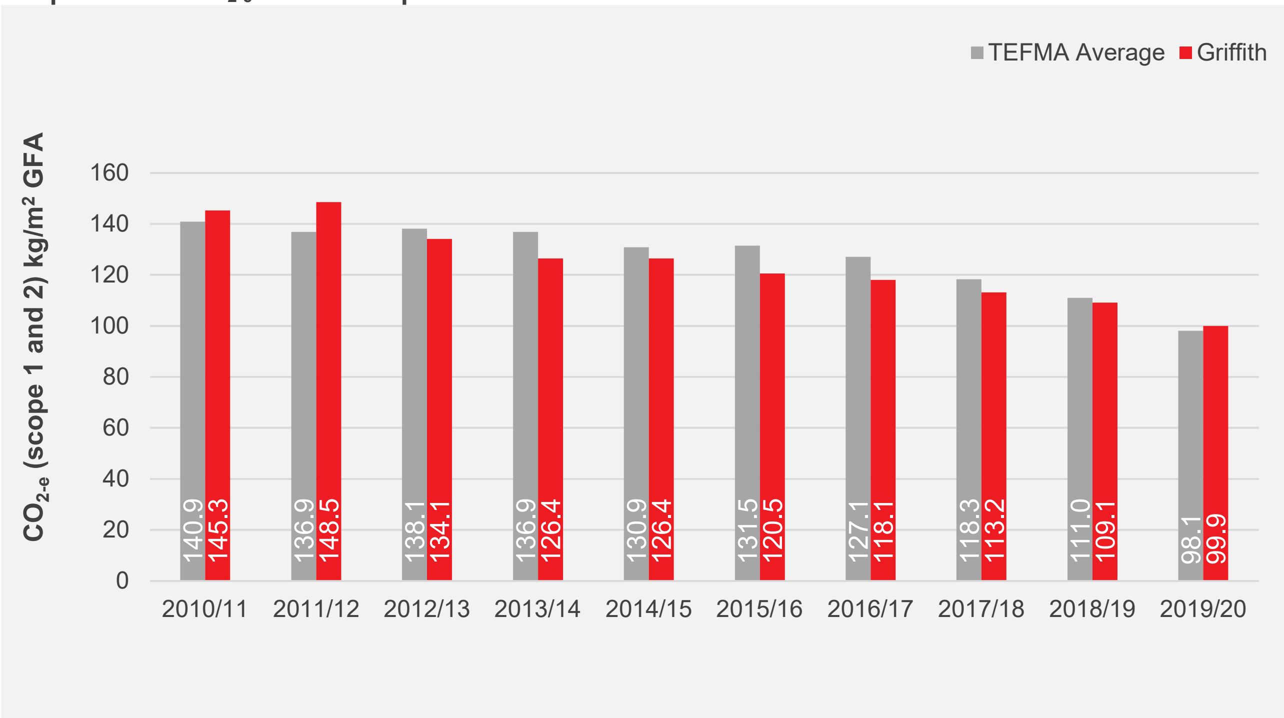
- Scope 1 'direct emissions' are nearly 37% lower. This is due to reduction in unplanned refrigerant releases from chiller plant and reduced vehicle fleet consumption due to the ongoing pandemic.
- Scope 2 'electricity (indirect) emissions' are 14 % lower. The main contributions have been the chiller replacements and ongoing work in energy efficiency, particularly around lower occupancy spaces.
- Scope 3 'other indirect emissions' are 57% lower. This is primarily a result of the reduction in business flights, due to ongoing border closures related to the pandemic together with significant reductions in IT equipment, food and waste emissions. Paper use has also reduced substantially but as much of this is carbon neutral paper it has no impact on the carbon emissions.

TEFMA benchmark data

The TEFMA Benchmark data provides the Higher Education sector with information for comparing an institution's performance against the sector on a range of metrics. The sector average for Scope 1 and 2 Green House Gas emissions per square metre of gross floor area continues to decline as the sector continues to invest in solar and other renewable sources of energy. As a result, Griffith are now performing 2% above the sector average. The roof top solar project together with the 50% renewable electricity contract are expected to address this next year.

TEFMA does not provide benchmark data on scope 3 emissions.

Scope 1 and 2 $CO_{2\text{-}e}$ Emissions per m^2 GFA



Note: [1]TEFMA excludes residences GFA. [2]2021 TEFMA average value not yet available. 3. Comparison relates to campus net consumption only.

Scope 1 emissions

Scope 1 emissions were 1.4 % of our total emissions for 2020/21. These include:

- Natural gas consumption for boilers, hot water heating and cooking
- Transport fuels i.e. fuel for fleet cars and other university vehicles
- Stationary fuels - for fixed equipment e.g. generators
- Synthetic gases e.g. refrigerant for cold rooms, air conditioning units, chillers

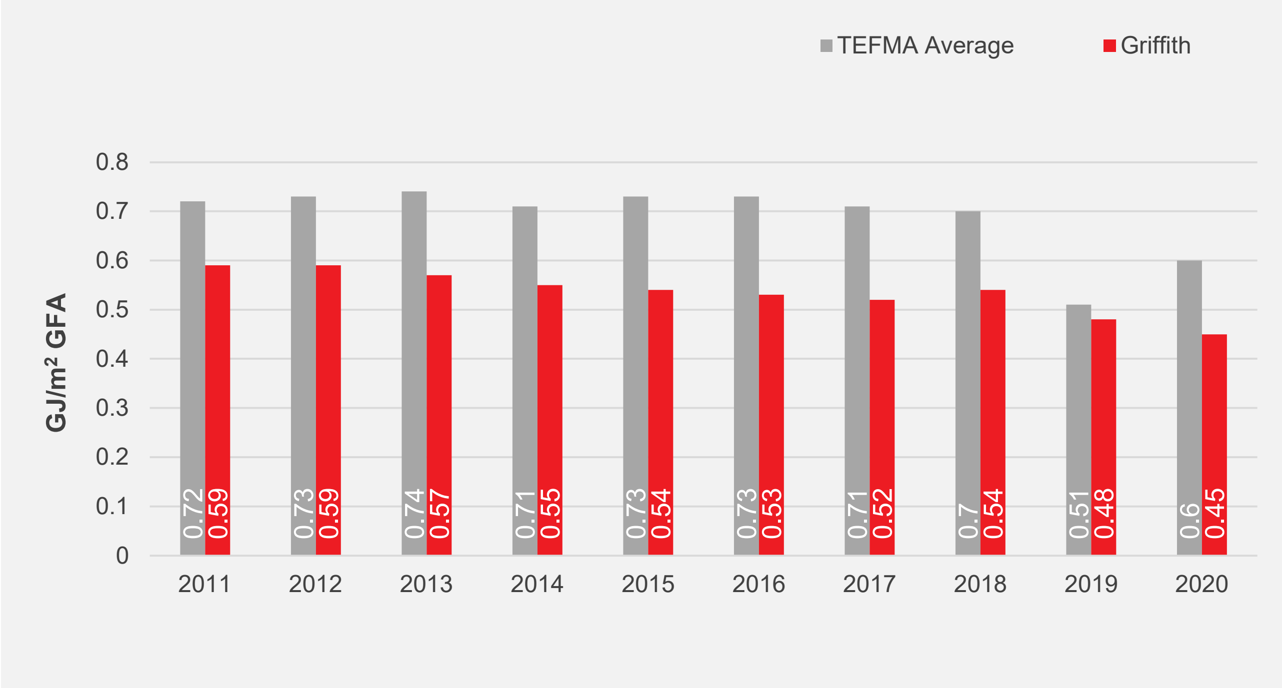
Savings are being made progressively as the car fleet shifts from petrol to hybrid vehicles and the opportunities to move to electric cars are being investigated. Refrigerant gases are another opportunity for reductions, as we replace aged chillers. When old chillers breakdown there is often a release of refrigerant. For our older chillers, these are gases of high global warming potential so the associated carbon emission is high.

