Griffith UNIVERSITY
Queensland, Australia

*Sprint team report*

# ACHIEVING NET ZERO CARBON EMISSIONS BY 2050

# Introduction

The Vice Chancellor's second phase Strategic Discussion Paper was issued in May 2019 and included the following proposal:

"*For the purpose of this strategy it is proposed that Griffith commit itself to the recommendations of the Intergovernmental Panel on Climate Change which reflect the best scientific consensus (including contributions from our own colleagues) on how to keep global warming to 1.5°C above pre-industrial levels. This would require us to aim for 45-50% decline in our $CO_2$ emission from 2010 levels by 2030 with an aim of reaching net zero $CO_2$ emissions around 2050. These are ambitious targets and would require a sustained effort around issues including reducing energy use and seeking renewable energy sources both on and off our campuses, reducing travel, waste and other sources of emissions. Given that we have only undertaken preliminary work in this area, it is proposed that a small team from Corporate Services and experts from within the Griffith community undertake some intensive work over coming months, particularly on issues around energy to test the feasibility and cost of making this commitment.*"

In June 2019, a project team was formed to consider the feasibility and cost of achieving the proposed emissions targets. This was co-chaired by

- Peter Bryant, Vice President Corporate Services
- Brendan Mackey, Director, Griffith Climate Change Response Program

The members included:

- Joanna Allen, Associate Director Engineering, Corporate Services
- Andreas Chai, Discipline Head of Economics and Business Statistics
- Christopher Fleming, Professor, Director MBA
- Robert Hales, Director, Griffith Centre for Sustainable Enterprise
- Nicola Collier Jackson, Director Campus Life, Corporate Services
- Paul Simshauser, Professor Department of Accounting, Finance and Economics
- Rodney Stewart, Deputy Head of School (Research), Griffith School of Engineering & Built Environment and Theme Leader - Cities Research Institute (CRI)

The group met fortnightly over a two-month period, terms of reference were agreed (refer appendix 1) and the following key areas were identified for investigation: Air travel offset proposal; Behavioural change – targeting areas such as travel, commuting, reducing food and beverage emissions; Carbon sequestration and storage in forests; Energy efficiency; Onsite renewables; and Offsite renewables - power sourcing strategies.

# Overview

Our strategy for achieving the ambitious mitigation goal of net zero $CO_2$ emissions by 2050 with a 2030 target of a 45-50% reduction against a 2010 baseline involves three main strategies:

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

Measures to implement these strategies will include:

- ensuring all new buildings are designed to operate efficiently
- we will invest in energy efficiency projects including retrofitting existing buildings and updating energy inefficient equipment
- existing buildings will be operated to optimise their energy efficiency, e.g. changing set points for air conditioning systems
- we will invest in on-site clean energy generation and purchase clean sourced energy from the grid
- policies will be developed and implemented to encourage energy saving and low carbon behavioural change in staff
- the current hybrid engine car fleet will be updated to electric vehicles
- waste will be reduced that would otherwise lead to landfill emissions.

Additional notable features of our mitigation plan include:

- **Aviation emissions** - after energy consumption, the largest source of emissions is from aviation travel. Reducing these emissions in line with the overall targets will require significant behavioural change on the part of the University academia, enabled and incentivised in no small part by innovative policies. An emission reduction target will be set of 25% by 2030 and an implementation plan will be developed through consultation with the university community.
- **Carbon offsets** - we will not use carbon offset schemes as a way of dealing with what is often thought of as 'residual emissions' in our greenhouse gas accounting system. Rather, where carbon offsets are used they will be for the purpose of promoting behavioural change in staff by, for example, increasing the cost of certain carbon intensive activities.
- **Forest ecosystem carbon** - we will also include in our university's greenhouse gas accounts the stocks and flows of carbon from the native forest under Griffith's stewardship. The conservation management of these forests will therefore bring mitigation benefits through avoiding emissions from deforestation and degradation, as well as allowing ongoing ecosystem sequestration. These mitigation outcomes will add to their existing value as reservoirs of biodiversity, their urban cooling effects, the eco-recreational opportunities they provide, and their role as living laboratories for research and teaching.

