School of Design and the Built Environment

LOW CARBON SCHOOLS: REDUCING CARBON EMISSIONS & FOSTERING INTERGENERATIONAL CHANGE

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DECLARATION

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethical approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number #RDHU-57-16.

Signature:

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SUMMARY / ABSTRACT

The increasing urgency to address climate change and reduce global greenhouse gas emissions requires effort and commitment from all sectors of the economy, and each individual in the community. While some progress has been made addressing industrial and sectorial emissions, reducing emissions at the community level remains a challenge. Little research has examined the role schools play in helping to address community-scale carbon emissions. This thesis addresses this gap in the literature and explores the barriers, enablers and strategies schools use to effectively reduce their own carbon emissions. It also interrogates how students can influence their families and homes around low carbon living. The research uses a mixed-methods design, including interviews, focus groups, surveys and analysis of utility consumption and cost data. A pragmatic epistemology is used, together with a social constructivist theoretical lens and a Reasoned Action Approach (RAA) to understand the relationship between human behaviour and their environments. All schools in this research were participants of an innovative school carbon reduction program in Western Australia. The key barriers facing schools attempting to reduce emissions included a lack of time, lack of knowledge and policy barriers. The primary enablers included implementing a systematic approach for measuring, monitoring and reporting emissions, a strategic process for identifying actions, principal support, and the use of school carbon reduction as an umbrella initiative to incorporate often disparate environmental programs (i.e. for energy, water and waste). This thesis contributes significant knowledge to the wide gap in the literature around carbon emissions in schools and shows that reductions can be made with minimal cost outlay. The research also confirms that schools can have a significant positive impact within the wider community through students influencing their families about sustainability and reduced resource consumption in the home.

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GLOSSARY OF TERMS

AuSSI:	Australian Sustainable Schools Initiative
BMW:	Building Management Works – A Department at the Western Australia's Department of Treasury that manages maintenance of all public buildings
BMS:	Building Management System
CCP:	Cross-Curriculum Priority
CO_2:	Carbon Dioxide
DoE:	Western Australia Department of Education
EfS:	Education for Sustainability
GHG:	Greenhouse Gas
LCA:	Life Cycle Assessment
kWh:	Kilowatt Hour
HS:	High School
ICSEA:	Index of Community Socio-Educational Advantage
LCL:	Low Carbon Living
LCRI:	Low Carbon Readiness Index
LCS:	Lighting Control System
LCSPP:	Low Carbon School Pilot Program
PS:	Primary School
RAA:	Reasoned Action Approach
RES:	Renewable Energy System
SC:	Secondary College
SLR:	Systematic Literature Review
STEM:	Science, Technology, Engineering & Math
WA:	Western Australia

LIST OF APPENDICES

1 Introduction

1.1 Background

Climate change is at the forefront of a global agenda where scientists are urging net zero carbon emissions by 2050 to prevent global temperatures rising 1.5 degrees above pre-industrial levels (Rogelj et al., 2018). Increased levels of carbon dioxide have already led to significant changes to the climate and environment, with these changes expected to continue, and even worsen, in the coming decades (CSIRO, 2016; Rogelj et al., 2018). Buildings account for up to 40% of global carbon emissions (UNEP, 2009), demonstrating the opportunity and imperative to reduce emissions in the sector. In Australia, along with expected changes in climate, is a predicted increase in energy usage and rising costs of utilities over the next two decades (Australian Energy Market Commission (AEMC), 2018). This will have a significant impact on many sectors of the economy (Hoegh-Guldberg et al., 2018). A report by the Australian Sustainable Built Environment Council (2018) has identified school buildings as having some of the most cost-effective carbon abatement opportunities, largely due to aging infrastructure and inefficiencies in schools. A study on the energy usage of schools in the ACT and NSW showed an increase in energy intensity (i.e. the ratio of energy input to useful output) of schools by 15% between 1999 and 2009 (Council of Australian Governments (COAG), 2012). This was due to an increased number of electronics used in schools (e.g. electronic whiteboards, laptops and tablets) and transition to more climate controlled classrooms (e.g. installing air conditioners in each classroom) (de Dear, Kim, Candido, & Deuble, 2015). This increase in the energy intensity of schools is likely to continue in the coming years unless it is addressed.

Despite rising utility consumption and costs, there has been mixed ambition and approaches from various levels of government in Australia to push carbon reduction in schools (Rauland, Odell, Hall, Newman, & Lewis, 2014). However, there has been a relatively consistent focus on Education for Sustainability (EfS), also called Environmental Education (EE), which, after gaining the focus of the Australian Government in the 1990s (Environment Australia, 2004) has become a well-established field of knowledge related to integrating sustainability and environmental principles into education. The focus on EfS resulted in several programs emerging over the years targeting sustainability in schools, with one of the most notable being the Australian Sustainable Schools Initiative (AuSSI). AuSSI was developed and initially funded by the Australian Federal Government to deliver a whole-of-school approach to sustainability. However, the program was defunded in 2010 (Department of the Environment Water Heritage and the Arts, 2010), with the expectation that individual States and Territories would continue to fund it. However, several states discontinued the program (Rauland et al., 2014). While the Australian Federal Government has done little since to target school carbon emissions, countries such as the United Kingdom and the United States of America have developed national programs to to increase the sustainability of the education sector (Department for children schools and families, 2009; Gregory Kats, 2006). While there are several other State-based programs targeting various aspects of sustainability in schools (i.e. energy, water, waste), few focus on the quantifiable aspects of carbon reduction and management (Rauland et al., 2014). This is despite an increasing financial incentive for schools to pursue resource efficiency measures because of increasing school autonomy over budgets.

To address this gap, a new Low Carbon Schools Pilot Program (LCSPP) was launched in 2016, in Perth, Western Australia. Fifteen schools within the Perth metropolitan area were chosen to participate in the two-year program, aimed at empowering and upskilling school administration and students with the information and tools needed to implement quantifiable carbon reduction initiatives to reduce their operational carbon footprint. By encouraging schools to share experiences, the program aimed to build a sense of community between the participating schools, and within the broader community. This program was used as the context for this research to examine effective carbon reduction strategies in schools, barriers and opportunities facing schools wanting to decarbonise, and how schools can influence and contribute to the reduction of carbon emissions within the community.

While many of the challenges of climate change and resource depletion are being addressed through energy efficiency measures and new technologies, a significant factor affecting their success is human behaviour, which remains a key challenge. Several theories have arisen to explain or predict behaviour, with a growing body of research dedicated to understanding proenvironmental behaviour (PEB), which can be defined as human behaviour that endeavours to minimise impact on the environment (Steg & Vlek, 2009). There is a growing body of research looking at the impact various aspects of sustainable living, including housing design, can have on attitudes and behaviour (Brossard, Lewenstein, &

Bonney, 2005; Dobbyn & Thomas, 2005; Steg & Vlek, 2009). Building on this research, Izadpanahi, Elkadi, & Tucker (2015a) have explored whether sustainably designed school buildings can influence children's pro-environmental attitudes and behaviour. Little research has taken this further to examine whether these sustainability attitudes and behaviour, particularly around carbon reduction, can influence low carbon living attitudes in the community.

1.2 Research Questions

This research answers the following overarching question:

> **How can schools reduce carbon emissions and influence community awareness of low carbon living?**

To answer this, the following sub-questions were asked:

1. Why should schools reduce carbon emissions?
2. What types of initiatives are schools implementing to reduce carbon emissions?
3. What are the barriers for schools to reduce their carbon emissions?
4. What effective enablers and strategies are used to implement low carbon initiatives in schools?
5. Can students influence family attitudes or behaviour around low carbon living?
6. Can a structured school-based program help to facilitate the process of carbon reduction in the community?

1.3 Significance of the Research

While there is a push for carbon reduction on a global scale, there is limited research documenting the role schools and education can play in helping to reduce carbon emissions locally. There are disproportionally few programs across Australia and globally that are actively targeting carbon reduction in schools (Rauland et al., 2014) compared to other segments of the built environment (i.e. residential and commercial buildings). Reducing emissions in schools can provide a flow-on benefit that extends to the families of the students. The opportunity to educate future generations on the issues of climate change and sustainability is significant, as demonstrated by the United Nation's establishment of the Decade for Education for Sustainability (DESD) that took place between 2004 and 2014

(Australian Government Department of the Environment and Heritage, 2007). While a significant body of research has evaluated the impacts of sustainability-related educational programs in schools, there remains a significant gap in understanding the impacts that carbon reduction programs have on the community, particularly through students influencing household proenvironmental attitudes and behaviour, creating intergenerational change.

The findings generated from this research will help to inform current and future carbon reduction programs and act as important reference material for stakeholders, such as school principals, councils, government and the private sector, who are keen to work with schools. It is likely the findings can also be used to inform programs for a range of other sectors, such as community organisations, including RSL clubs, surf living saving clubs, and nursing homes, both in Australia and globally.

