COMP372

Technical Report

User's Manual

Title: Your dashboard guide

For: Craig Cliff, University of Otago's Sustainability Office

By: Jonathan Chua

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1. Abstract

The goal of the User's Manual is to serve as a documentation / help guide for users to easily use and interact with the dashboard. In the context of this project, the User's Manual is targeted towards university management-level stakeholders at Otago University and potentially other universities in New Zealand.

The dashboard allows users to easily engage and demonstrate in a visual way the impact of selected University variables on greenhouse gas emissions on campus and how adjusting these variables affect the emissions – ultimately setting a precedent for policy and management decisions required to reach the University's goal of Net Carbon Zero by year 2030.

Screenshots were included as a visual aid to communicate key points throughout the document. We hope that the dashboard will be a great, engaging tool for relevant users to help guide Otago University towards Net Carbon Zero.

2. Introduction

The University of Otago has set an ambitious goal of Net Carbon Zero (NCZ) by the year 2030. In this context, NCZ is described as a combined effort between reducing greenhouse gas emissions and offsetting these emissions i.e. by purchasing carbon credits.

Craig Cliff, the NZC Programme Manager from Otago University's Sustainability Office was interested in developing a visual, interactive dashboard to highlight how the University's decisions around managing variables on campus affect progress towards NZC.

Craig hopes to use the dashboard for connecting the University's operations, teaching and learning, and colleagues to deliver sustainable progress in NZC. It is also anticipated that the dashboard will help drive work around University Sustainability Assessment Frameworks by other New Zealand universities. This document provides a guide for users (mainly University management-level stakeholders) to use the dashboard easily.

Three variables (affecting emissions) were included in the dashboard. Users interact with these slider bars to engage with the graphical output. Within a team of four, I worked on the development and deployment, while Monique and Brett worked on the logic between variables and the graphical output. Don worked on his own approach using PowerBI. Other deliverables include a dashboard URL and a GitHub repository.

3. Brief overview of site and deployment

The dashboard can be accessed using the link: https://otago-university.shinyapps.io/ghg-app/. Currently, we have signed up for a free account under shinyapps.io. This means that the site is capped to only 25 hours of active use per month. Briefly, the dashboard is hosted within RShiny, which is a R package (refer to Figure 1 below). The R script was written using RStudio. In terms of deployment, www.shinyapps.io was used to generate a shareable website link and deploy the dashboard onto the Internet browser. A copy of the file repository can be accessed on GitHub, which will be provided to Craig separately.

Figure 1: Software used and deployment tool for the dashboard

4. R programming language

R is a programming language and an open-source software environment for statistical computing and graphics. In recent years, R has gained increased popularity amongst statisticians and researchers. The software provides a wide range of statistical and graphical techniques and is highly extensible via a suite of packages. A key advantage of using R is the ease of which users can carry out data manipulation, calculations, and plot graphical displays and interactive visualisations. For more information about R, please visit www.r-project.org.

RStudio is an Integrated Development Environment (IDE) for the R programming language. It provides a user-friendly interface for developing the R script required for loading the dashboard. Its features are similar to those offered by R, with the ability to import and manipulate data, and plot graphical outputs and visualisations.

Without going into too much technical detail, RShiny – also known as Shiny – is a R package that allows users to build interactive web apps or dashboards in this case. RShiny uses Shiny code, which is a mixed integration of native HTML (Hyper Text Markup Language) and CSS (Cascading Style Sheet) code with RShiny functions to make the dashboard more visually appealing. The key advantage of RShiny is the combination of both the computational power of R and the interactivity of the modern web package.

To deploy the dashboard onto the web for sharing purposes, www.shinyapps.io was used to generate a website link URL. shinyapps.io is a service that runs in the cloud on shared servers that are operated by RStudio. The shinyapps.io dashboard in this project is self-contained and operates on the data that was uploaded with the application. A GitHub repository was used for version control practices.

5. Main dashboard features

Currently, the key feature of the dashboard is the ability for users to interact with the slider bars (different variables) and assess how they impact on the projected greenhouse gas emissions over the years till the year 2032. The emissions are

further broken down into various sub-categories such as student air travel, staff air travel, purchased goods and services, waster, and combustion.

There is also a text paragraph below the graphical plot displaying the variable levels that the user selected (with the slider bars) and output statements reporting on how many trees are needed to be planted and how much carbon credits will need to be purchased to offset these emissions by 2030 – based on the user's selected scenario (user inputs) – to reach Net Carbon Zero by 2032.