# Emission Reduction Pathway

Our strategy is based on achieving an emissions reduction pathway that will deliver net zero emissions by 2050 against a 2010 baseline with indicative targets for 2030 and 2040 (Figure 1).

Greenhouse house gas inventories account for three classes of emissions:

- Scope 1 - are the emissions released to the atmosphere as a direct result of an activity, or series of activities at a facility level. Scope 1 emissions are sometimes referred to as direct emissions. An example is the emissions from driving vehicles belonging to Griffith's car fleet;
- Scope 2 - are the emissions released to the atmosphere from the indirect consumption of an energy commodity. For example, these 'indirect emissions' come from the use by Griffith of the electricity produced by a coal fired power station; and
- Scope 3 - are indirect greenhouse gas emissions other than scope 2 emissions that are generated in the wider economy. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business. A relevant example here are the emissions from the international travel undertaken by university staff.

We will be taking measures that address emissions from all three of these emissions classes.

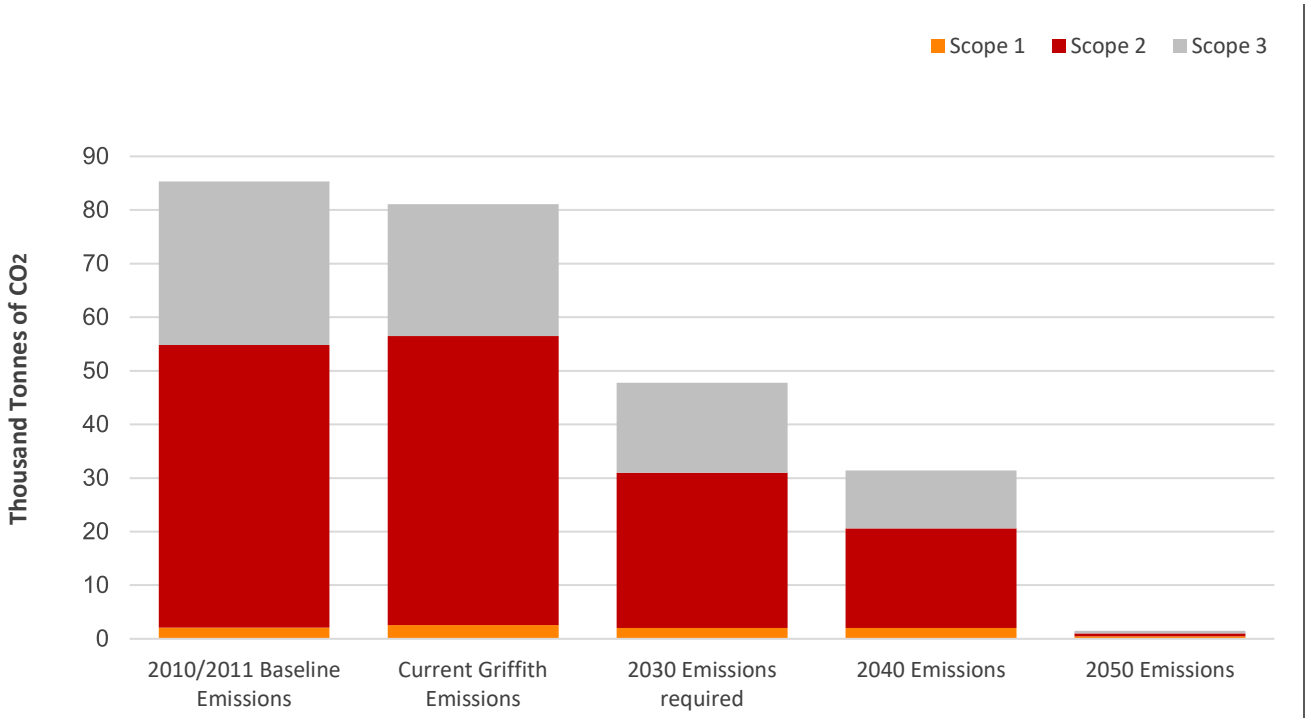



**Figure 1: Emission reduction pathway for achieving net zero emissions from a 2010 baseline by 2050**

For Griffith to meet the 2030 emissions target, an annual reduction of 3,200 tonnes of $CO_2$ will be needed every year, a total reduction of 38,405 tonnes. Savings in the last three years suggest that this is achievable if the current levels of investment in energy efficiency are maintained.