1.4 Research Paradigm

This research is framed within the broad issue of global climate change and is set in the context of a low carbon schools pilot program that aims to empower schools to take quantifiable actions to reduce their carbon emissions. Social impact is a major element of the conceptual research framework. How social impact is defined and measured is a key theme of the research which brings industry practices and academic theory together. The notion of a school building as a source of learning that can be included in a teacher's pedagogy, and the role of intergenerational influence of low carbon living knowledge from students to their parents, are key themes in the research. From a psychological perspective, the measurement of change in proenvironmental attitudes is a way to predict proenvironmental behaviour (PEB) and, for the purposes of this study, it serves as a method to measure the social impact of the Low Carbon Schools Pilot Program (LCSPP).

1.5 Thesis Outline

Chapter 2 discusses the current literature related to carbon reduction in schools, including the barriers and challenges of implementing sustainability initiatives in schools, along with the benefits, intergenerational influence, proenvironmental attitudes and behaviour, and program impact and evaluation.

The geographical and situational context is then discussed in Chapter 3, providing an overview of the context in which this study takes place. The methodology and research design is discussed in Chapter 4, along with the limitations of the study.

Chapter 5 presents the results from all 13 schools participating in the research. The results presented focus on the analysis from each school's low carbon action plan, their utility consumption and costs from electricity, gas and water, their carbon emissions, and the results from a survey sent to each school's low committee members and parents. The chapter concludes with a short evaluation of the Low Carbon Schools Program (LCSPP).

Chapter 6 presents results and analysis from four case study schools selected for this research. Each school's utility consumption and cost data, carbon emissions, and survey results are presented, along with information gathered from interviews with school stakeholders and focus groups with students. The final section of the chapter describes a cross-case analysis where the key themes and findings from all case study schools are compared and discussed.

Chapter 7 discusses the implications of the findings of the research. It highlights the key themes and similarities and differences with other studies, identifies the practical implications and assertions from the results and suggests recommendations for future research.

The final chapter, Chapter 8, reflects on the six original research questions and summarises the key findings, before providing recommendations for further research.

2 Literature Review

2.1 Introduction and Approach

While there is an abundant literature describing the potential for buildings to reduce carbon emissions, when an initial traditional literature review was conducted, there were very few articles focussing on school carbon reduction. Therefore, this study used two literature review techniques to gain a better understanding of the collected works related to this research. A systematic approach was used to review the literature related specifically to carbon emissions reduction in schools to provide a structured and in-depth understanding of the global literature. A traditional (i.e. narrative) approach was used for all other topics related to the research. The following sections describe the literature in more detail.

2.1.1 Systematic Literature Review

A systematic literature review (SLR) approaches the literature with a set of inclusion criteria about the articles to be reviewed, and can enable generalisations about the literature that a narrative or traditional literature review may not so easily yield (Pickering & Byrne, 2014). The systematic approach to literature reviews is common in the health sciences, however it is still a new method in research areas such as climate change (Berrang-ford, Ford, & Paterson, 2011). This approach was used for this study to understand the overall state of peer-reviewed literature around carbon emissions reduction in schools. The process involved developing an SLR protocol to guide the study, conducting a database search, reviewing title and abstracts returned, exploring articles that met the inclusion criteria and reviewing and categorising the final cohort of articles. These processes are further described in the following sections.

2.1.1.1 *Databases & Inclusion Criteria*

The search strategy involved an automated search using online databases with a set of inclusion and exclusion criteria. A series of searches in the titles, abstracts and keywords of the literature were conducted with the search terms outlined in Table 1. Each search included a ‘School’ (S) keyword in combination with either a ‘Carbon’ (C) or ‘Similar Topics’ (O) term, shown in Table 1. It should be noted that there are many components of the carbon reduction process. For example, energy efficiency, which involves reducing energy consumption, is a major source of carbon emissions in buildings. However, focusing purely on one resource, such as energy, does not provide a holistic or accurate view of a school's total carbon emissions, which also includes, for example, water, waste and transport. Further, when topics such as energy efficiency are discussed, there is not always reference to carbon emissions. This research views discussions of carbon emissions as a key aspect of addressing climate change. Therefore, this study only focussed on articles that directly mentioned carbon emissions (or related terms) and related terms/topics, as outlined in Table 1.

"Web of Science" and "ProQuest" databases were selected to provide results from different disciplines. Considering climate change and carbon emissions are global issues that require the action of local and national governments, "grey literature", in the form of government reports, were also included and captured via Google searches and snowball sampling from relevant articles. The results returned from the search strings with titles or abstracts that satisfied the inclusion criteria were exported to Mendeley, which is a literature and reference manager (software application). To ensure replicability and transparency, a detailed record of the search keywords and processes were kept. 73 documents met the inclusion criteria and were exported. Of these, 23 articles were duplicates between the databases or, upon a second examination of the full text, did not satisfy the requirements for inclusion. The final number of articles reviewed for the SLR totalled 42.

Table 1: Search categories and specific terms used.

Category	Search terms
School (S)	school*, educat* facilit*, educat* build*, educat* sector, learn* facility*
Carbon (C)	carbon reduc*, carbon emission*, carbon footprint*, CO2 reduc*, CO2 emission*, CO2 footprint*, GHG, GHG reduc*, GHG emission*, GHG footprint*, Greenhouse* gas*, greenhouse* reduc*, greenhouse* emission*, greenhouse* footprint*
Similar Topics (O)	"carbon positive", "carbon neutral", "carbon negative", "low carbon", "net zero", "climate change" AND building*, "global warming" AND building*

Table 2: Inclusion criteria for articles to be included in review.

Inclusion Criteria
Peer-reviewed article or government report
Written in English
Explicit focus on the environmental impacts of the school building
Explicit focus only on primary or secondary schools
Explicit mention of carbon emissions (or synonym listed in Table 1)

2.1.1.2 *Limitations of the SLR*

Variation in the way researchers review the inclusion criteria of articles could result in different articles being exported and analysed. This may limit the replicability of this study. Another limitation lies in potential inconsistencies in the way electronic databases display results using the same string of search terms. Last, some articles returned by the search strings were not available due to library restrictions on access. It is possible some relevant articles were omitted as a result.

2.2 Overview of the SLR Literature

The literature satisfying the inclusion criteria was grouped into categories based on an initial analysis of the abstract. Category was selected based on the overarching theme of the article (e.g. energy consumption in schools). The categories and the number of articles in each are demonstrated by Figure 1which provides a brief overview of the primary categories or themes.

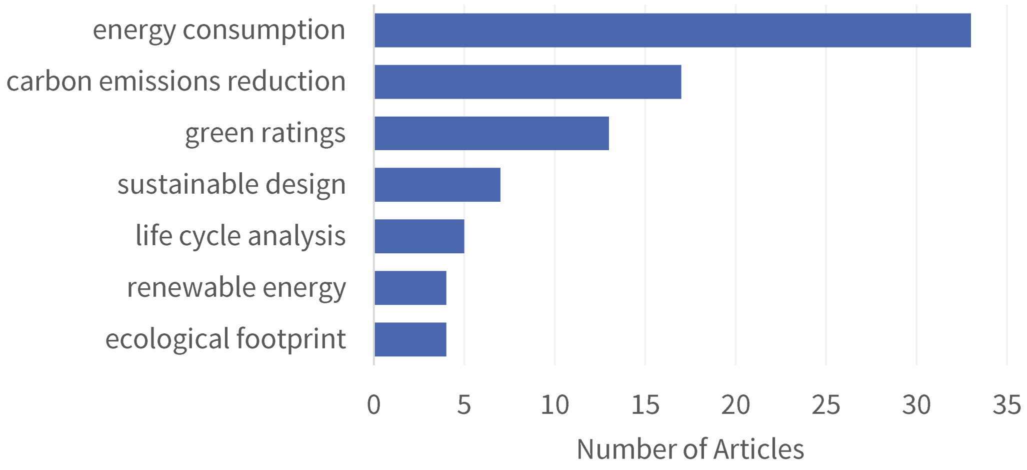


Figure 1: Number of articles in the SLR for in each category.

Within the literature, energy efficiency was overwhelmingly the most commonly discussed area related to emissions in schools, with nearly 80% of the articles included in the SLR mentioning energy, and 50% exclusively focusing on energy. Comparatively, around 15% of articles mentioned gas or transport, and only 10% mentioned water, waste or procurement. Only nine articles discussed three or more building emissions areas. Articles focussing specifically on school carbon emissions reduction formed the second largest category. While the search endeavoured to get articles specifically related to carbon emissions in schools, only thirteen of the exported articles specifically focussed on addressing carbon emissions in schools in a holistic and quantifiable way (i.e. not only focussing solely on one resource area, such as energy consumption).

2.2.1 Geographical Distribution / Types of Literature

There was an unequal geographical distribution of literature returned for the SLR. Over 60% of articles had European authors (see Table 3), with over 40% of these coming from the United Kingdom. Articles from the Asia-Pacific region only included scholarship from South Korea and Australia. Thus, it is clear there was an uneven geographical distribution in the results. Articles from other countries such as the United States may have also not surfaced in the search results due to differences in language used, such as “green schools”. While other regions may be targeting school sustainability in various ways, it is clear that there is little emphasis on quantifiable emissions reduction. Further, this study only included articles written in English, which may be an additional factor affecting the distribution.