Scope 2 emissions - Our energy footprint

The largest part of our carbon footprint is the Scope 2 indirect emissions associated with the generation of electricity consumed on campus. To meet our carbon target, we will need to focus on reducing our electricity consumption.

A comparison of the TEFMA benchmarks (shown below) indicates that the University's electricity consumption per m^2 GFA is lower than the sector average. After a reduction in the benchmark last year (2019), the benchmark has increased but the Griffith value shows a small improvement. The reasons for the change in benchmark have not been advised but are likely to include pandemic impacts and sector investments in energy efficiency, green power and renewable generation (both on and off site).

Electricity consumption – per m² GFA



Note: [1]TEFMA excludes residences GFA. [2]2021 TEFMA average value not yet available.

In previous years, since the baseline year, our scope 2 off site electricity emissions were calculated using the Location based method. This uses a factor for conversion from kwh consumed to carbon emissions based on the consumer's location, by state. Commencing from this year, we will move to reporting the associated carbon emissions from our off site generated electricity on the market based method. This option is now included in the Greenhouse Gas Protocol methodology and offers us a simple way to account for the reduced carbon associated with our commitment to the off site renewable generation from the Columboola Solar Farm. The difference in the result for this year is approximately 4% better than if calculated on the Location based method.

Energy efficiency projects

Over the 2020/21 period, the following projects were completed:

- chiller plant replacements at Queensland Conservatorium (S01), Psychology (M24) and GRIDD I (N27)
- Decommissioning chiller plant at Graduate Centre (S07) providing chilled water from existing plant at the adjacent Webb Centre (S02))
- Building tuning and controls improvements including reducing plant run times over holidays and weekends and more energy efficient mould reduction programmes

These projects are described in more detail on the following pages. Projects in progress and planned for future years are described in the final part of this report.

New Chiller Plants

Most of the cooling for the University's air conditioning is provided by chiller plants, which produce and distribute cold water to air conditioning systems. The University's 19 chiller plants account for over 20% of total electrical energy consumption and details of recent improvements in energy efficiency over the majority of these plants are given in Appendix 1. This shows an estimated 10% total improvement across the campuses over the last 3 years as a result of many small improvements to the controls.

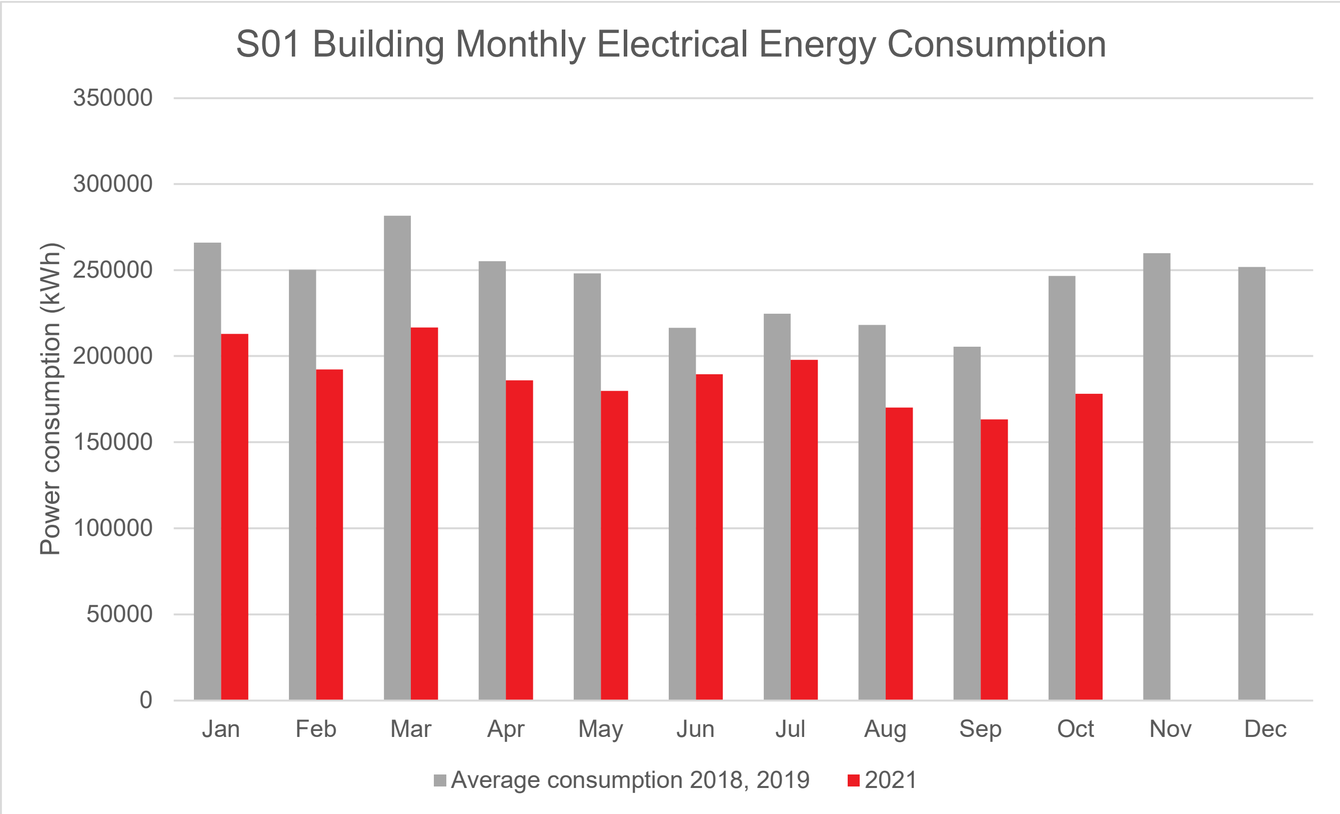
This year, three new chiller plants were commissioned at Psychology (M24), GRIDD 1 (N27) and Queensland Conservatorium (S01) following complete replacements of the existing plants. The works were primarily completed because the existing plants had reached the end of their service life, becoming unreliable and costly to maintain. Further benefits are that more energy efficient equipment has been installed, and plant with older refrigerants with higher Global Warming Potential have been decommissioned. These refrigerants are being phased out under the Montreal Protocol and form a substantial part of our Scope 1 emissions.