The 2030-2050 pathway will require additional effort and investment as the more accessible actions will have already been undertaken in the decade to 2030. A detailed 2030-2050 pathway will be developed and regularly updated in the coming decade to reflect emerging opportunities (e.g. further greening of the grid) and technologies.

# Pathway to 2030

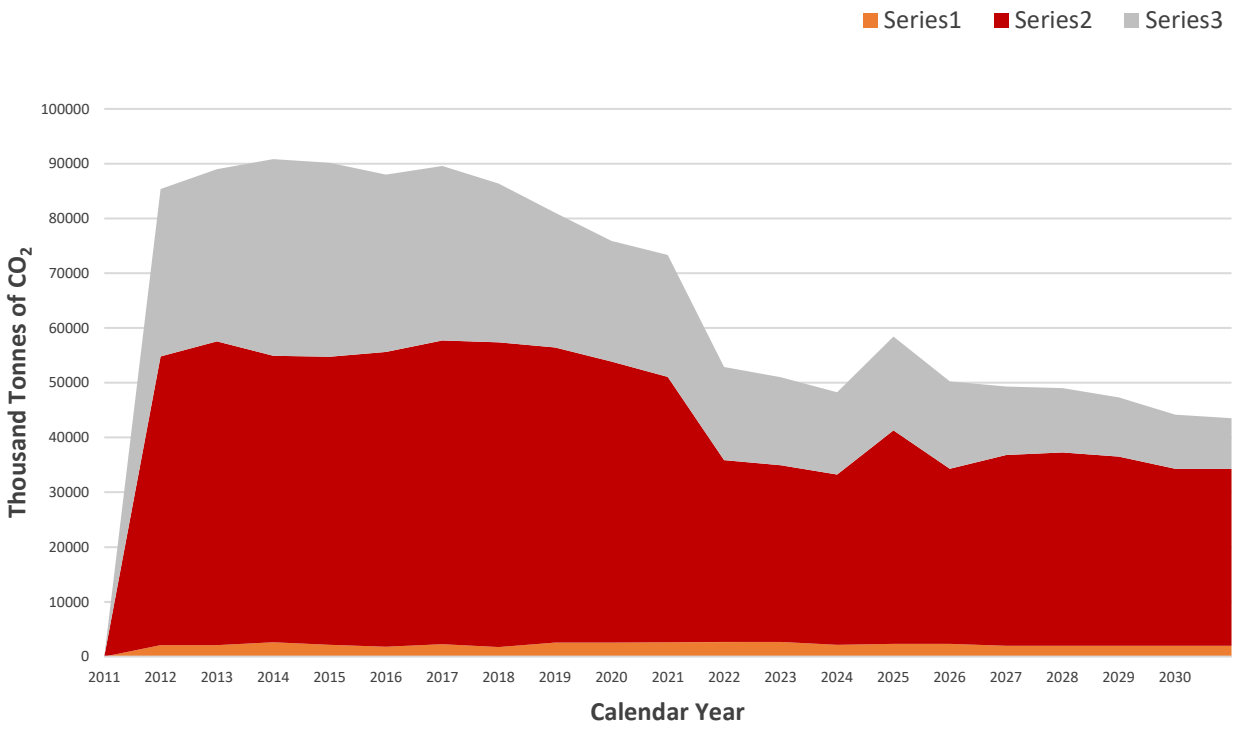
We have evaluated the range of measures available for implementing the three mitigation strategies and the three scopes of emissions and have identified a feasible and cost-effective suite of actions for meeting the 2030 target of 45% reduction from a 2010 baseline (Table 1).