Table 3: Geographical distribution of reviewed articles.

Region	# of Articles	Percentage
Europe	27	64%
Asia Pacific	10	24%
North America	3	7%
Middle East	1	2%
South America	1	2%

The majority of articles (over 50%) were peer reviewed, 20% were government reports, which were all based in the United Kingdom, and the remaining were conference proceedings or industry reports. The oldest article was published in 2000 and 80% of the articles were published between 2008 and 2018, indicating this is a relatively recent area of research.

2.3 Carbon Emissions and Buildings

The energy use and construction associated with buildings accounts for up to 40% of carbon emissions worldwide (Global Alliance for Buildings and Construction, 2016). As global populations increase and millions of people are provided access to energy in emerging economies, energy demand is expected to increase by at least 50%, which will significantly contribute to greenhouse gas emissions (International Energy Agency, 2017). In Australia, buildings account for up to half of national electricity consumption (Harrington & Toller, 2017) and contribute to a quarter of the country’s greenhouse gas emissions (ASBEC, 2016). This demonstrates the imperative, and the significant opportunity, to address carbon emissions from buildings. A 2012 government study found that while energy consumption has decreased over the last ten years in commercial and public buildings, energy consumption increased in schools, with further increases expected by 2020 (Council of Australian Governments (COAG), 2012; Thewes, Maas, Scholzen, Waldmann, & Zürbes, 2014). These increases can be attributed to the increased use of technology in classrooms and new government requirements to climate control classrooms (de Dear et al., 2015). Further, a study looking at the opportunities for decarbonising building stock in Australia identified schools as one of the most cost-effective contemporary carbon abatement opportunities (ASBEC, 2018). This represents a significant opportunity for school buildings to be targeted for emissions reduction.

2.4 Energy Efficiency, Renewable Energy & Net-Zero Buildings

The majority of articles in the SLR focussed on energy efficiency in schools, with several articles citing issues with school building inefficiencies and ageing infrastructure (Boscolo, 2010; De Santoli, Fraticelli, Fornari, & Calice, 2014; Jenkins, Peacock, & Banfill, 2009; Zeiler & Boxem, 2013). A study on school buildings in the United States highlighted the substantial gaps in appropriate maintenance and upkeep of most schools in the country (21st Century School Fund, U.S. Green Building Council Inc, & National Council of School Facilities, 2016).

One study analysed the energy consumption and building typology of 50 schools in Italy and discovered that none conformed to the minimum building regulations for building envelopes, frames and thermal bridges (Boscolo, 2010). Another study with 15 schools in Argentina found they used 80% more energy than required to maintain comfortable thermal conditions (Filippín, 2000). When future impacts of climate change on schools were modelled for schools in the UK, it was found there was a potential risk of overheated classrooms and school spaces because of inadequate shading and ventilation in schools due to poor building design (Jenkins et al., 2009). Both Kats (2006) and Zeiler & Boxem (2013) argue that schools are typically only built to minimum building standards.

Common approaches to increasing energy efficiency in schools involved improving HVAC (heating, ventilation and air conditioning) systems (AlFaris, Juaidi, & Manzano-Agugliaro, 2016; Gregory Kats, 2006; Wargocki & Wyong, 2013) and lighting upgrades (e.g. swapping lights for LEDs) (Carbon Trust, 2012). One study examining the energy efficiency of a school in the United Arab Emirates estimated a 34% reduction in energy use through a few simple HVAC control and efficiency improvements (AlFaris et al., 2016). Another study, looking at the feasibility of reducing carbon emissions through energy retrofits in schools with a life cycle cost analysis, concluded that LED lighting upgrades were the most cost-effective retrofit option for South Korean educational facilities (Hong, Kim, & Kwak, 2012a).Given the rapid changes in sustainability technology prices, such as LEDs and solar PV, the economic benefit of these upgrades is increasingly more evident (EPA Office of Air and Radiation - Climate Protection Partnerships Division, 2017). Other studies discussed other opportunities for efficiency gains, such as replacing single-pane windows with double-glazed windows (De Santoli et al., 2014) and increasing natural ventilation (Gil-Baez, Barrios-Padura, & Molina-Huelva, 2017).

Installing renewable energy systems on schools was also discussed as the pathway for schools to address their carbon emissions. For example, researchers Hong, Koo, & Kwak (2013), developed a framework for implementing a renewable energy system (RES) (e.g. solar PV, solar thermal, wind, or geothermal) at a school. The study recommended the use of a process and RES tool to help governments make decisions about the highest impact and lowest cost RES option for each school (Hong et al., 2013). Other studies focus on the technological side of renewable energy at schools, examining the specific type of panel best suited for schools in the South Korean context (Park et al., 2016) and size of panels needed depending on energy consumption (Congedo, D’Agostino, Baglivo, Tornese, & Zacà, 2016; Katsaprakakis & Zidianakis, 2017). Solar photovoltaics are highlighted as having significant potential to mitigate school carbon emissions if they are sized appropriately to the energy demands of the school (Economou, 2011).

Live energy consumption monitoring is also identified as a way for schools to reduce consumption and save carbon emissions while engaging the school community. Koumoutsos et al. (2015) have examined the implementation of a smart-metering system in 50 schools in Greece in conjunction with an online platform designed to educate students and staff about schools’ live energy data while engage the school community in reducing their consumption. The authors’ showed that providing live energy data to schools, along with targets for reduction, was successful in reducing consumption, highlightung the importance of addressing consumption both at the technological and social levels. Other studies have also shown that providing electricity consumption information to homeowners increases the likelihood of reducing their consumption (Dolan & Metcalfe, 2013; Jessoe & Rapson, 2012; Karlin et al., 2014).

Building design approaches, such as Passive House and net zero energy buildings (e.g. nZEB or ZEB), were also discussed in relation to resource efficiency in schools. Passive House is an energy efficiency design methodology that orients buildings to take advantage of natural solar heat, resulting in minimal heating and cooling (Dorer, Haas, & Feist, 2005). A zero energy building (ZEB) is defined as a building that is highly energy efficient and uses either fully on-site power generation or off-site renewable energy so there is no consumption needed from the grid (Zeiler & Boxem, 2013). Some studies have explored the feasibility of the ZEB approach to schools (Pasunuru et al., 2014), with others advocating the use of the Passive House (aka Passivehaus) approach to achieve a zero carbon school (Tatchell, 2012).

2.5 School Carbon Emissions Reduction

Zeiler & Boxem (2013) note that energy and resource efficiency should always be the first step for an established school when beginning their carbon reduction journey. Others have noted that focussing on the consumption of just one resource (e.g. purchased electricity) is insufficient (Global Action Plan, Stockholm Environment Institute, & Eco-Logica Ltd, 2006). For example, one study suggests that up to 70% of a school’s carbon footprint can come from the emissions associated with procurement and transport (student and staff commute) (Global Action Plan et al., 2006), demonstrating the importance of looking at school carbon emissions from multiple sources.

However, even within the literature specifically focussed on school carbon emissions, there is still a heavy focus on direct emissions from energy. Several articles set out to determine the best strategies for carbon reduction in the education sector in South Korea, particularly in relation to how the country can achieve the carbon reduction targets (CERTs) outlined in the Kyoto Protocol (Ji et al., 2016; Kang, Lee, Hong, & Choi, 2018). One study suggested that improving thermal performance through the replacement of leaking windows and retrofitting lights to LEDs might prove a cost effective and achievable pathway to reducing emissions (Koo, Kim, & Hong, 2014). Another study suggested that school building emissions could be reduced by over 50% by designing buildings that incorporate elements such as high-efficiency HVAC and renewable energy (Chung & Rhee, 2013).

Several European countries have initiated programs to reduce carbon emissions in schools. For example, the “School of the Future” initiative, launched in the European Union in 2011, ran for five years and focussed on implementing solutions in schools to achieve high performance zero carbon outcomes (Kempe et al., 2015). Case studies of schools participating in this initiative described design plans that aimed to achieve up to 75% reduction in energy consumption from large-scale retrofits, such as increased insulation and energy monitoring devices (Erhorn-Kluttig, Erhorn, Kempe, Höfle, & Görres, 2016). There is also a growing emphasis on net zero energy buildings (nZEB) in the EU, with policies mandating all new buildings must be nZEB by 2020 (D’Agostino, 2015), which includes school education facilities. In Ireland, the Department of Education and Skills worked on developing low-energy school designs that reduce carbon emissions through integration of multiple efficiency approaches, such as high thermal performance and passive solar design (Sheppard, 2011).