Queensland Conservatorium (S01) Chiller Plant

The new S01 chiller plant was commissioned in January 2021 and replaced the existing end of life chiller plant with chillers that operate with 2 to 2.5 times the efficiency of the old chillers. This means that the new chillers typically consume less than half of the electrical energy of the old chillers to produce the same amount of cooling. The resultant estimated energy savings are shown in Table 2. The forecast savings are supported by building power consumption figures which show significant reductions in year-on-year building consumption since the new plant was commissioned in January 2021 (see figure below).

Table 2: S01 Chiller Plant Energy Savings and Return on Investment

Total cost of works	$1,818,000
Annual power savings	420,000 kWh
Annual $tCO_{2\text{-}e}$ reduction	391,000 tCO2-e
Project spending per annual $tCO_{2\text{-}e}$ saved	$4.65
Annual electrical bill savings	$58,800.00
Return on investment:	31 years

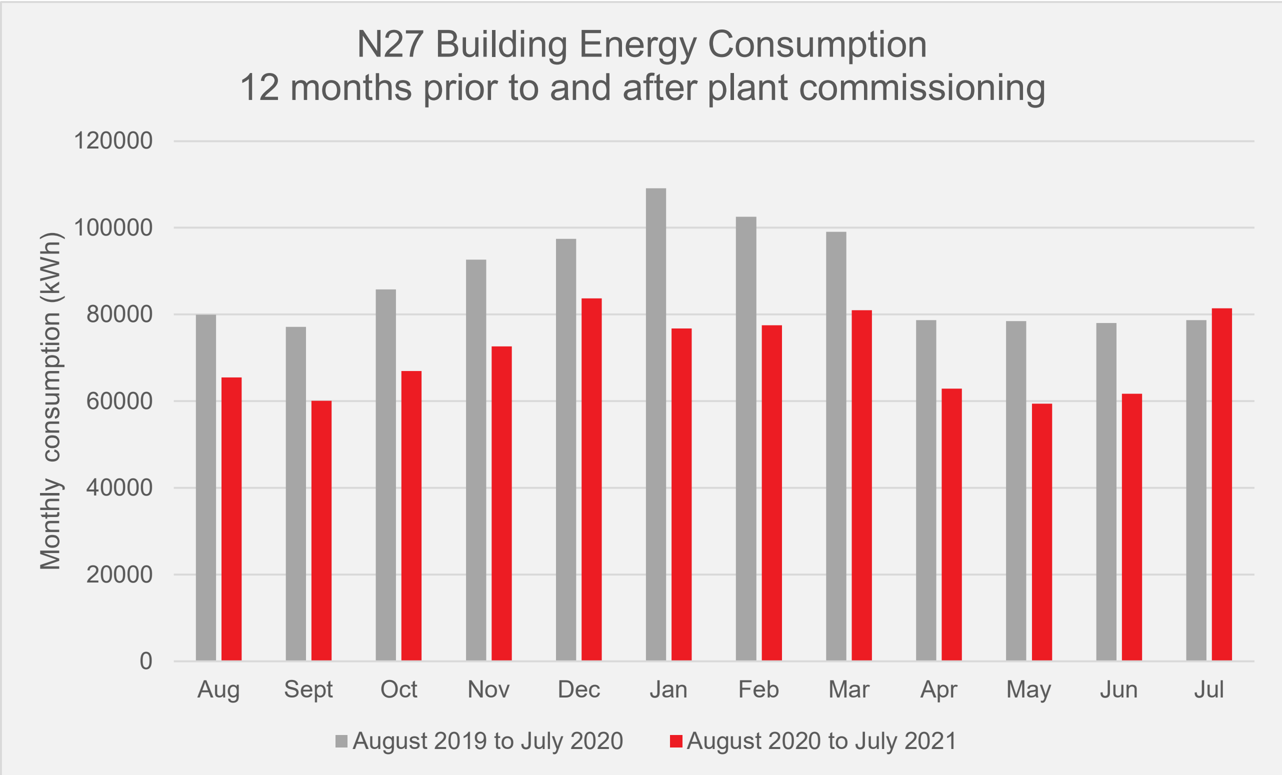


Griffith Institute for Drug Discovery 1 (N27) Chiller Plant

The new N27 chiller plant was commissioned August 2020 and replaced the unreliable existing chiller plant. Based on electricity metering data, the new chiller plant is estimated to operate using 55% less power consumption compared to the old plant. The associated energy savings are outlined in Table 3. This estimate is consistent with the reduction in building energy consumption in the 12 months before and after commissioning of the new chiller plant as shown in the graph below. The graph shows a 22% saving each month except for July which at the height of winter is when there is very low load on the chiller plant as the building is mostly heating. The building is a research building and has operated as normal throughout the pandemic.

Table 3: N27 Chiller Plant Energy Savings and Return on Investment

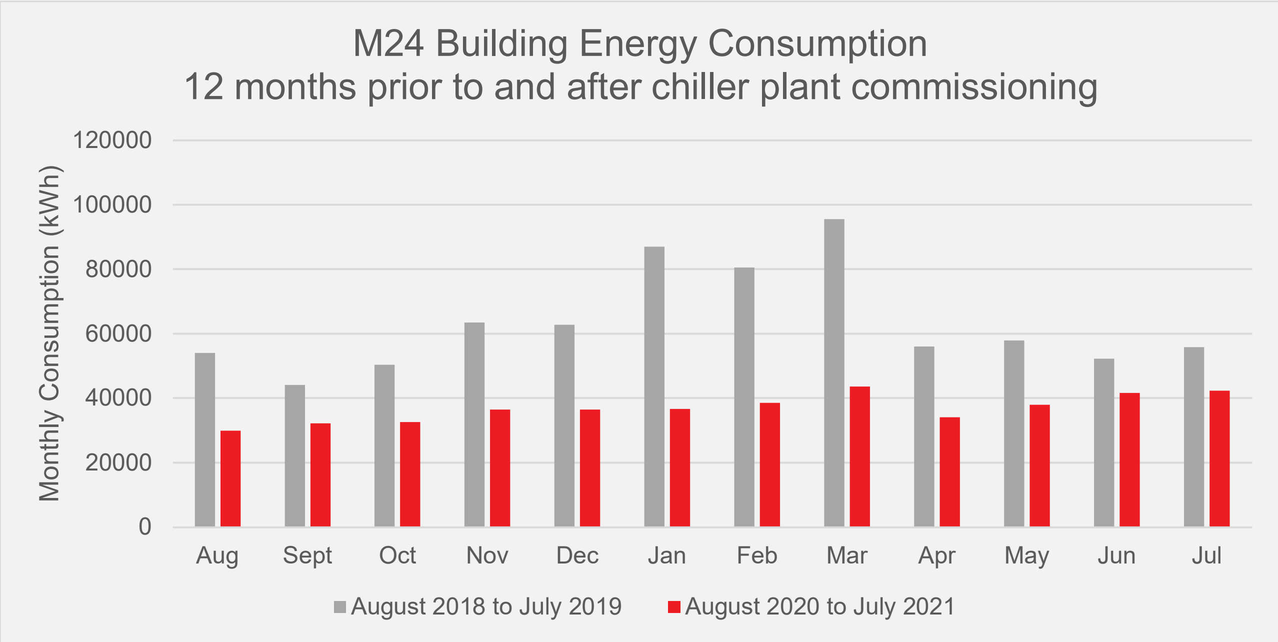
Total cost of works	$438,000
Annual power savings	195,000 kWh
Annual $tCO_{2\text{-}e}$ reduction	181,000 tCO¬2-e
Project spending per annual $tCO_{2\text{-}e}$ saved	$2.42
Annual electrical bill savings	$27,300.00
Return on investment:	16 years



Psychology (M24) Chiller Plant

The new M24 chiller plant was commissioned in August 2020 replacing end of life plant. This plant provides chilled water to M24, Social Sciences (M10) and Education (M06). The original chiller plant was not metered so we cannot directly report the associated reduction in energy consumption. We would expect an improvement of 20–30%.