**Table 1: Pathway to achieve 2030 target**

| Year | | Initiative | Tonnes $CO_{2\_e}$ saving per annum | Capital cost $ | Payback years |
|---|---|---|---|---|---|
| 2020 | REDUCE | High efficiency chiller replacements (staged rollout) – additional cost over like for like replacement, to be invested as existing plant requires replacement, excluding Gold Coast chillers[2] | 1,934 | 586,500 | 6.2 |
| 2020 | AVOID & REDUCE | Carbon stored and sequestered in forests | 1,314 | 0 | 0 |
| 2020 | REDUCE | Energy efficiency measures, review building temperature set points, BMS fine tuning, retro-fit VSD drive to pumps, mech vent and cooling towers where applicable | 2,187 | 700,000 | 2 |
| 2021 | AVOID | Purchase of 40% renewable power[3] | 16,504 | 0 | 0 |
| 2021 | AVOID | Investment of $1.5 million per annum in on site solar | 5,771 | 13,650,000 | 15.6 |
| 2021 | AVOID | Reduction in air travel of 25%[1] | 2,961 | 0 | 0 |
| 2022 | REDUCE | Review of server room temperatures, behavioural change program, extensive marketing, reduction in paper use, waste reductions | 550 | 420,000 | Varies with measure |
| 2023 | AVOID | University car fleet to electric and other transport initiatives | 500 | 100,000 | 5 |
| 2028 | REDUCE | Water cooled chiller plant at Gold Coast[4] | 2,394 | 20,000,000 | 43 |
| **2030** | | **45% reduction on 2010 achieved – total** | **34,115** | **35,460,000** | |

[1] indicative target for the Sustainability Committee to confirm
[2] like for like replacement cost for chillers and associated installation costs assumed to be met by Asset Management Plan
[3] based on 2017/8 consumption figures; $CO_2$ savings reduce as consumption from grid reduces
[4] high level total project cost estimate provided by Arup, to be refined when siting known.
All costs in 2019 dollars.

**Proposed Carbon emissions pathway to achieve 45% reduction by 2030**




# Emission reduction pathway measures

## Energy efficiency

Electricity consumption scope 2 and 3 emissions account for 77% of the total emissions for 2017/8 year.

Key areas for reducing energy use were identified and investigated further:

- Gold Coast Water Cooled Chilled Water Plant (district cooling)
- chiller upgrade opportunities for maximising efficiency (district cooling)
- lighting Control
- Thermal Comfort Case Studies, reviewing temperature set points
- Building Energy Benchmarks identifying target buildings for audit.

The proposed measures for adoption are:

- continue to extend the metering and monitoring programme to improve information on energy use, particularly the breakdown between air conditioning and general lighting and power
- to identify volunteer buildings for adopting the recommendations identified in the Thermal Case Study report regarding relaxing set points for heating and air conditioning to reduce energy consumption
- to consider the water cooled chiller plant option for the Gold Coast as part of the Master plan and Capital Management plan activities to replace the existing air cooled machines. This would realise the potential to save 45% of current consumption of this plant. Refer to the detailed report in Appendix 2
- evaluate options for lighting control on a case by case basis, generally as part of a refurbishment
- purchase the highest efficiency chillers possible when due for replacement.

The contributions and costings are summarised in the pathway table later in the report with further details in Appendix 2.

## New buildings

Build on existing Design Guidelines and Procedures to set ambitious targets for new buildings including consideration of low energy or carbon neutral buildings. This may increase the initial cost of construction.

## Renewables – on site generation

Where electricity use cannot be avoided, using power from renewable sources, e.g. wind or PV has zero carbon emissions. Continuing to invest in onsite generation, reduces the maximum demand of the site, reduces the network charges component of the electricity bill and provides clean power. Roof top opportunities have been identified as follows:

**Table 2: Photovoltaic opportunities**

| | kW | Energy Generated (kWh p.a.) | $TCO_{2\_e}$[1] | Investment[2] | Estimated Savings p.a.[3] |
|---|---|---|---|---|---|
| Nathan roof tops | 2,000 | 3,200,306 | 2,944 | $7,000,000 | $448,040 |
| Gold Coast roof tops | 1,900 | 3,040,291 | 2,827 | $6,650,000 | $425,640 |
| **Total** | **3,900** | **6,240,597** | **5,771** | **$13,650,000** | **$873,680** |

1. Using scope 2 conversion factor of 0.79 and scope 3 factor of 0.13 (per 2018 NGER values for Queensland)
2. Based on $3500/kW to include associated infrastructure upgrades
3. Based on current average cost of power 14c/kWh

This will be undertaken on a building by building basis, with an annual investment of $1.5 million for each year up to 2030 and beyond to support the net zero emissions in 2050 target.