Several reports written to inform carbon emissions reduction in UK schools were some of the most comprehensive approaches to school carbon reduction in the literature. The earliest UK study providing an evidence-base for carbon footprinting of UK schools suggested a school carbon footprint should include: 1) direct emissions from school buildings and equipment (e.g. energy & water); 2) transport emissions from commuting staff and pupils and; 3) embodied emissions of the goods and services consumed in schools (Global Action Plan et al., 2006). This report proposed a hybrid methodology for obtaining the data needed for a school’s carbon footprint, including both top-down data (e.g. resource usage/cost data sourced directly from government or suppliers) and bottom-up data (e.g. questionnaires or records schools keep of purchases and other school activities). They also noted the importance of taking the following steps into consideration when approaching school carbon reduction: “linking with the curriculum, using a ‘whole school’ approach, tying into existing (and future) services within schools, and; being sensitive to different local needs.” (Global Action Plan et al., 2006, p. 12). A later strategy report by the UK Department for Children, Schools and Families (DCSF, 2010) suggested that waste should also be added to a school carbon footprint in addition to energy, transport and procurement emissions. The importance of schools learning how to effectively manage their buildings is also highlighted, along with the potential for schools to influence their communities through their carbon reduction initiatives (DCSF, 2010).

Life Cycle Assessment was discussed as a holistic approach to calculating the carbon emissions of schools (Alshamrani, Gala, Alkass, Galal, & Alkass, 2014; Emami, Marteinsson, & Heinonen, 2016; Gamarra et al., 2018; Jensen et al., 1997). LCA is a highly detailed approach and involves calculating the environmental impact of every aspect of the building, including material extraction, construction, maintenance and operation (Jensen et al., 1997). Several studies used LCA methodology to calculate the carbon emissions of schools. Some focussed on the emissions associated with school buildings during a particular phase, such as the construction phase (Emami et al., 2016) or design phase (Alshamrani et al., 2014). Gamarra et al. (2018) examined LCA results of schools in hot climates and found the largest proportion of carbon emissions were attributed to lighting, heating and cooling the school building. Another study looked at creating LCA benchmarks for schools (Ji et al., 2016).

At a school action level (i.e. teachers and school administration implementing solutions), Lewis, Mansfield, & Baudains (2014) highlighted the success one Australian primary school had integrating a quantifiable carbon emissions reduction target within the school’s curriculum. The school implemented a “Ten Tonne Plan” that saved 10 tonnes of carbon emissions in one year through high engagement with students and an interactive carbon emissions trading currency called Boya (Lewis et al., 2014). The program was widely accepted by the school and surrounding community, demonstrating the potential for implementing school sustainability using a systems thinking approach (Lewis et al., 2014). Another study approached school carbon reduction through the lens of student performance, and proposed design guidelines for retrofitting educational facilities based on both carbon emissions metrics and student achievement outcomes (Elzeyadi, 2009).

Within the literature around sustainable school buildings, the idea of “green schools” is frequently referenced. However, there is no standard definition of what constitutes a “green school” and the term is loosely defined (Zhao, He, & Meng, 2015). While a green school can incorporate a carbon emissions calculation element, there is inconsistency about how a green school’s impacts are measured and reduced (Ramli et al., 2012), leading to a lack of clarity about what exactly a green school is (Iwan & Rao, 2017).

2.6 Barriers & Challenges with School Carbon Reduction & Consumption

Within the literature, there were several technological, organisational and policy issues identified. Several articles noted the difficulty in benchmarking and predicting energy or greenhouse gas emissions in schools due to the large number of variables contributing to a school’s resource consumption pattern (Filippín, 2000; Hong, Paterson, Mumovic, & Steadman, 2014; Sekki, Andelin, Airaksinen, & Saari, 2016; Vadney et al., 2012). Using electricity or carbon emissions benchmarks is beneficial in understanding whether a school’s consumption or emissions is higher or lower than expected (Ji et al., 2016). Lourenço, Pinheiro, & Heitor (2014) identified key performance indicators for sustainable energy consumption in schools based on eight Portuguese case study schools and noted that user behaviour and interaction with the building was a significant factor when implementing sustainable energy use strategies in a school. This study, and others, highlighted inconsistencies between electricity use and factors such as size of school and number of students, suggesting there are other elements at play, such as leaking windows and the energy use behaviours of teachers and students (Armitage, Godoy-Shimizu, Steemers, & Chenvidyakarn, 2011; Filippín, 2000). These issues highlight the importance of taking into account the context of each school, as well as using relevant terms and variables (e.g. CO_2 per student) when comparing consumption and carbon emissions between schools (Filippín, 2000).

Schools designed or retrofitted with sustainability principles also, in some cases, showed some discrepancies in the expected versus actual environmental performance of the building. Pegg, Cripps, & Kolokotroni (2007) reported that a post-occupancy evaluation of five low-energy schools in the UK had higher carbon emissions than expected, emphasising the importance of improving assumptions and predictions about school building emissions.

Filippi & Sirombo (2015) also identified this issue in Argentinean schools and recommended incorporating post-occupancy evaluations into school sustainability audits. This disconnect between expected and actual performance was also identified in residential and commercial building occupant behaviour (Shove, 2007). There is a growing need to consider the already established practices of individuals when implementing efficiency technologies due to these disconnects (Breadsell & Eon, 2019).

While occupant behaviour is an important aspect to consider in relation to carbon reduction in schools, some studies identified correlations between emissions and school characteristics. One study found that pupil density (number of students per m^2) was more important than total school size (m^2) when it comes to carbon emissions from energy consumption (Armitage et al., 2011). Another study of electricity consumption and cost at Finnish child care centres and schools also found inconsistencies between building age, electricity cost and occupant density. However, they also found correlations between occupant density and electricity cost (Sekki et al., 2016).

In the built environment sector, many types of rating systems have been developed to rate the environmental performance of buildings. Building rating systems (usually referred to as green rating systems) can be used to influence the design of a building to be more sustainable, or these can be used with existing buildings to provide insight into environmental impact (Alshamrani et al., 2014). Some of the rating systems that are the most widely used include LEED (USA), BREEAM (UK), GreenStar (Australia) and CASBEE (Japan) (Shan & Hwang, 2018). While green rating systems primarily target commercial or residential buildings, many commonly used green rating tools have also incorporated guidelines for smaller buildings and communities, and education facilities such as universities and schools (Ramli et al., 2012). However, accreditation entails a financial cost. Considering many schools struggle with funds and often lack staff time and expertise around sustainability (Evans, Whitehouse, & Gooch, 2012), these rating systems are not always practical for existing schools wishing to decarbonise, and are more commonly used for new buildings.

While there is abundant opportunity for school buildings to be designed with rigorous sustainability principles (Roach, 2011), there are many barriers to sustainable school design. Kershaw and Simm (2014) identified several key barriers to the design of low carbon schools. These include the difficulty of designers accurately predicting school resource consumption patterns due to increases in IT and school facility use outside of school hours, challenges with school administrators understanding how to use Building Energy

Management Systems, and the perceived additional cost with designing sustainable buildings (Kershaw & Simm, 2014). They noted that for low carbon school design to become mainstream, not only do barriers need to be reduced, but drivers and incentives for low carbon design must be also be increased.

One way to address sustainable school design is to implement government policies (ASBEC, 2018). However, even with government policies in place to ensure schools are built sustainably, it is important that policies are explicit about expected outcomes. This was highlighted in a study by Moncaster & Simmons (2015) that explored how four schools in the UK were designed under government sustainable school policies between 2004 and 2010. The authors' discovered that while the participating schools were being designed with sustainable features, designers did not predict what the carbon emissions of the school would be once built, despite an emphasis from the UK government on reducing carbon emissions. They speculated this was because of ambiguity in the policy and guidelines, and showed a discrepancy between the schools that the policy-makers envisioned, and the schools that were built under the policy (Moncaster & Simmons, 2015).

2.6.1 School-Level Barriers & Enablers

At a school level, there are several barriers that can prevent schools from pursuing carbon reduction, much less, sustainability. Evans, Whitehouse & Gooch (2012) classified barriers facing schools when implementing sustainability initiatives into three main categories: grassroots barriers, administrative barriers and conceptual barriers. Grassroots barriers were considered those that affect teachers daily, including lack of time, information, insufficient training or expertise about sustainability, resistance from staff or parents, and a crowded curriculum. Administrative barriers are those related to administration, such as lack of program funding or conflicting administrative policies. Conceptual barriers are those where teachers or staff lack an understanding about sustainability at a broad level (Evans et al., 2012). Issues with stakeholders having a lack of knowledge about efficiency or sustainability were confirmed in a number of studies (Tabert, 2009; Tesiero, Nassif, Singh, & Flurchick, 2014). One study investigated school stakeholder perceptions of the enablers and barriers to long-term sustainability of evidence-based programs with over 800 stakeholders (Pinkelman, Mcintosh, Rasplica, Berg, & Strickland-Cohen, 2016). This study identified the main barriers as: 1) staff buy-in, 2) time, and 3) money. Other barriers to sustainability or energy efficiency uptake included a lack of follow-through by the school leader responsible for sustainability initiatives (Warner & Elser, 2015). Schools can address barriers around a lack of time by engaging parents in school programs (Langley, Nadeem, Kataoka, Stein, & Jaycox, 2010). However, many schools do not prioritise parent engagement in programs or experience difficulties engaging parents (McIntosh et al., 2014).