It is anticipated that a couple of additional features could be explored in the future, such as the ability to export and / or download the page with user inputs and the graphical plot output. Another feature would be the ability for Craig to add more variables / slider bars onto the dashboard and observe the interactions of these additional variables. Instructions on how to achieve this would be described in further detail on the Developer's Manual (provided separately).

6. User interface components

When the link https://otago-university.shinyapps.io/ghg-app/ is entered onto the Internet browser, the following page screenshot will be loaded (refer to Figures 2 and 3 below).

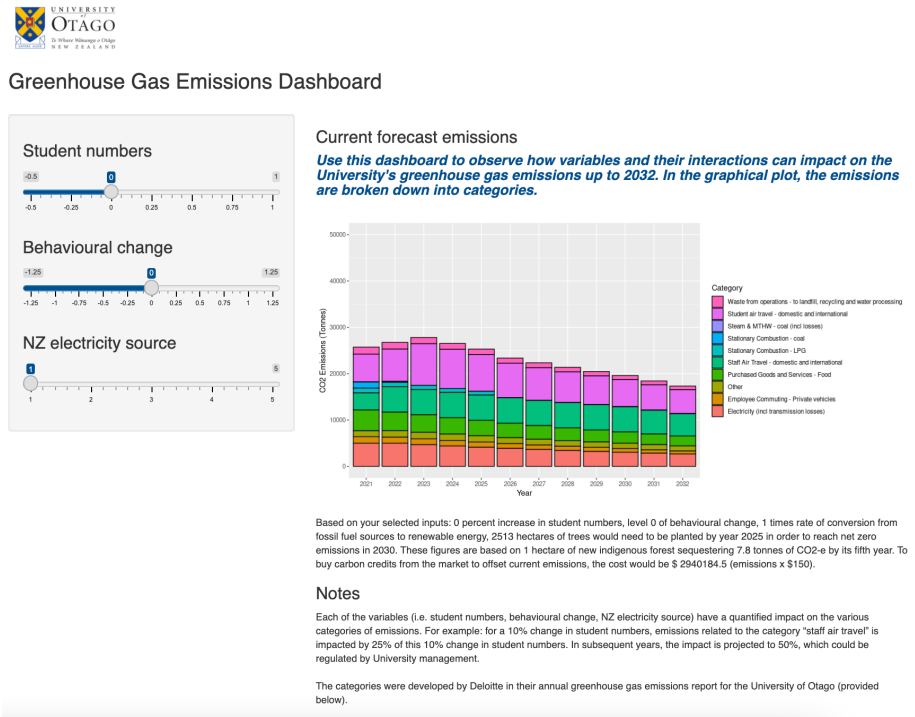

Figure 2: Top half of the dashboard home page screenshot

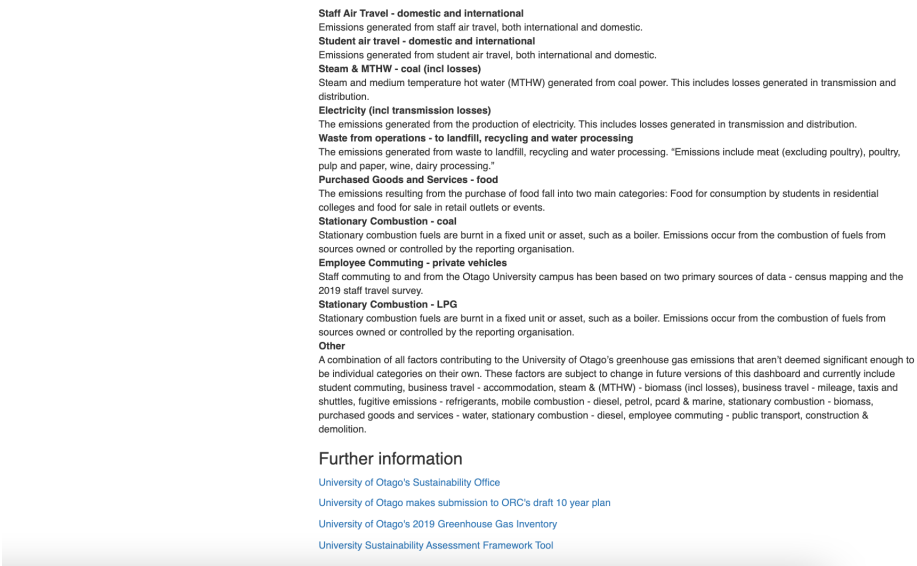

Figure 3: Bottom half of the dashboard home page screenshot

On the left panel, you can see three slider bars, namely student numbers, behavioural change, and NZ electricity source. Further information on these variables can be accessed when you hover over the respective slider bars, where

pop-ups will appear (refer to Figure 3 below). On the right main panel, you can see a graphical plot output, which will visually change based on the user's slider bar selection inputs. In default, all the slider bars are set to zero or the current state.