M24 building wide energy consumption decreased by 317,000 kWh (42%) year on year from 2018/19 to 2020/21 after the new plant was commissioned (see graph below). Note that due to ongoing changes in building occupancy due to COVID-19 and variable weather conditions, it is not possible to determine what portion of these savings can be attributed to the new chiller plant.



Building Tuning

A variety of small building tuning projects have been completed. Two have been highlighted here where significant reductions in energy consumption have been achieved.

Air Conditioning System Shutdowns

The University buildings contain over 4000 individual air conditioning units. Recent control system improvements included the option to control groups of units and rapidly schedule them on/off to reflect public holidays, lockdowns and other opportunities when the air conditioning is not required.

The estimated annual energy saving due to reduced consumption on public holidays during Christmas 2020 and the first half of 2021 from having these additional control features is shown in Table 5. The saving was estimated based on the relative reduction in public holiday energy consumption compared to previous years, factoring for influences such as COVID-19 and weather conditions.

Table 5: Public Holiday Shutdown Energy Savings

Annual power savings	184,000 kWh
Annual $tCO_{2\text{-}e}$ reduction	171,120
Annual electrical bill savings	$25,760.00

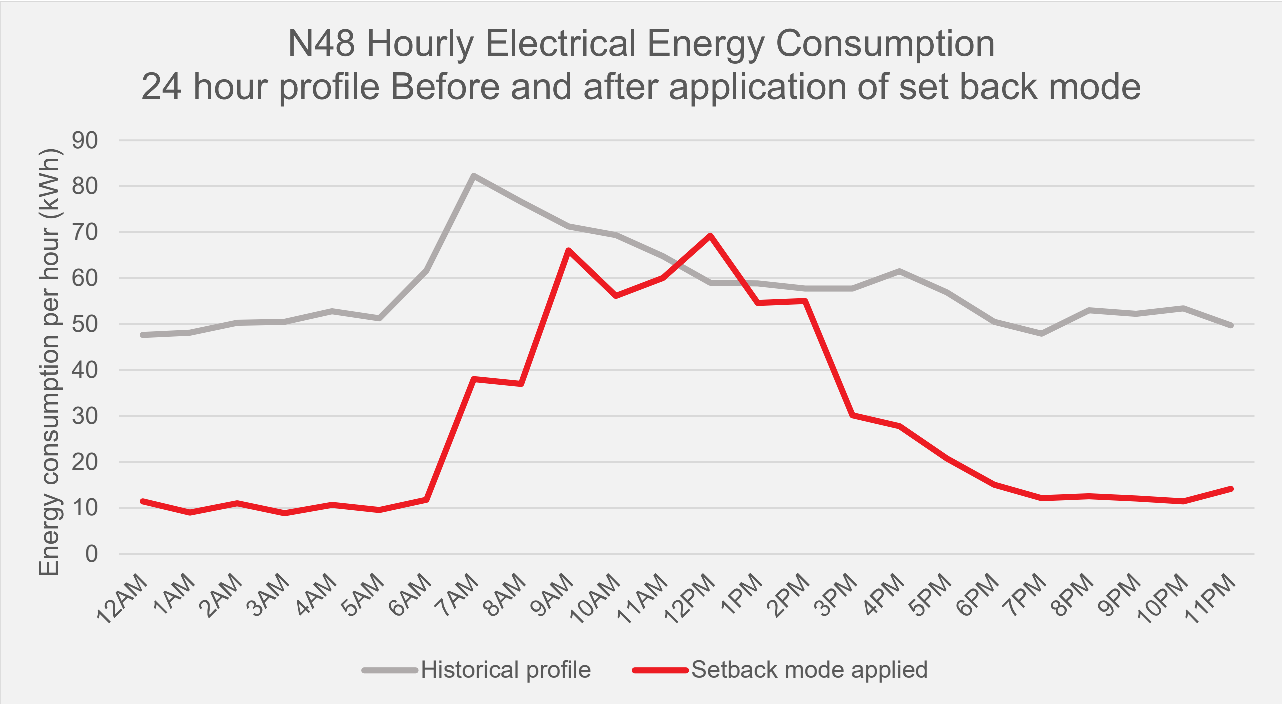
Setback Mode

For energy efficiency, general air conditioning systems should typically only operate when the rooms served are occupied by people. However, specialised spaces such as laboratories often require certain room conditions to be maintained 24/7.

Historically, the level of air conditioning supplied to these spaces has been the same during both occupied and unoccupied periods. Setback mode has been introduced to reduce energy consumption where appropriate by providing a reduced level of air conditioning during unoccupied periods while still maintaining the required conditions.

During unoccupied periods, set back mode may allow for a wider band of space temperatures, reduce the volume of air supplied, or only operate the air conditioning system periodically as needed to maintain the required conditions e.g. in lecture theatres which are prone to mould if the humidity is high, the air conditioning is set to maintain the normal 23.5 °C during lectures and if not occupied on any day to run twice a day for 45 minutes and/or when the humidity in the room exceeds 67% (depending on the controls infrastructure capability). Any changes to operating conditions are reviewed with the area's key stakeholders before proceeding.

An example of an early application of setback mode is for the Anatomy teaching laboratory in Health Sciences (N48). The graph below shows the building's energy consumption profile on a typical winter day before and after the introduction of setback mode. While energy consumption of the building during the day when the space is occupied remains similar with and without setback mode, overnight energy consumption when the laboratory is unoccupied drops here from around 50 kW to 10 kW due to the reduction in energy consumption for heating. Based on year-on-year data, building consumption reduced 59% following the introduction of set back mode in this laboratory. It is estimated that around 40% (140,000 kWh) of this reduction is due to the application of setback mode, while the rest is attributable to COVID-19 related reduction in building utilisation.