From an enabler perspective, Pinkelman et al. (2016) identified: 1) staff buy-in, 2) school administrator support, and 3) consistency as key enablers of sustainability initiatives. Consistency was defined as a common approach among staff, teams and school stakeholders (e.g. using a common language or working towards a common goal). Principal support (or lack thereof) can be an important enabler or barrier to school sustainability (Evans et al., 2012; Tooth, 2005). Other studies have proposed that facilities managers are the best suited to be advocates for energy efficiency in commercial buildings (Curtis, Walton, & Dodd, 2017) and providing school business managers with the agency and input on school strategies can incentivise them to take action to increase efficiency and better manage resources (Aldridge, 2008; Southworth, 2010).

A UK study on school carbon emissions suggested that one way to address the barriers that schools face that prevent them from pursuing sustainability is for local authorities (i.e. local governments) to become more involved. Local authorities can assist school carbon reduction by adopting an approach to improving school energy performance at a policy level and providing multi-level support to schools undergoing carbon reduction initiatives (Department for children schools and families, 2010). In addition, since retrofitting existing school buildings can be costly, governments can play an important role in providing support (Congedo et al., 2016).

2.7 Co-Benefits of School Carbon Reduction

When schools are designed or retrofitted to increase efficiency or reduce carbon emissions, there are a number of co-benefits, or benefits to schools and society. The following sections discuss the co-benefits most commonly discussed in the literature.

2.7.1 Decreased Utility Costs

A key study in the United States on the impacts of sustainably designed schools showed that green schools use an average of 33% less energy than conventionally designed schools (Kats, 2006). The ResourceSmart program in Victoria, Australia, is a government-funded program that helps schools reduce resource consumption from energy, water, and waste. It has over 1,300 participating schools and has helped them save over $20 million dollars and 60,000 tonnes of CO_2-e since 2008 ("About ResourceSmart Schools", 2019). Simple initiatives, such as scheduling lighting to be turned off after school, can save a school at least $10,000 (Tesiero et al., 2014), with numerous studies showing similar costs savings of sustainable retrofits to existing schools (Congedo et al., 2016; Dalla Mora, Righi, Peron, & Romagnoni, 2017; Dias Pereira, Raimondo, Corgnati, & Gameiro Da Silva, 2014; Rose, Thomsen, Bergsøe, & Mørck, 2015) and the financial benefits of designing schools sustainably (Afkhamiaghda, Keesee, & Holiday, 2017; Alshamrani et al., 2014; Zanni, Righi, Dalla Mora, Peron, & Romagnoni, 2015).This shows the significant potential for schools across Australia and globally to address inefficiencies to save money as a result of addressing carbon emissions.

2.7.2 Improvements in Occupant Health and Performance

Considering students and teachers spend up to 90% of their time indoors (Kats, 2006), literature has explored the effects buildings can have on occupants. Numerous studies have cited the strong link between poor indoor environment quality (IEQ) and negative impacts on the health and performance of building occupants (Chatzidiakou, Mumovic, & Summerfield, 2012; Dascalaki & Sermpetzoglou, 2011; Dorizas, Assimakopoulos, & Santamouris, 2015; M. Lee et al., 2012; G. Smith, Mumovic, & Curtis, 2013; Teeuwen, Bruggema, & Zeiler, 2015). Thermal comfort, which is one of the primary measures of IEQ, can have significant impacts on student well-being and performance (Zeiler & Boxem, 2009), with some studies even linking poor thermal comfort to energy efficiency measures in school buildings (i.e. keeping rooms warmer or colder than the ideal temperature range) (Wargocki & Wyong, 2013). This highlights the importance of ensuring highly efficient HVAC (heating, ventilation and air conditioning) systems are used in school buildings (Yang, Yan, & Lam, 2014). Other studies that looked at other aspects of buildings found that the amount of green space, natural light and acoustics (e.g. loud, echoing or unsettling noises) can also have impacts on the working abilities of school staff and students (Sheehan, 2015).

When school buildings are designed sustainably, many of these issues with IEQ can be addressed since sustainable buildings typically include features such as increased ventilation and more natural light – both of which have been shown to have positive impacts on student health and performance (Kats, 2006). However, a study examining the thermal comfort of students in an energy efficient school showed students and staff experienced poor thermal comfort, indicating more consideration should be given to the IEQ of school classrooms when designing a sustainable school (Golshan, Thoen, & Zeiler, 2018).

2.7.3 Community Influence

As highlighted by Rauland et al., (2014), schools have huge potential to act as a catalyst for community engagement around sustainability. Whole-school sustainability initiatives have also demonstrated they can encourage action and participation both within the school and between the school and the outside community through the dissemination of information from children to parents (Ballantyne, Connell, & Fien, 2006), and the direct involvement of parents themselves (Armstrong, Sharpley, & Malcolm, 2004). The implementation of sustainability initiatives, such as school gardens, has shown that they can attract community interaction while promoting sustainability and activating students and staff to further green the campus (Rilla, 2013).

Schools also often serve as community hubs, hosting community organisations and activities outside of school hours, giving them a unique opportunity to influence communities. They can, thus, play an important role in demonstrating and showcasing low carbon approaches and behaviours, which can offer trickle-down educational benefits by educating and encouraging communities towards sustainability (Dean, 2013; Kershaw & Simm, 2014; Sustainable Development Commission, 2008).

> *"Schools have the potential to become beacons of good practice for their communities and replicators of positive sustainable behaviours, not just through their teaching but through also their management and their engagement with local communities."(Sustainable Development Commission, 2008, p. 7)*

2.7.4 School Buildings as Learning Opportunities

One of the most significant co-benefits of reducing carbon emissions in schools are the educational opportunities. Several researchers have raised concerns about the disconnects between how sustainability is taught and how it is demonstrated through the actions of schools (Broom, 2015; Kennelly, Taylor, & Serow, 2011). For example, some schools might teach about energy conservation but act in a way that contradicts this teaching (Cotton, Winter, & Bailey, 2013).

School buildings themselves can act as an important influencer in the hidden curriculum (i.e. the unintended things students learn at school outside of the taught curriculum), which can either strengthen or weaken the school's curriculum (Fien, 2003). There is often little emphasis within schools on using school buildings (or data from school buildings) as teaching aids (Cole, 2014). Orr (1997) identified school buildings as a largely overlooked element of education in schools, suggesting they can be used both as a medium for educating and a source of learning, describing this concept as the "architecture as pedagogy". Others have referred to educational buildings as 3D textbooks (Newton, Wilks, & Hes, 2009).

Dean (2013) suggests that school buildings and facilities can provide useful hands-on learning opportunities to help educate students about sustainability, while Rauland et al. (2014) notes the importance of providing tangible opportunities to "implement" sustainability, thereby empowering students to take action. Studies have found that the involvement of students in the calculation of their ecological footprint in categories such as food, energy, and water usage at a personal and school-wide level can result in a high level of engagement of students and increased probability of actions around sustainability, taken both on and off campus (Gottlieb, Vigoda-Gadot, & Haim, 2013; Gottlieb, Vigoda-Gadot, Haim, & Kissinger, 2012). Other studies have highlighted that by involving students in school programs, such as an energy efficiency program, students showed an increased enthusiasm for school programs and exhibited more agency (Broom, 2015; Dimick, 2012).

The retrofit of an existing school building can also provide a plethora of learning opportunities for the students as they can see first-hand the changes being made and the effect they have on a building (Koumoutsos et al., 2015). Cole (2014) used the term 'Teaching Green (School) Building' to describe "green" educational facilities that seek to incorporate green building education into architecture, and through an extensive literature review, developed a framework for linking architecture and environmental education. The model shows that a sustainable building can serve as both a medium for sustainable education and an active tool of the educational process, suggesting learning can take place across a spectrum of contexts (Cole, 2014).

Further, while traditional environmental education methods have proven successful in educating children in many respects, there is growing evidence that children often feel powerless about how they can change or help to influence environmental issues (L.-S. Lee, Lin, Guu, Chang, & Lai, 2012). This suggests environmental education may often fail to incorporate a much-needed action component (Ballantyne et al., 2006). This further highlights the importance of engaging students in hands-on activities around school carbon reduction.

2.8 Education for Sustainability

Education for Sustainability (EfS), also called Environmental Education (EE), is a well-established field of knowledge related to integrating sustainability and environmental principles into the curriculum within schools (Australian Government Department of the Environment Water Heritage and the Arts, n.d.). On a global scale, environmental education (EE) was catalysed in 2002 by the United Nation’s declaration, in the years 2005 – 2015, as the Decade of Education for Sustainable Development (DESD). After this declaration, countries around the world, including Australia, took the pledge to further advance Education for Sustainability (EfS) in their communities (Tilbury, Coleman, & Garlick, 2005). This was undoubtedly beneficial to EE in schools and gave rise to numerous sustainable school programs (Tilbury et al., 2005). One of the most notable programs created in Australia was the Australian Sustainable Schools Initiative (AuSSI), which was developed and initially funded by the Australian Federal Government to deliver a whole-of-school approach to sustainability. However, the program was defunded federally in 2010 (Department of the Environment Water Heritage and the Arts, 2010) with the expectation that the individual States and Territories would continue to fund it. This occurred in varying degrees (Rauland et al., 2014).