## Renewables – off site generation

Griffith are currently reviewing our power purchasing contract and considering options for a minimum of 40 % renewables through a University Portfolio within the Whole of Government Power Purchasing Deal from late 2020 to 2028. At the end of that contract, Griffith's target would move to greater than 50% renewables for purchased power based on a market review closer to the time of contract start.

Whilst this does not reduce our emissions under the National Carbon Offset Standard (NCOS) or National Greenhouse and Energy Reporting (NGER) reporting methods, there is still a difference in carbon emissions per annum. Based on 2018 consumption, the saving is approx. 13,000 tonnes of Scope 2 emissions (based on a reduction from the grid conversion factor for Queensland of 0.79 to 0.60 kg $CO_2$/kWh at 40% renewable) and assuming Scope 3 emissions reduce by 40% also, another 3,500 tonnes for scope 3 (associated with the transmission and distribution of the power). Increasing the proportion of renewables in power purchased supports the adoption of renewables in the State and by exercising the option of purchasing Large Scale Renewable Energy Certificates, the University could claim the reduction in Carbon foot print to NCOS requirements.

## Behavioural change

By employing information awareness, price incentives and green nudges, the aim is to increase awareness of how individuals' actions relate to carbon emissions and reward positive changes in behaviour, and the associated reductions in emissions. Areas identified for action are:

- dashboards to provide information on campus activities related to emissions
- encouraging electric vehicles for commuting
- encouraging use of public transport and active transport solutions (bicycle, walk etc)
- ride sharing app to encourage car pooling
- reducing food waste.

The resolution reached is to implement the Dashboards to provide information to the University community and work with the Sustainability Committee to address the specific activities and identify associated targets (for more information on dashboards, please refer to Appendix 3).

## Low carbon travel

Measures to follow up on include:

- a target for the Griffith fleet to be 100% electric by 2025
- funding for a study around electric vehicle charging infrastructure in 2020 CMP to understand current use of existing charging points, encourage private electric vehicles on campus and to support the shift of the Griffith fleet to electric
- a target for the inter-campus Bus fleet to be electric by 2030 to be evaluated with the Contractor
- transport study - look at frequency of inter-campus bus service to encourage use instead of fleet cars; consider adding a Southbank/Nathan route; consider hopper bus to connect with rail stations
- review video conference facility provision to encourage virtual participation, reducing both air and road travel.

## Aviation emissions mitigation plan

Aviation emissions were 15% of the 2017/18 year total carbon emissions and are therefore a significant component of our carbon pollution profile that must be addressed. However, the university system has various kinds of rewards and positive feedbacks in operation that promote and incentivise academics to travel far and often. Participation in national and international conferences, for example, is generally taken as a measure of an academic's impact and standing and, among other things, is used as evidence in support of promotion applications. To reduce staff aviation emissions therefore requires not just individual behavioural change but some fundamental shifts in institutional culture and perceived academic norms such as measures of prestige and merit. Reducing academic aviation emissions therefore is a complex problem for which there is no off-the-shelf handbook of technical solutions and is a problem faced by the entire higher education sector.

To address this mitigation challenge, an aviation emissions reduction target is set of 25% by 2030. A plan specifying the measures to achieve this target will be developed over a 12-month period through consultation with the university community – all staff, the NTEU and other stakeholders - to consider options including (i) incentive programs, (ii) prospects for an internal cap and trade scheme and the role of offsets, (iii) prospects for upgrading and investing in new information communication technologies to enable more effective virtual meetings and engagements, (iv) university policy reform, and well as related matters such as questions of equity.

The university's Sustainability Committee will be responsible for developing a draft plan, undertaking the necessary consultations on options, and reporting to the Vice Chancellor, within a time frame that will enable the plan to be launched in 2021.

## Forest Ecosystem Carbon

Griffith has a total of 179 hectares of bush land across its five campuses with the majority at Nathan and Gold Coast. A first pass assessment estimates that the total stock of forest ecosystem carbon is around 82,000 tonnes of $CO_2$ equivalent which is increasing annually at the rate of around 1,313 tonnes $CO_2$ per year (Table 3). Further details are provided in the forest carbon report, Appendix 5.