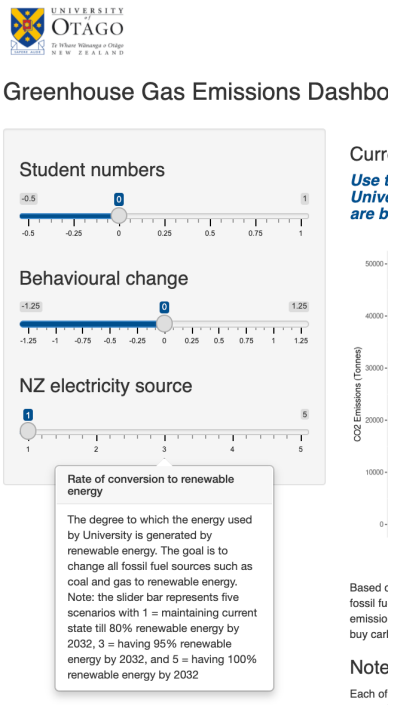

Figure 3: Pop-up example for one of the slider bars / variables that display a detailed description

On the graphical plot, the emissions are separated out by year (from 2021 to 2032). The emissions are broken down into further sub-categories, each of which could be impacted differently by the three variables (student numbers, level of behavioural change, and NZ electricity source). For example: student numbers can have a different quantified impact on each of the different sub-categories. The formulae for each of these impacts were pre-determined by Craig and his team at the Sustainability Office (refer to the Appendix for an example).

The key takeaway from the graphical plot is to quantify how much of an impact each sub-category can be affected by the three variables (slider bars) – and ultimately all these sub-categories add up to obtain the total emissions over every year.

Below the graphical plot, you can see a paragraph of text, that reports the user's selections and calculates how many trees are needed to be planted and how much worth of carbon credits are needed to be purchased – based on the graphical plot. How many hectares of trees would need to be planted by 2025 in order to reach net zero emissions in 2030 is calculated using the formula:

# of hectares to plant = total emissions (in tonnes of CO2-equivalent) / 7.8

This calculation is based on one hectare of new indigenous forest sequestering 7.8 tonnes of CO2-e by its fifth year.

How much it would cost to buy carbon credits from the market to offset this level of emissions is calculated using the formula:

*# carbon credit costs = total emissions * $150*

For further information about the sub-categories, a list of explanations are provided below the "Notes" section on the right bottom panel (as shown on Figure 3). If you are interested to find out more about the work that Otago University's Sustainability Office is doing, especially around the Net Carbon Zero programme, there are links to resources provided under "Further information" on the bottom of the dashboard's right panel as well.

7. Frequently asked questions

- **What do you mean specifically by "level of behavioural change"?**
  Answer: Level of behavioural change is a broad term used in this project to describe the University's level of commitments and actions to reduce greenhouse gas emissions. Examples of actions can include launching initiatives for free public transport, reducing prices for vegan food options, or installing pop-up recycling stores on campus.

- **Where can I find more information on how this dashboard was developed?**
  Answer: Section 3 of this document (Brief overview of site and deployment) provides an overview on what software and deployment tools were used to develop this dashboard. For more technical details, please refer to the Developer's Manual (provided separately).
- **How is this dashboard relevant to my organisation?**
  Answer: Climate change and sustainability are growing issues that are currently facing organisations around the world, who are also facing increasing pressure to take responsibility and drive change for the Earth's future. The dashboard can be used as a tool to educate stakeholders on how organisations can adopt certain major indicators that will help reduce emissions.
- **Where did you get the data from?**
  Answer: The data in this project was provided by Craig Cliff, from the University of Otago's Sustainability Office. The data were loaded into the R script which was then parsed when the RShiny app was run on the site link.
- **Is it possible to download the dashboard into a PDF with input variables and the graphical output?**
  Answer: This feature was considered "nice-to-have" in this project and the short timeframe meant we could not get around to deploying that feature, but this could be something to look at in the future.
- **For the sub-categories on the graphical plot, can the plot show each of their specific emissions numbers?**
  Answer: This could be an additional feature that Craig could potentially explore in future development of the dashboard. Unfortunately, in this project, the team ran out of time and resources to consider these "nice-to-have" features.