Nevertheless, in 2014, sustainability was included as a national cross-curriculum priority in the Australian Curriculum (Moore, Almeida, & Barnes, 2018). Despite this recommended priority, many Australian schools have yet to meaningfully integrate sustainability across their curriculum (Hill & Dyment, 2016). One study found that teachers still perceive sustainability as additional work (Dyment & Hill, 2015) and teachers also largely lack the knowledge and understanding of sustainability to incorporate it into the curriculum (Dyment et al., 2015). A lack of conceptual knowledge about sustainability was also identified as a barrier to the uptake of sustainability in the curriculum in another study with Queensland schools (Evans et al., 2012). An approach many schools strive for in EfS is a whole-school approach (Barr, 2011). This approach is defined by a school embedding sustainability into all aspects of the school, including school governance, curriculum, resource management and operations, and grounds maintenance (Tilbury & Henderson, 2004).

2.9 Intergenerational Influence

Some literature suggests that children can have a significant influence on parental attitudes and behaviours (Duvall & Zint, 2007). Within marketing research, the ability for children to influence parent food purchasing behaviours is referred to as “pester power” (McDermott, O’Sullivan, Stead, & Hastings, 2006). Another study has shown that children can play an important role in influencing their parent’s behaviour around smoking (Satchwell, 2012).

A primary question investigated for this research is the influence children can have on their parents and family members around low carbon living. In environmental education, intergenerational influence can be defined as the process where “school students act as catalysts of environmental change among their parents and other community members” (Ballantyne et al., 2006, p. 414). Intergenerational influence also occurs in the opposite direction. That is, older generations influence younger generations (i.e. the influence of parents or guardians on their children), with most literature focussing on this flow of influence (Larsson, Andersson, & Osbeck, 2010; Satchwell, 2012).

When it comes to environmental issues, many studies have shown that students can influence their family members to be more sustainable (Boudet et al., 2016; Larsson et al., 2010; Maddox, Doran, Williams, & Kus, 2011). One study measuring the influence of students on their parent’s electricity usage behaviours found that households with students who participated in a student-centric electricity conservation program used less electricity than the control group (Agarwal, Rengarajan, Sing, & Yang, 2017). A similar study showed that children who participated in an intervention to encourage energy-saving behaviours took the knowledge home and this resulted in an increase in self-reported energy saving behaviours by their parents (Boudet et al., 2016). Children participating in waste education programs at school have also been shown to influence home practices around recycling (Maddox et al., 2011). Other studies have demonstrated that children can influence their parent or guardians’ perceptions of the environment by discussing environmental topics with them (Ballantyne, Fien, & Packer, 2001; Vaughan, Gack, Solorazano, & Ray, 2003). Ballantyne et al., (2001) showed that 21% of students discussed sustainability behaviour changes with their parents.

The ability for students to positively impact the attitudes and behaviours of their family members and parents represents an opportunity for them to play a larger role in addressing climate change. Some environmental educators have also highlighted the potential for environmental education programs to specifically incorporate intergenerational education components, which has the potential not only for students to influence the behaviour of adults they interact with, but could also strengthen the student's learning of the subject (Ballantyne et al., 2006). Others suggest that children bring unique perspectives to challenging topics such as climate change and argue that child-based climate change communication is an underutilised pathway for climate action (Lawson et al., 2018). This highlights the importance of viewing children as active influencers and providing opportunities for students to lead within schools and incorporate intergenerational learning components in environmental education programs (Larsson et al., 2010).

2.10 Proenvironmental Attitudes & Behaviour

Proenvironmental behaviour (PEB) and proenvironmental attitudes are terms that describe human behaviours or attitudes that seek to minimise impacts on the environment (Steg & Vlek, 2009). Attitude can be defined as "a latent disposition or tendency to respond with some degree of favourableness or unfavourableness to a psychological object" (Fishbein & Ajzen, 2011, p. 76). The exploration of what precedes or determines attitudes or behaviour, and understanding how to best encourage PEB is becoming increasingly important as the push for lower resource consumption and efficient consumption behaviours increases (Osbaldiston & Schott, 2012). The next sections describe approaches to measuring proenvironmental attitudes and behaviour and the theories regarding predicting PEB.

2.10.1 PEB Theories

2.10.1.1 *Reasoned Action Approach*

A framework for predicting behaviour that has proven useful in explaining environmental behaviours is the Reasoned Action Approach (RAA) – a model that combines the Theory of Planned Behaviour and Theory of Reasoned Action (Fishbein & Ajzen, 2011; Steg & Vlek, 2009). Fishbein and Ajzen (2011) highlight the importance of first approaching this framework with a definition of behaviour. The Reasoned Action Approach (RAA) framework focusses on a few key areas:

- **Behavioural Beliefs (i.e. Outcome Expectancies)** – A person's belief about the positive or negative consequences they might experience if the behaviour is performed.
- **Attitude** – A person's favourable or unfavourable disposition towards performing a behaviour. Attitude is influenced from behavioural beliefs and how a person perceives performing the behaviour.
- **Perceived Norm** – A person's perception of whether a behaviour will result in a positive or negative social outcome. If a person perceives a social pressure linked to engaging with the behaviour that is negative, they are less likely to perform the behaviour and vice versa.
- **Control Beliefs (i.e. Perceived Behavioural Control)** – A person's beliefs about the personal or environmental factors that can help or hinder their ability to perform the behaviour.

The combination of behavioural beliefs, attitude, perceived norm and perceived behavioural control then form a person's *intention*, which subsequently influences the behaviour. In general, when a person has a more favourable attitude and more perceived behavioural control, the stronger the intention is for a person to perform the behaviour (Fishbein & Ajzen, 2011). However, while an intention to perform a behaviour may be strong, there are other factors that come into play that prevent a behaviour from being carried out, such as level of skills/abilities to carry out the behaviour or control of behaviour (e.g. if behaviour can only be addressed by government agents).

2.10.1.2 *Other Theories of PEB*

Other researchers approach PEB as a combination of self-interest and concern for others (i.e. pro-social) (Bamberg & Moser, 2007). Researchers who emphasise pro-social behaviour (i.e. a combination of self-interest and concern for others) as the basis for environmental behaviour often apply the norm-activation model (NAM). The NAM views personal and moral norms, or feelings of strong moral obligations, as the determinants for pro-social behaviour (Bamberg & Moser, 2007). Moral and normative concerns concede that if an individual holds a larger societal value (such as human rights) or they feel a sense of moral obligation to act they are more likely to subscribe to proenvironmental behaviour (Steg & Vlek, 2009). There are studies that suggest that moral norms play a significant role in particular proenvironmental behaviours such as energy conservation, recycling, travel mode choice and proenvironmental buying (Bamberg & Moser, 2007).

The value-belief-norm (VBN) theory is a more recent theory that combines the norm-activation model (NAM) and uses the New Ecological Paradigm (NEP) as one of the five linear factors that affect a person’s ecological worldview (Stern, 2000). Steg & Vlek (2009) noted that VBN has been successful in explaining some PEBs in multiple studies, such as willingness to change behaviour or policy acceptability. However, the RAA is more effective in predicting more difficult or “high-cost” behaviours, such as reducing car use. This is likely to be due to the additional factors that RAA includes, such as perceived behavioural control and non-environmental motivations (Steg & Vlek, 2009). Other theories such as “practice theory” emphasise the importance of an individual’s system of practice in relation to an efficient technology (Shove, 2007) and is commonly applied in energy efficiency behaviour research (Eon, Breadsell, Morrison, & Byrne, 2017).

2.10.2 Measuring Proenvironmental Attitudes & Behaviour

There are several approaches to measuring proenvironmental attitudes. One of the most widely used is the New Environmental Paradigm (NEP) scale; developed in 1978 and later revised in 1992 (Dunlap & Van Liere, 1978). Other scales have also been developed, such as the Environmental Attitudes Inventory, which brings together constructs from the 12 scales that preceded it (Gifford, 2014). Much of the research aimed at measuring proenvironmental attitudes focusses on environmental topics, ranging from wildlife conservation to energy efficiency. However, there appears to be a gap in the literature focussing specifically on carbon emissions reduction or climate action. In response to the lack of measurements around low carbon attitudes, Brien et al. (2018) developed the Low Carbon Readiness Index (LCRI) which is a three-item measure of low carbon ambitions. Analysis of the LCRI showed a high level of convergent validity with other environmental measures, such as “NEP”, “environmental identity” and “environmental striving”, showing the LCRI is effective at measuring intended attitudes (Brien et al., 2018). In tests with over 700 individuals, the LCRI showed that an individual’s personal goals to reduce carbon emissions is highly associated with an increased likelihood that the individual will engage with other low carbon behaviours (Brien et al., 2018). Brien et al. (2018) also showed in later studies that the LCRI could predict a reduction in real general energy use.

Many studies have sought to determine the strongest determinants of PEB (Ajzen & Fishbein, 1977; Grob, 1995). Gifford (2014) identified many factors that can influence proenvironmental behaviour (PEB), such as values, demographic, feelings of responsibility, attitude, and personality. The infrastructure and facilities within a place (such as the presence or lack thereof of a recycling bin at a school) can also play a part in encouraging or constraining PEB (Gifford, 2014; Heath & Gifford, 2002). One meta-analysis of 46 studies on PEB found "intention" was the strongest indicator of PEB, and that attitude, perceived behavioural control, and moral norm were significant independent predictors of behavioural intention (Bamberg & Moser, 2007). Other studies also identified "attitude" as a significant determinant that can help predict PEB (Bamberg & Moser, 2007; Eilam & Trop, 2012).