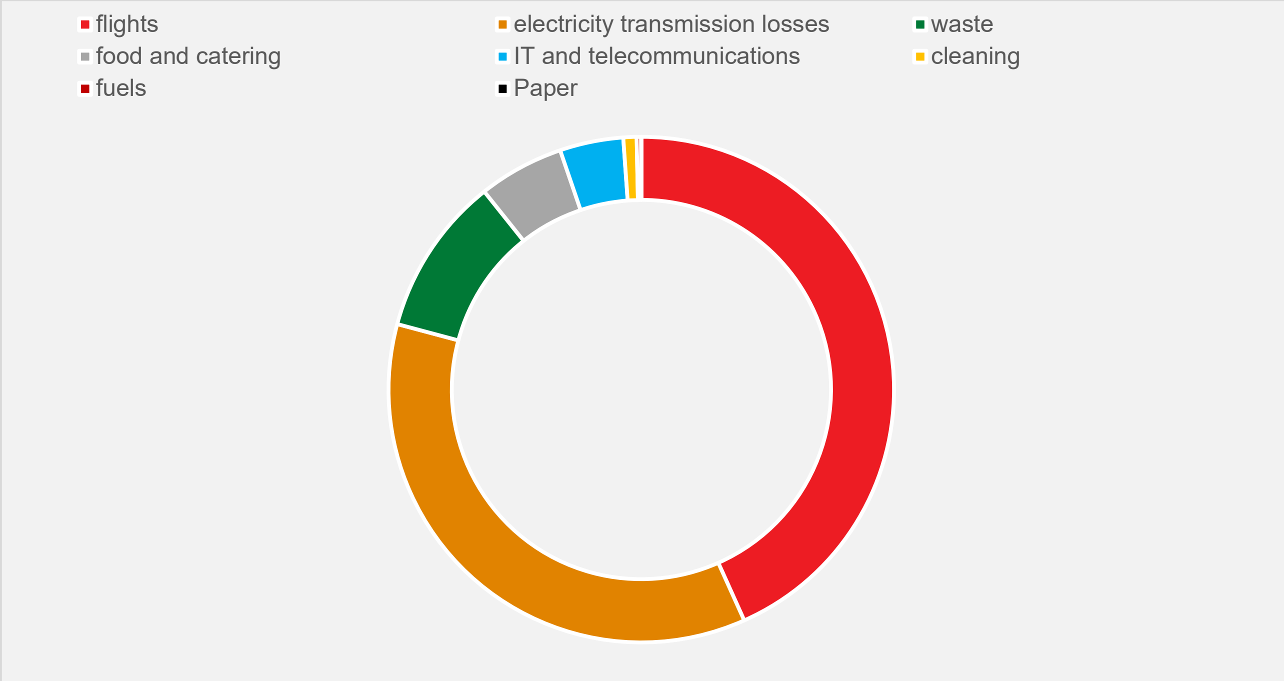


Setback mode has also been applied to Nathan lecture theatres (N02, N18, N22 and N63) and a variety of other spaces to keep humidity levels low enough to prevent mould growth without running air conditioning for long periods. There is additional work underway to bring setback mode to the Queensland Conservatorium (S01) and Gold Coast lecture theatres starting with Ian O'Connor Building (G40).

Scope 3 emissions

The University has monitored Scope 3 emissions from 2010/11 onwards and reported on progress on managing waste and flight related emissions as they have significant potential for improvement. The breakdown of Scope 3 emissions for 2020/21 is as follows:

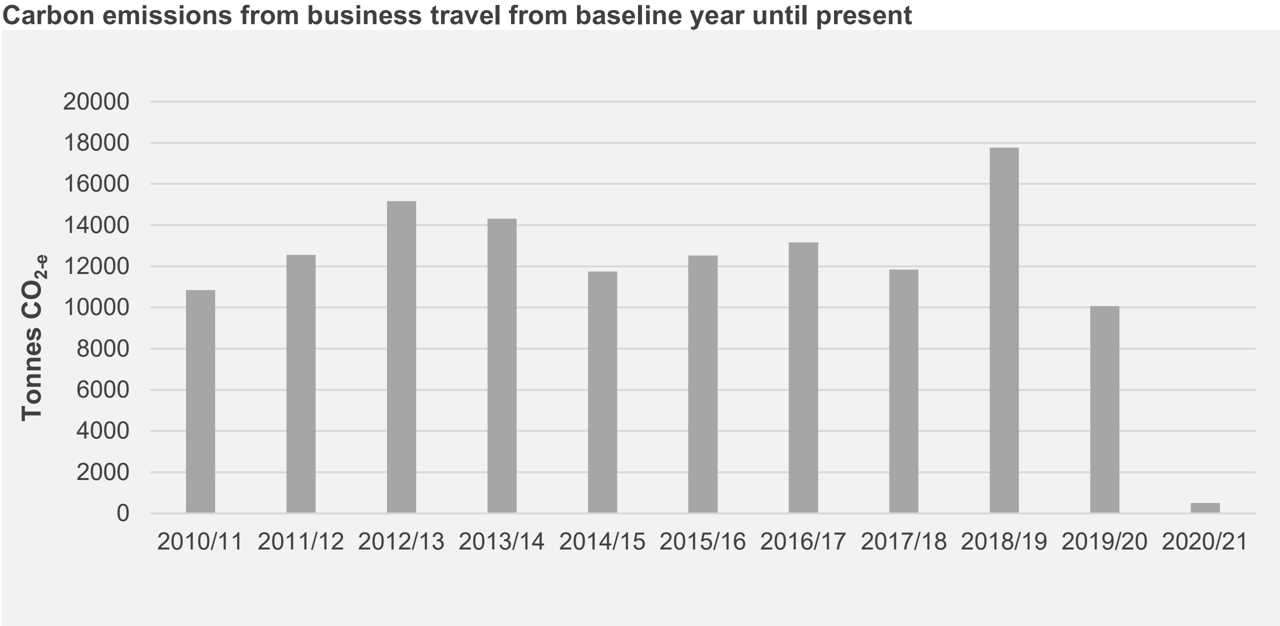
2020/21 Scope 3 emissions



Managing our flights

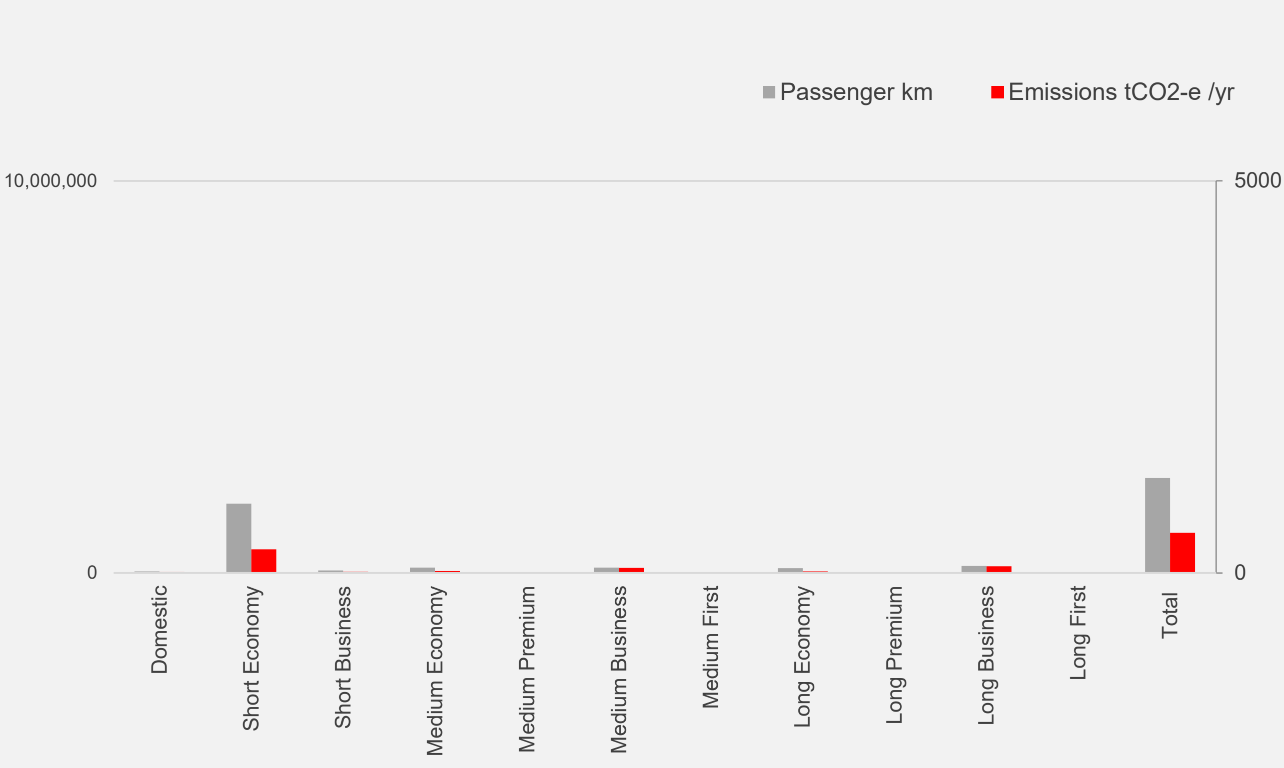
In the 2020/21 reporting year our total passenger kilometres were 2,422,799 equating to 510.9tCO_{2-e}. This is approximately 5% of the flights in the previous reporting year. This is due to the ongoing international and state border closures due to the pandemic. Discussions continue regarding a suitable level for a target of reduction in air travel which is raising awareness of the issues so there may also be some contribution from the focus on reducing air travel and the shift toward online conferences and meetings.