By continuing to protect and manage these forests, Griffith will be avoiding emissions by maintaining their existing carbon stocks and also enabling ongoing sequestration.

**Table 3 Summary statistics of ecosystem carbon stocks and flow – in tonnes of carbon and tones of $CO_2$ equivalent for the forest at Griffith's four campuses.**

| Campus | Gold Coast | Nathan | Mt Gravatt | Logan | Total |
|---|---|---|---|---|---|
| Forested Area (ha) | 28 | 120 | 22 | 9 | 179 |
| Vegetation Biomass Carbon (t) | 1,822 | 10,440 | 1,490 | 392 | 14,144 |
| Soil Organic Carbon (t) | 508 | 5,492 | 1,770 | 399 | 8,169 |
| Total Forest Ecosystem Carbon (t) | 2,330 | 15,932 | 3,260 | 791 | 22,313 |
| Total Forest Ecosystem $CO_2$ equivalent | | | | | 81,889 |
| Annual increment in biomass carbon stock (t C) | | | | | 358 |
| Annual increment in biomass carbon stock (t $CO_2$ equivalent) | | | | | 1,313 |

To more accurately calculate the current carbon stocks and their annual increases we recommend establishment of a network of permanent, long-term ecosystem measurement and monitoring plots within representative areas of Griffith's forest estate. Annual surveys of these plots would enable data to be systematically collected on tree growth and carbon storage in the key pools (living and dead biomass, soil C). These data would also enable the carbon impact of any forest management actions, such as fuel reduction burning, to be accounted for. We also recommend that the system of permanent forest monitoring plots and annual field surveys be incorporated into the coursework of one or more established environmental science and ecology undergraduate courses (i.e. 2051 ENV, 2603 ENV, 3241 ENV, 2304 ENV) and that the additional resources needed to establish the plots and collect and analyse the data are provided to the School (further details in Appendix 5).

## Offsets

As noted under air travel, the contribution, if any, of using carbon offsets will be considered in the context of the aviation emission reduction plan and options for incentivising behavioural change. Examples of offset schemes include offset air travel, green power, Large Scale Renewable Energy certificates (LREC).

# Innovation options

The above is one pathway, there are many ways of achieving the goal. As we plan the implementation the following actions were noted:

- **Investigate alternative financing mechanisms** – given the very clear pay-back of several pathway options and the various federal and state government grant and funding schemes, alternate capital funding sources to support the various pathway initiatives should be investigated. Ideally the program can be supported by funding sources outside of the University's Capital Management Plan.

  Options for investigation include:

  - Green Bonds
  - long term low interest loans
  - Integrated Services Models using an Energy Service Company (ESCO) for initial audit, project proposal and post retrofit measurement and verification
  - Revolving Loan Funds (RLF) where the loan is repaid by the ESCO from the energy savings and the budget dedicated to the RLF increases over time and can be used to fund further retrofits

- **Investigate options for going off grid at Logan** – working in collaboration with Griffith's researchers and commercial partners deploy innovative technologies and energy generation and storage systems to achieve the ambition of taking the Logan campus "off-grid".
- **Reconsider air travel options** – more efficient aeroplanes**,** electric aeroplanes, train travel and so on.
- **Keep up to date with new technologies** – particularly for the pathway from 2030 to 2050 as many innovations are expected including increased output from PV installations, improved batteries.

The team concluded that by 2030 the options available to us will be very different to that available now so no specific plan was made for the second stage from 45% of 2010 emissions in 2030 to net zero carbon.