2.10.3 Types of Proenvironmental Behaviour

There are several ways to approach the categorisation of proenvironmental behaviour as there are so many ways PEB can be interpreted (Gardner & Stern, 2008). Some researchers opt for dichotomous approaches to categorising actions, defining actions either as *curtailment*, which is a change in behaviour to reduce consumption and change in routines (e.g. switching off appliances when not in use), or *efficiency*, which are one-off choices that involve the adoption of an efficient technology (e.g. installing solar PV on the home) (Karlin et al., 2014). Curtailment actions require a change of habits for the individual and must be repeated over time to have a positive environmental effect, whereas efficiency actions have lasting effects for a single action (Gardner & Stern, 2008). Other dichotomous approaches include *high-impact* (e.g. installation of solar PV) versus *low-impact* behaviours (Gifford, 2014). Gifford (2014) suggests that high-impact behaviours (how often an individual drives) are more rooted in habit, whereas low-impact behaviours (e.g. how much one recycles) tend to be more influenced by attitude, personal norms and values.

Approaches to categorise PEB that are more detailed include the approach by Stern (2000), which identified four types of environmentally significant behaviour:

- environmental activism;
- nonactivist behaviours in the public sphere;
- private-sphere environmentalism; and
- other environmentally significant behaviours.

Within *private-sphere environmentalism*, which describes actions such as purchasing personal and/or household products that have less of an environmental impact, Stern (2000, p. 409) further categorised actions based on the type of decision they involved: "*purchase of major household goods or services, use and maintenance of environmentally important goods, waste disposal* and *green consumerism"*. The advantage of this type of categorisation allows for a deeper understanding of the types of PEB and the implications these have in society.

Some researchers have categorised proenvironmental behaviour (PEB) specifically in relation to the household (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Other researchers used principal component analysis on self-reported measures of past behaviour to develop eight domains of action (Whitmarsh, 2010). Lanzini & Thøgersen (2014), describing the spillover effect, which says that when an individual performs a proenvironmental behaviour there is more likelihood they will perform more proenvironmental behaviours in the future. "Behavioural clustering" is a similar concept whereby if an individual performs one particular PEB (e.g. recycling) they are highly likely to perform another specific action (e.g. using reusable bags), and therefore these two (or more) actions are considered to be clustered (Gillis, 2016).

2.10.4 Role of Self-Efficacy

The Reasoned Action Approach (RAA) highlights perceived behavioural control as a key element to PEB. Perceived behavioural control is similar to the idea of self-efficacy, which can be defined as "the belief that one can successfully execute the behaviours required to produce certain outcomes" (Hanss & Böhm, 2010, p. 48). The basic principle behind self-efficacy is a positive correlation between the amount that an individual believes they can master or accomplish a given behaviour and the likelihood of the individual initiating and/or continuing that behaviour (Barry, Harper, Berryman, & Farley, 2016). Put simply, someone is more likely to change behaviour if they believe they can do it. Further, they are likely to continue a changed behaviour if they experience a level of success in performing that behaviour (Bandura, 2006).

In the realm of climate change, this is a crucial psychological element to consider given that research indicates low self-efficacy is correlated with a higher avoidance around climate change (Grothmann & Patt, 2005). Many studies have shown that young people, in particular, experience worry and anxiety about climate change. However, they can feel disempowered about their ability to act on climate change (i.e. have low sense of self-efficacy) (Lee et al., 2012; Skamp, 2010; Stuhmcke, 2012).

2.10.5 Influencing Attitudes and Behaviour

The strategies around influencing behaviour change are varied. However, there are two broad types of behaviour change strategies: antecedent strategies and consequence strategies (Abrahamse, Steg, Vlek, & Rothengatter, 2005). Antecedent strategies focus on changing the factors that lead to the behaviour change, such as "information and education, prompting, modelling, behavioural commitments, and environmental design" (Steg & Vlek, 2009, p. 313). Consequence strategies, on the other hand, target the consequences following the behaviour, such as rewards and penalties. Education, an antecedent strategy, can act as a primer for PEB (Gifford, 2014). Interventions to encourage environmental behaviour can have short-lived effects (Abrahamse et al., 2005), which highlights the importance of long-term studies (Steg & Vlek, 2009).

A meta-analysis which looked at the most effective treatments for promoting PEB in individuals highlighted how different PEBs require different strategies to encourage change (Osbaldiston & Schott, 2012). For example, while social modelling and commitment may be effective at promoting home energy conservation, making it easy and providing rewards is far more effective for encouraging a different PEB, such as curbside recycling (Osbaldiston & Schott, 2012).

Several studies looked into the impacts of peer comparison data on household energy consumption (Abrahamse et al., 2005; Ayres, Raseman, & Shih, 2013; Karlin, Zinger, & Ford, 2015; Miller & Prentice, 2015). A meta-analysis of studies looking at the effects of feedback on energy conservation found there was significant evidence amongst the studies to indicate that providing information to occupants about similar household energy consumption leads to a reduction in energy consumption (Karlin et al., 2015). However, there is some discrepancy about the most effective methods of providing information and the extent to which it influences behaviour (Abrahamse et al., 2005).

Considering people spend up to 90% of their day indoors (Kats, Perlman, & Jamadagni, 2005), Tucker & Izadpanahi (2017) tested the hypothesis that students in a sustainably designed school would likely have more proenvironmental attitudes, and therefore behaviour, than students in conventional school buildings. Their results, which were consistent with earlier studies, showed that there was a statistically significant difference in environmental attitudes and behaviour between sustainable school students and conventional school students (Izadpanahi, Elkadi, & Tucker, 2015).

2.11 Program Impact Evaluation

A key objective of this research is to measure and analyse the social impact of the Low Carbon Schools Pilot Program (LCSPP). Measuring social impact, however, is complex due to the wildly varying definitions and approaches to measurement. The literature around theory-based evaluation, social impact definitions, and methods for measurement are outlined in the sections below.

2.11.1 Social Impact Models

Measuring the impact of a program or intervention has been around since the 1960s and the term “social impact” has had a history of change (Hehenberger, Harling, & Scholten, 2013). Social impact, sometimes referred to as ‘social value’, can be broadly defined as societal or environmental change leading to different interpretations and definitions of what is considered social impact (Grieco, 2015). For the purposes of this research, social impact is defined as the effect of an organisation’s activities contributing to short and long-term outcomes in communities and for individuals (*Logic Model Development Guide*, 2004).

The social impact of a program or intervention goes beyond pure program outputs (e.g. number of participants or money saved) to include program outcomes, which are wider changes in attitude, beliefs, knowledge or action, both in the short-term and longer term (Grieco, 2015). A further distinction is made between outcomes and impact, where outcomes can be defined as lasting change at an individual level and impacts as wider community or societal changes and shifts (Ebrahim & Rangan, 2010).

Within social impact literature, there is a disproportionate lack of theoretical and conceptual framing for social impact analysis and measurement (Ebrahim & Rangan, 2014; Galloway, 2009), with a steep disconnect between the academic, corporate, and third sector organisations in defining and measuring social impact (Ebrahim & Rangan, 2014; Mulgan, 2010). This is most evident with the abundant, and sometimes contrasting, definitions of common evaluation approaches, such as logic models and theories of change (ToC) and the hundreds of social impact methodologies that have been developed since the 1960s (Mulgan, 2010; A. Nicholls, 2015; Zappalà & Lyons, 2009).

Some of the most common approaches include Social Return on Investment (SROI), Results Based Accounting (RBA), and Cost-Benefit Analysis. However, each of these methods have contexts and applications they are best suited for. Logic models have been a common approach for many NGOs, social enterprises and programs and can act as a useful tool for both planning and evaluating programs (Nicholls & Stevenson, 2015).

The W.K. Kellogg Foundation (2004) p.7, defines a logic model as:

> *"a picture of how your organization does its work – the theory and assumptions underlying the program. A program logic model links outcomes (both short- and long-term) with program activities/processes and the theoretical assumptions/principles of the program."*

While there are many other methodologies used by practitioners, it is outside the scope of this research to comprehensively examine the strengths, weaknesses and applications of each. This research accepts logic models as an appropriate approach to measure the social impact of small community programs.

In the realm of environmental education and sustainability programs, there is a significant body of literature showing the impact sustainability education programs can have on students, particularly in terms of learning outcomes (see Block et al., 2012; Grodzinska-jurczak, Bartosiewicz, Twardowska, & Ballantyne, 2003; Maddox, Doran, Williams, & Kus, 2011; Rickinson, Hall, & Reid, 2016). However, there is little research demonstrating the impact a program can have on the school itself (including all staff), and the wider community, particularly regarding proenvironmental attitudes or behaviour (Tabert, 2009). Further, the impact measurement methods used for these types of programs and the level of rigour are varied and inconsistent (Rickinson et al., 2016). This demonstrates a gap in the literature in this area.