- **There is an error with the graphical plot. How do I resolve it?**
  Answer: If there is an error, it may be related to the R script code or the need to update the software. Please refer to the Developer's Manual (provided separately).
- **Who can I contact for more information or collaboration opportunities?**
  Answer: Please contact Craig Cliff from the Otago University's Sustainability Office. Contact details can be found here: https://www.otago.ac.nz/sustainability/contact/

8. Significance of this dashboard – business case

Organisations around the world including educational institutions are facing increasing pressures to take responsibility and drive positive change around climate change and sustainability. The University of Otago has committed to the Net Carbon Zero Programme – mainly driven by the Craig and his team at the Sustainability Office.

The precedent for this project, as Craig said at the start of this project, was that there was currently no dashboard or tool available for Otago University – or any other universities in New Zealand – to demonstrate in a visual way the impact of the University's management decisions on greenhouse gas emissions. As part of Craig's role in giving presentations and talks to stakeholders about how the University can progress towards Net Carbon Zero, it would be ideal to have a tool that is able to instantly visualise the impacts and interactions of selected variables on the University's greenhouse gas emissions.

In this manner, there is a clear and easy message to stakeholders (from the dashboard tool) as to what actions could drive the biggest change around the University's role with Net Carbon Zero. For instance, whether managing student numbers or setting up new sustainability projects would be more worthwhile in creating a higher impact, considering a whole range of other factors i.e. the sub-categories shown on the graphical plot. In addition, it will allow stakeholders to

determine how the University could try to offset these emissions i.e. by purchasing carbon credits or planting new trees.

9. University Sustainability Assessment Framework

There are presently a few tools out there that help universities assess and monitor their sustainability plans and targets. An example of a framework around University Sustainability Assessment can be accessed here: https://www.greenofficemovement.org/sustainability-assessment/. This open-source tool provides a database template with some indicators, and further resources to help universities evaluate their sustainability performance.

This project is a small piece of that puzzle and a significant step towards what Otago University can do to assess their greenhouse gas emissions and evaluate what options there are to help the institution reach Net Carbon Zero.

10. Conclusion

We hope that the dashboard will go a long way in helping the University of Otago's Sustainability Office progress towards Net Carbon Zero over the next decade – and potentially set the path for other universities in New Zealand to follow and develop similar assessment frameworks for climate change and sustainability. We are thankful for this opportunity to contribute in a way towards Net Carbon Zero. We appreciate that the dashboard will be a continuous work in progress, with the opportunity for Craig to change variables and / or add more features to it. Hopefully, this work will make future modifications easier and more straightforward to work with.

Appendix

Adjustment	**Students (EFTS) (% growth or decline)**														
	% change	**10%**													
		2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Impacts	Staff Air Travel - domestic and international	No impact	No impact	No impact	25%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	Student air travel - domestic and international	No impact	No impact	No impact	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Steam & MTHW - coal (incl losses)	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Electricity (incl transmission losses)	No impact	No impact	No impact	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Purchased Goods and Services - Food	No impact	No impact	No impact	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Waste from operations - to landfill, recycling and	No impact	No impact	No impact	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Stationary Combustion - coal	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Employee Commuting - Private vehicles	No impact	No impact	No impact	25%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	Stationary Combustion - LPG	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Student commuting	No impact	No impact	No impact	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Business Travel - accomodation	No impact	No impact	No impact	25%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	Steam & MTHW - biomass (incl losses)	No impact	No impact	No impact	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Business Travel - mileage, taxis and shuttles	No impact	No impact	No impact	25%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	Fugitive Emissions - refrigerants	No impact	No impact	No impact	50%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Mobile Combustion - diesel, petrol, pcard & mar	No impact	No impact	No impact	25%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	Stationary Combustion - biomass	No impact	No impact	No impact	50%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Purchased Goods and Services - water	No impact	No impact	No impact	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Stationary Combustion - diesel	No impact	No impact	No impact	50%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	Employee Commuting -public transport	No impact	No impact	No impact	50%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%

Figure A1: Quantified impacts of the variable “student numbers” on emissions sub-categories

In this example, for a 10% change in student numbers, emissions related to the sub-category “staff air travel” is impacted by 25% of this 10% change in student numbers. In subsequent years, the impact is projected to 50%. The quantified results are calculated using these impact figures and formatted into a CSV file for parsing in RStudio and RShiny. In situations where there were no impact, this was because of other factors, for example, the University’s commitment to 100% renewable energy sources meant that the “coal” sub-category would be irrelevant and therefore have no impact on emissions.