Carbon emissions from business travel from baseline year until present



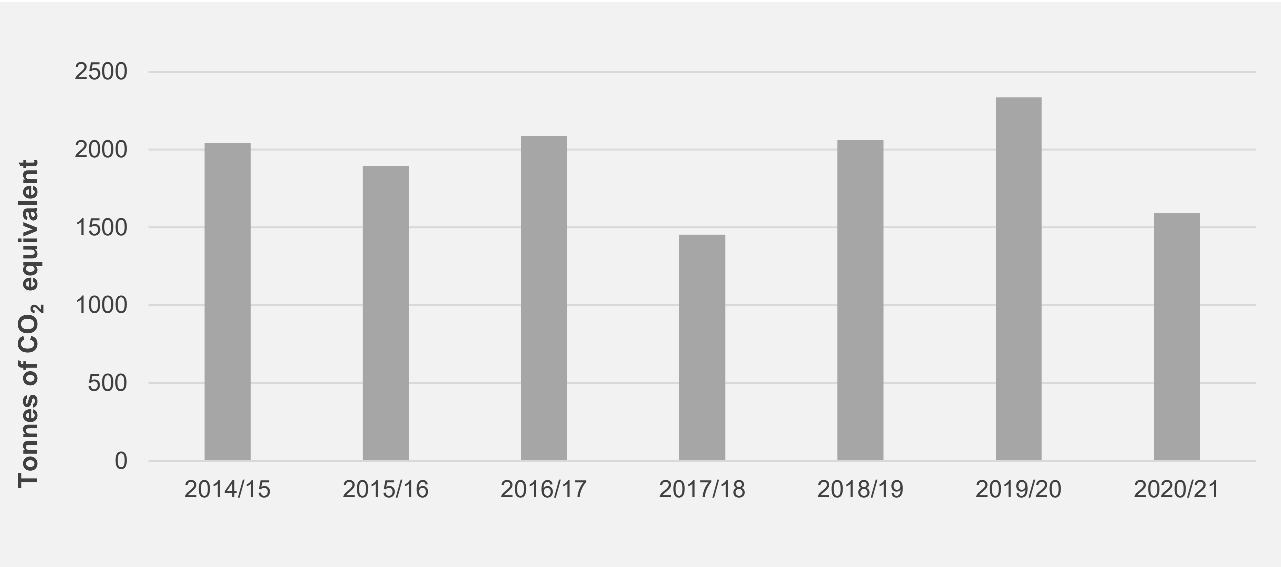
The breakdown of the business air travel data is as follows:

Business air travel



Managing our waste

Annual Carbon emissions from Landfill Waste



The increase in 2019/20, was a result of the changed methodology for the new waste contract. The waste was previously weighed but is now based on an average bin weight. Close attention has been paid to waste management over the past year which has resulted in a better outcome in 2020/21, assisted by reduced campus activity. New initiatives for waste handling are being developed for implementation and we will continue to actively monitor as the year goes on.

The TEFMA benchmark data is for landfill and recyclable waste combined. As the data on recyclable waste is considered unreliable, a comparison to TEFMA benchmark data is not presented here.

Pathway to 2030 target

The Net Zero Emissions report written in 2019 outlined the University's approach to meeting the recommendations of the Intergovernmental Panel on Climate Change, for inclusion in the Vice Chancellor's Strategic Plan 2020-2025: Creating a future for all. The report outlined three key strategies for reducing our carbon footprint:

- avoiding emissions
- reducing emissions
- generating and purchasing clean energy

The report set out a pathway to the 2030 target, which includes the following key levers

- high efficiency chiller replacements for replacements planned for end of life assets including the Nathan central chiller facility
- Carbon storage and sequestration in forests
- Energy efficiency measures including review of building and server room temperature set points, fitting VSD drives to mechanical equipment where applicable, occupancy sensors etc
- Off site renewables – purchase of 50% renewable power - our new electricity sourcing agreement commenced late 2020. The arrangement includes a 50% renewable portion (together with the associated certificates) from a new solar farm which is now expected to start producing in mid 2022.
- On site renewables – investment of $13.8 m in roof top solar generation and other onsite renewable measures
- Reduction in air travel of 25% by 2030
- Reduction in paper use, waste, behavioural change programme
- Migration to electric car fleet or other low carbon transport options
- Water cooled chiller plant at the Gold Coast Campus.

As the largest contributions to our carbon footprint, the first initiatives focus on reduction in energy consumption and flight related emissions as follows:

Flights

The University community will work together to target a reduction in air travel of 25% by 2030 by looking at initiatives such as investing in digital technology to enable virtual meetings and conferences, to incentivise travel reduction and to review University policy relating to international collaboration.