## Accounting methods

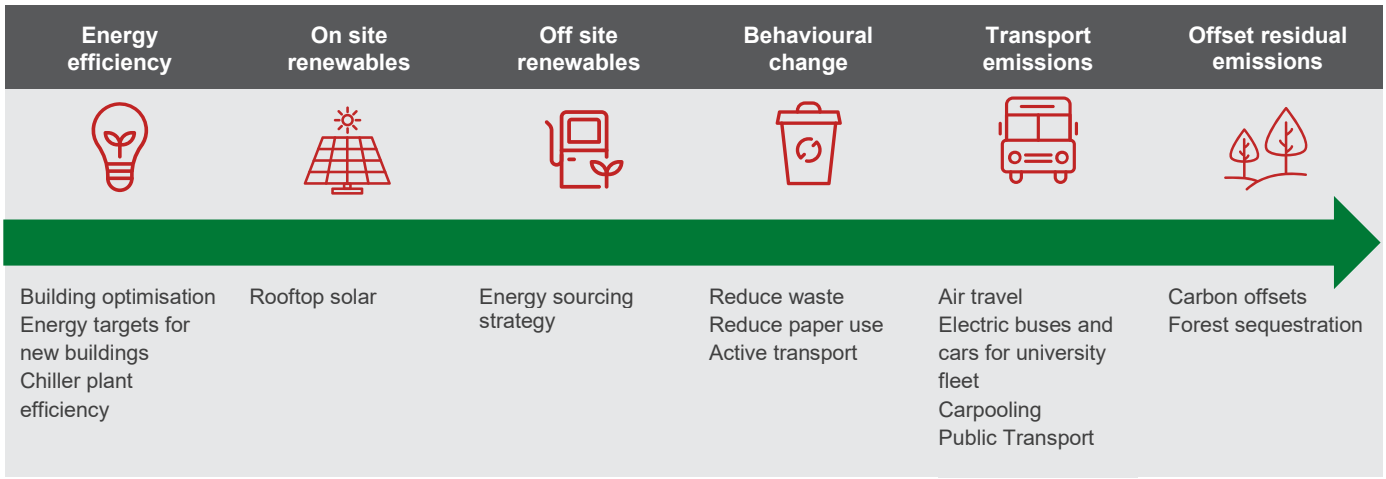
There were many discussions around the best framework for reporting and it was noted that the definition of Net zero has not yet been agreed by the IPCC.

We are required to continue reporting under the NGER Framework but this does not capture all activities. There is a desire to expand on an existing formal framework to include our other activities such as biodiversity, forest carbon sequestration, and indirect emissions. PAS 2060 has been identified as an option. A definitive methodology has not yet been settled on.

The resolution was that the team seek to understand best practice from other organisations and identify or develop a reporting standard that allows progress to be monitored and communicated.

# Conclusion

Our pathway to 45% decline in $CO_2$ emissions involves initiatives in the following areas:




Achieving the 2030 target for a 45% reduction is achievable but requires investment in changing policy, behaviour, investment priority, energy sourcing and innovative thinking. Key measures include:

## Avoiding emissions by

- Behavioural change including reducing emissions relating to commuting by encouraging shifting to electric vehicles and public transport.
- Investing in on site renewable generation with a budget allocation of $1.5 million p.a.
- Increasing proportion of offsite renewables in power purchased.

## Reducing emissions by

- Adopting a range of energy efficiency measures including
    - Water cooled central chillers Gold Coast $20 million
    - High efficiency chiller replacements $0.60 million
    - Building optimisation – lighting control, LED replacements, tuning air conditioning systems
- Introducing ambitious targets for energy efficiency for new buildings

This document outlines one pathway, but other activities can be substituted to achieve the same outcome.

The path beyond 2030 is currently less defined but net zero emissions 0% by 2050 is achievable if the efforts that enable achieving the 2030 target are carried on, albeit ways of working, technology and solutions will evolve.

# Appendices

1. Terms of reference
2. Arup reports:
    - ARP-REP-001[02] Griffith University Carbon Target Report – 260819
    - ARP-REP-002[02] Griffith University Lighting Control Report
    - ARP-REP-003 Chiller Upgrade Feasibility Study (final - rev B)
    - ARP-REP-004 Building Energy Benchmarks Rev1
    - Thermal Comfort Case Studies Rev1
    - 20190807 Additional Detail on Chiller Upgrade Works Memo Rev1
3. “Strategies for Promoting Behavioural Adaptation” Andreas Chai
4. “Draft Proposal: Griffith University Air Travel Carbon Offset Policy” Robert Hales
5. “Accounting for native forest carbon” Rebekah Grieger and Brendan Mackey