Adjustment	**Level of behavioural change**		Very Low =	Low = -1	Mod = 0	High = +1	Very High = +2			Need to add IF rule to ensure emissions don't go below zero						
	% change	**1**														
		2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	
Impacts	Staff Air Travel - domestic and international	No impact	No impact	No impact	-5%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	-60%	-65%	
	Student air travel - domestic and international	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	
	Steam & MTHW - coal (incl losses)	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	
	Electricity (incl transmission losses)	No impact	No impact	No impact	-5%	-10%	-15%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	
	Purchased Goods and Services - Food	No impact	No impact	No impact	-5%	-10%	-15%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	
	Waste from operations - to landfill, recycling and	No impact	No impact	No impact	-5%	-10%	-15%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	
	Stationary Combustion - coal	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	
	Employee Commuting - Private vehicles	No impact	No impact	No impact	-10%	-15%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	-60%	
	Stationary Combustion - LPG	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	
	Student commuting	No impact	No impact	No impact	-10%	-15%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	-60%	
	Business Travel - accomodation	No impact	No impact	No impact	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	
	Steam & MTHW - biomass (incl losses)	No impact	No impact	No impact	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	
	Business Travel - mileage, taxis and shuttles	No impact	No impact	No impact	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	
	Fugitive Emissions - refrigerants	No impact	No impact	No impact	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	
	Mobile Combustion - diesel, petrol, pcard & mar	No impact	No impact	No impact	-10%	-15%	-20%	-25%	-30%	-35%	-40%	-45%	-50%	-55%	-60%	
	Stationary Combustion - biomass	No impact	No impact	No impact	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	
	Purchased Goods and Services - water	No impact	No impact	No impact	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	
	Stationary Combustion - diesel	No impact	No impact	No impact	-10%	-20%	-30%	-40%	-50%	-60%	-70%	-80%	-90%	-100%	-100%	
	Employee Commuting -public transport	No impact	No impact	No impact	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	

Figure A2: Quantified impacts of the variable “level of behavioural change” on emissions sub-categories

Adjustment	**NZ electricity grid renewables - % in 2030**		**5**	80%	80%	81%	82%	83%	84%	85%	90%	95%	100%	100%	100%
	Scenario	**5**	**4**	80%	80%	81%	82%	83%	84%	85%	88%	92%	95%	98%	100%
			3	80%	80%	81%	82%	83%	84%	85%	86%	88%	90%	92%	95%
			2	80%	80%	80.50%	81%	81.50%	82%	82.50%	83%	84.00%	85%	86%	87%
			1	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
		2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Impacts	Staff Air Travel - domestic and international	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Student air travel - domestic and international	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Steam & MTHW - coal (incl losses)	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Electricity (incl transmission losses)	No impact	No impact	No impact	No impact	-5%	-10%	-15%	-20%	-25%	-50%	-75%	-100%	-100%	-100%
	Purchased Goods and Services - Food	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Waste from operations - to landfill, recycling and	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Stationary Combustion - coal	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Employee Commuting - Private vehicles	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%
	Stationary Combustion - LPG	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Student commuting	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%
	Business Travel - accomodation	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%
	Steam & MTHW - biomass (incl losses)	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Business Travel - mileage, taxis and shuttles	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%
	Fugitive Emissions - refrigerants	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Mobile Combustion - diesel, petrol, pcard & mar	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%
	Stationary Combustion - biomass	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Purchased Goods and Services - water	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
	Stationary Combustion - diesel	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%
	Employee Commuting -public transport	No impact	No impact	No impact	No impact	No impact	-2%	-4%	-6%	-8%	-10%	-12%	-14%	-16%	-18%

Figure A3: Quantified impacts of the variable “NZ electricity source” on emissions sub-categories