Electricity

The scope 2 electricity emissions remain the greatest part of our emissions. Energy reduction projects in progress and planned for next year are as follows:

- Completion of the replacement of the Central Chiller Plant (N45) with a new Chiller Plant West (N80) in December 2021
- Replacement of one chiller at each of G21, G22 and G29 – pending approval of the Asset Management Plan
- On site renewables –Installation of the roof top photovoltaic panels will commence in 2022
- Energy efficiency initiatives – the project will continue into 2022, reviewing temperature set points, installing variable speed drives, occupancy sensors and other energy efficiency projects

Our forecast electricity consumption to 2030 shown in the graph below includes the following key milestones

2022 Completion of Chiller Plant West (N80)

2023 Opening of Technical Annexe (N81)

2025 Opening of ADaPT building at Gold Coast

2025 Practical completion of Arrivals Building (N82) (second half of the year)

2026 Completion of exit from Mount Gravatt (first half of the year)

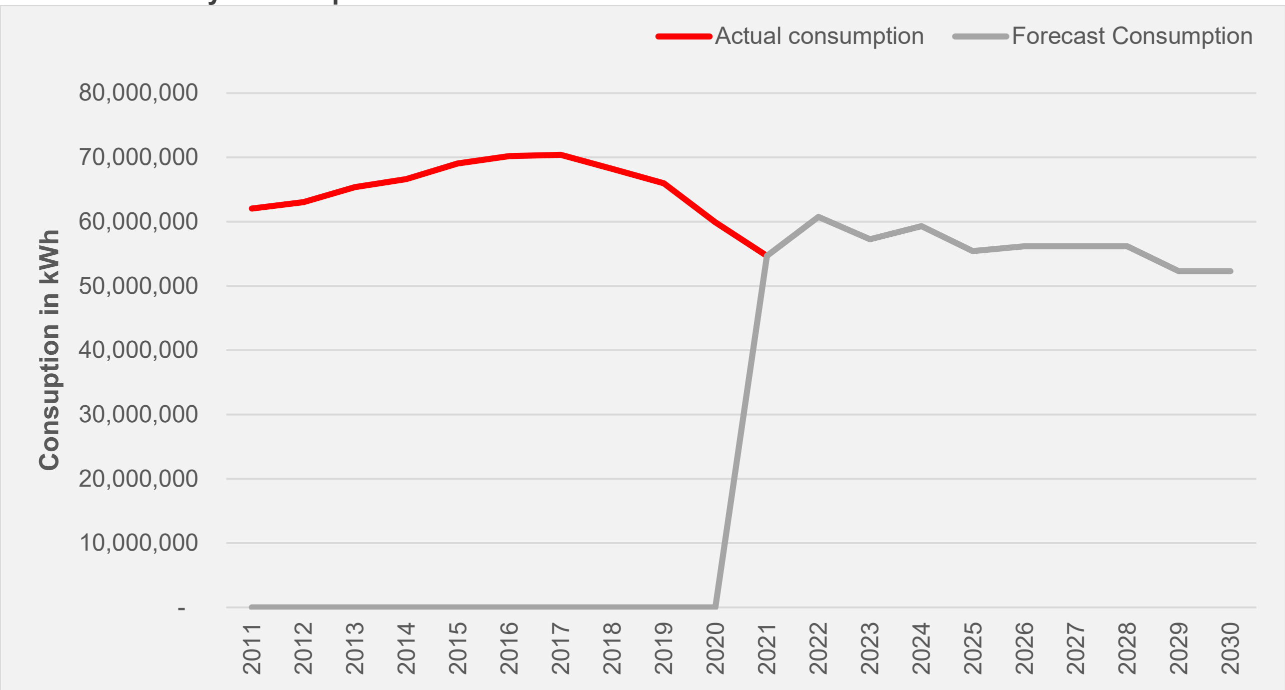
2027 City Campus open

2029 Completion of water-cooled chiller plant at the Gold Coast

2029 Demolition of Science 1 (N25)

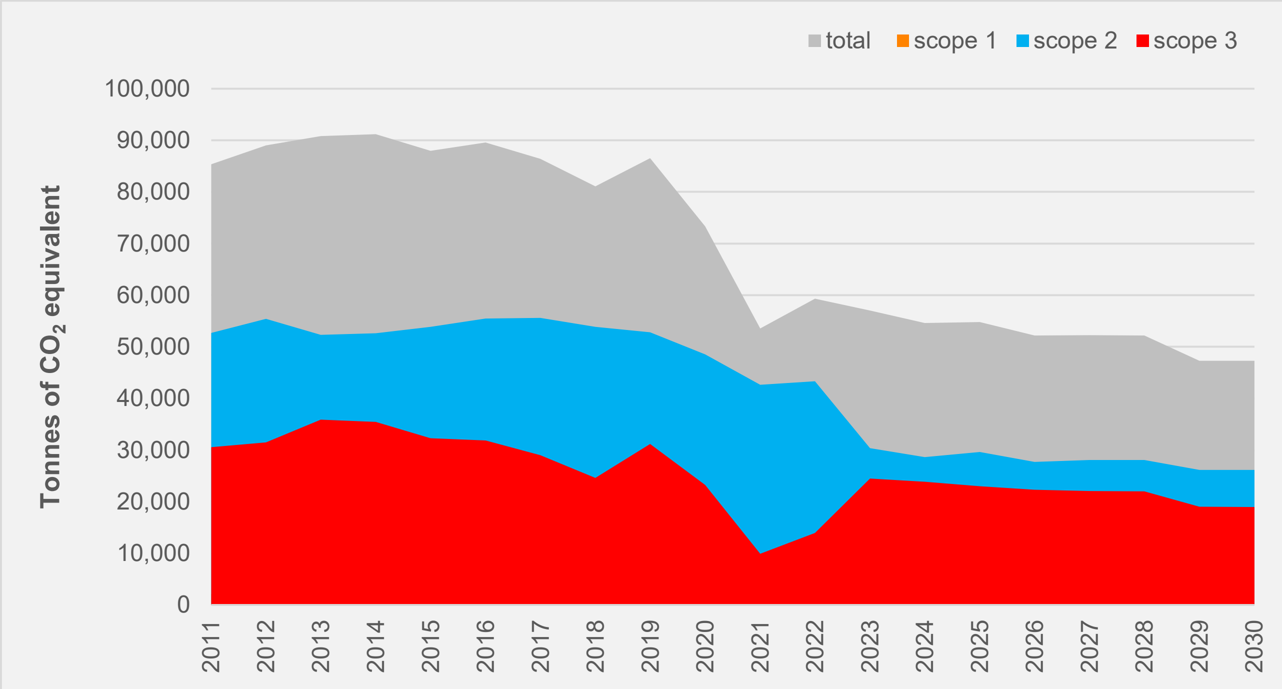
Together with the progressive rollout of replacement chillers across all campuses, energy efficiency projects and rooftop solar (2022 – 2025):

Annual electricity consumption forecast to 2030



The carbon emissions associated with our electricity consumption will include the benefits of the 50% renewable energy from 2022. Our forecast emissions are as follows:

Annual carbon emissions to 2030



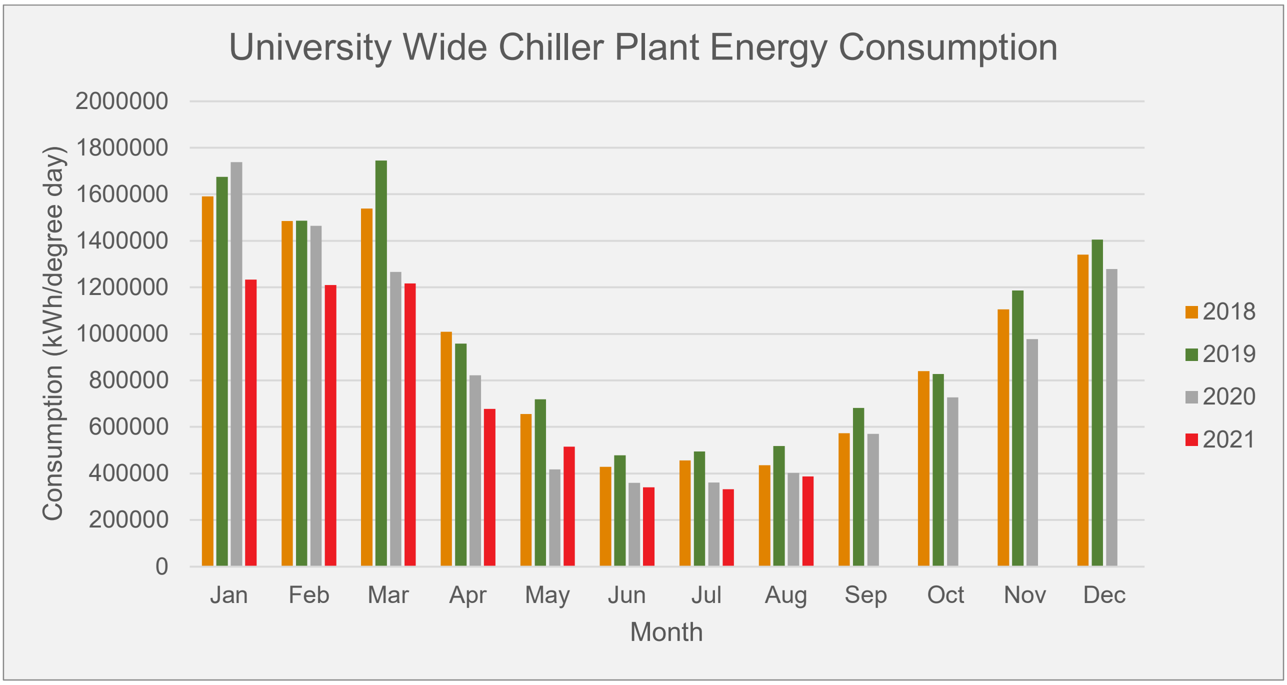
The forecast for 2021/22 is based on

- activity levels on campus similar to 2018/19 for the latter part of the year
- 50% renewable portion from the electricity sourcing agreement (from April 2022).
- Flights are estimated at 5,000 tCO_{2-e} (50% of the 2010 baseline). The first quarter flights were very low, second quarter to December is also expected to be low and then once there is some certainty around the Queensland borders being open and the quarantine arrangements for international arrivals as we move into 2022, flights are likely to move back towards their normal activity levels.

Appendix A: University Wide Chiller Plant Energy Consumption

University Wide Chiller Plant Energy Consumption

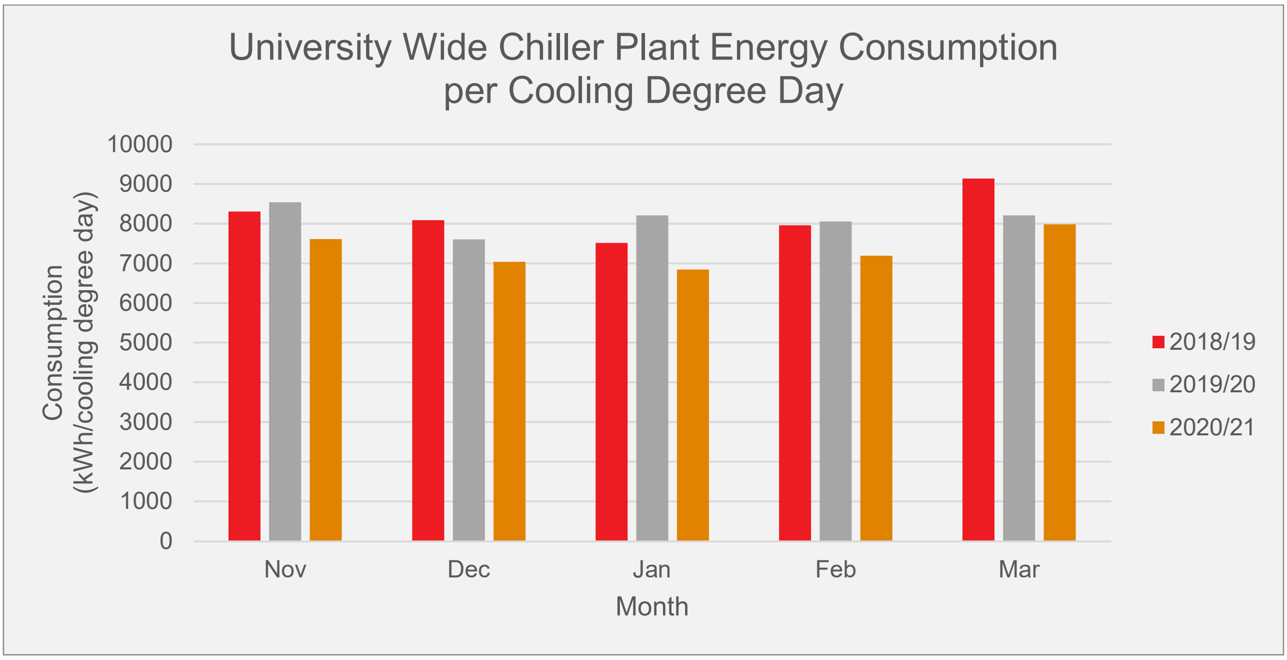
Monthly combined chiller plant energy consumption since 2018 is shown in the graph below. Note that the graph only includes chiller plants where sufficient long-term data is available for reporting[1], which excludes the new chiller plants at S01, N27 and M24. Based on this data, chiller plant energy consumption reduced by 27% (2,161,000 kWh) from the period of January - August 2019, to January - August 2021.



A significant contributor to the reduction in energy consumption was the relatively cool summer in 2021. To factor out the impact of the cooler summer, a ratio of monthly chiller plant energy consumption to *cooling degree days* was calculated for the months of November to March and is shown in the graph below. *Cooling degree days* is a commonly used measure for estimating how much air conditioning energy is needed for a period based on the outside air temperature curve.

Based on this data, it is estimated that there was a 10% reduction in chiller plant energy consumption from summer 2019/2020 levels to 2021 after factoring for the cooler weather. The reduction is due to a variety of factors including changes in building utilisation, building optimisation works and chiller plant operational improvements.

[1] Note: Long term energy consumption data is available for chiller plants representing 78% of the University's total capacity. Plants excluded due to insufficient availability of long-term data include M14, M24, N27, N75, N79 and S01.



Chiller Plant Control Upgrades

Between December 2020 and May 2021, GU upgraded chiller plant control systems in G37, G40, G53 and S02 to improve plant reliability, reduce maintenance costs, improve monitoring capabilities and reduce energy consumption. The upgrades bring the control systems to the same standard as most other GU chiller plants including the new plants discussed above.

There is insufficient long-term data available to assess the reduction in energy consumption due to the upgrades, however it has been estimated that the works will reduce the energy consumption of the plants by at least 3% or 100,000 kWh per annum as outlined in Table 4.

Table 4: Chiller Plant Control Upgrades Energy Savings and Return on Investment

Total cost of works	$67,840
Annual power savings	100,000 kWh
Annual $tCO_{2\text{-}e}$ reduction	93,000 tCO2-e
Project spending per annual $tCO_{2\text{-}e}$ saved	$0.73
Annual electrical bill savings	$14,000
Return on investment:	5 years