2.12 Summary

This chapter has highlighted the key concepts that emerged from the literature. It is evident there is a significant gap specifically targeting carbon reduction in schools, with most articles returned from the SLR primarily focussing on energy efficiency. In addition, there are several technical and organisational barriers that schools face when it comes to school decarbonisation. Schools lack the time, knowledge and resources to decarbonise. And while countries such as the UK have made significant strides in this area, there is no national focus in Australia for school decarbonisation. Despite the barriers to school decarbonisation, the research shows there is significant potential for schools to influence students, creating a flow-on effect where students can influence their family members and act as active players in combatting climate change. However, the research in this area is limited, with most intergenerational influence focussing on how older generations can influence younger generations.

This review has established the key themes and conceptual framework for this research. This, along with the theoretical principles of this research, are discussed in the next chapter.

3 Research Context and Participant Overview

3.1 Western Australia

This research was conducted with schools in Western Australia, Australia, and therefore the research findings are most immediately relevant within this geographical context. Compared to other states in Australia, Western Australia is largely supported by the mining industry for natural resources, such as iron and natural gas, with mining accounting for 29% of Western Australia’s Gross State Product (GSP) (Department of Jobs Tourism Science & Innovation, 2018). Western Australia’s history of environmental education began with the national Australian Sustainable Schools Initiative (AuSSI), where it was delivered in schools with funding from the federal government. Once this funding ceased in 2010, the program was replaced with a less hands-on version of the AuSSI program - later renamed ‘Sustainable Schools WA’ (Rauland et al., 2014), which employed one state government representative to develop and coordinate curriculum resources and a network of providers delivering various sustainability activities for schools. In contrast, other states, such as Victoria, further developed and expanded their environmental education programs and contributed over $8 million to their ResourceSmart program, which assists schools in increasing their utility efficiency (Rauland et al., 2014). Despite the low level of action for school sustainability at a state government level, local governments, such as the City of Fremantle, where most schools participating in this research resided, are ambitious in how they address community carbon emissions, which includes supporting schools (City of Fremantle, 2019).

It is also important to note the landscape of the WA Department of Education (DoE) in relation to school funding and policies. Shortly before this research commenced, the DoE adopted a new funding structure for government schools called the one-line budget, or student-centred budget. This new funding structure meant schools were provided with a sum of money based on the number of students attending the school and the school managed funding for the different areas of the school (e.g. library resources or utility bills). This meant that if a school could reduce their energy consumption they could choose to reallocate those savings as they saw fit to other areas of the school. Previously, schools could not keep savings (Rauland et al., 2014).

3.2 Defining Community

Given the focus on community within this research, it is necessary to discuss how it is defined in this study. Drawing the boundaries and defining community has been a challenge for many decades, with the first definition of "community" from a sociological perspective emerging in the 1970s (Smith, 2001). Community can be defined in a number of ways and contexts, but it will be broadly explored in three different ways in this thesis: place, interest and communion. Place includes geographical community. Interest is a community where individuals are linked by a common interest, factor or belief (e.g. sexual orientation, religious belief, sports), and communion can be seen as a community that can be defined as a profound meeting or encounter or deep attachment to a place, group or idea (e.g. communion of saints) (Smith, 2001). It is recognised that these types of community will overlap in various ways. For example, a geographical community may share a sense of place but may not have any connection or a sense of community otherwise (Dall'O', Bruni, & Panza, 2013).

Within a school context, community can also be approached in several ways. Senge et al. (2000) introduces the concept of a "learning school", which he describes as having three elements: the classroom (teachers, students and parents), the school (superintendents, principals, administrators and school board/committee members) and the community (community members and lifelong learners) (Senge, Cambron-McCabe, Lucas, Smith, & Dutton, 2012). This conceptualisation of a learning school community, along with the concept of community, were used to inform how community is defined in this research.

For the purpose of this research, the "school community" and the "wider community" will be defined as:

- **School community**: 1) Students, 2) School administration (principals, administrators, school board members), 3) Teachers and, 4) P&C members (e.g. Parents and community members))
- **Wider community:** 1) Geographical neighbourhood around the school, 2) Extended family members or guardians of students (e.g. uncles, aunts, cousins etc.) and, 3) Close relationships of the parents of students (e.g. close friends, colleagues)

For this research, the school community is examined, however it is worth noting that schools participate in multiple types of communities and bring together diverse groups of individuals. Because of this, schools have a tremendous opportunity to influence not only the students, but the parents and the community associated with the school around sustainability. Studies have highlighted how schools can become demonstrations of sustainability and provide an opportunity for the community to engage with, and learn from the school (Dean, 2013; Kershaw & Simm, 2014).

3.3 The Low Carbon Schools Pilot Program

3.3.1 Program Overview

All thirteen schools involved in this research were participants in a Low Carbon Schools Pilot Program (LCSPP) that took place in Perth, Western Australia. The LCSPP was created by a small consultancy called SimplyCarbon, with support from the City of Fremantle and the CRC for Low Carbon Living, which was a national research and innovation hub that funded research in the low carbon built form environment sector. The CRC for Low Carbon Living funded a three-year scholarship for a full-time PhD student (Portia Odell) and a part-time project manager to assist with research outcomes.

The two-year program took place between 2016 and 2017 and aimed to empower and upskill school administration and students to enable them to implement quantifiable carbon reduction initiatives. The program was also designed to build community between the participating schools and to encourage the sharing of experiences. The program had between a $500 and $1,500 fee for participation. However, the majority of schools did not pay the full amount since the program partnered with several local governments that provided program fee assistance for schools within their council geographic area. A total of 15 schools participated in the LCSPP, however, only 13 were included in this research due to gaps in data and significant changes to student numbers and subsequent building infrastructure.

3.3.2 Partners

The program formed several partnerships with local and state government, not-for-profits and industry representatives. Examples of some of the key partnerships that the program made are shown in Table 4.

Table 4: Partners of the Low Carbon Schools Pilot Program.

Industry Type	Name	Contribution
Local Government	City of Fremantle	Financial (subsidised schools to participate)
	City of Melville	
	City of Cockburn	
Universities	Curtin University	Provided in-kind time from Research Manager and was the enrolling institution of PhD student
	University of Melbourne	Assisted with the provision and analysis of surveys to capture information about public attitudes toward Low Carbon Living (LCRI)
Government School Programs	Waste Wise *(Waste Authority)*	In-kind workshop presentation, cross-promotion, representatives on CRC Advisory board
	Water Wise *(Water Corp)*	
	Travelsmart *(Department of Transport)*	
Industry Representatives	Synergy *(Government Energy Utility)*	In-kind provision of individual School Annual Energy Load Reports
	Sustainable Action	Provided free on-site energy audits for participating schools
	Dolphin Lighting	In-kind workshop presentation
	Flowless *(Water Auditing Company)*	Provided specialised advice to schools, free flow restrictors & discounted water audits
	Josh Byrne & Associates	In-kind workshop presentation
	Lifecykel	Donated two Mushroom Boxes (as a fundraising option for schools)
	Solar Analytics	Free software to schools
	Moore & Moore Cafe	Discounted Venue Hire
State Government	Building, Management & Works (BMW) *(WA Department of Finance)*	In-kind workshop presentation, ongoing discussion for managing schools planned Low Carbon Actions, representative on CRC Advisory board
	Department of Education	Representative on CRC Advisory board

NFPs	Living Smart	In-kind workshop presentation – potential to get parents involved
	Millennium Kids	Delivered nine in-kind workshops with students at participating schools, representative on CRC Advisory board
Financial Institution	Bendigo Bank	Donated $500 to assist with workshop costs

3.3.3 Participant Requirements

In order to participate, each school had to agree with the following set of requirements:

- Provide a letter of support from the school principal acknowledging the school’s participation;
- Establish a school sustainability committee of at least three people, including the business manager, a teacher and a parent/P&C representative;
- Commit at least one person from the committee to attend each workshop;
- Provide access to relevant records and utility bills; and
- Commit to participating in research-related activities, such as surveys and interviews.

While it seems obvious that schools would require the support of the Principal and/or school leaders to embark on any new initiative (particularly if it required a financial commitment), school leaders also needed to know that they had the support of the staff who would ultimately implement the program in their school. Rauland et al. (2014) highlights the risk associated with relying on one sustainability champion. This led to the requirement that schools establish a committee to enable the workload to be distributed amongst several participants. Three key positions were identified as being critical to the success of the program and were thus required – at a minimum – to sit on the committee. These included the business manager/office admin, a teacher and a parent/community member.

The Business Manager was required as they were vital in accessing utility bills, which were needed to capture the data for tracking the success of the program. They were also involved in financial decision-making at school, which was essential to finance low carbon initiatives. As parents and P&C representatives commonly drove sustainability initiatives in schools, they were also identified as being key persons to sit on the committee. Parents often have time to volunteer and can help with fundraising activities, which can be critical for sustainability programs. While the LCSPP was not explicitly designed to engage students in the initial two-year pilot (it was designed to upskill and enable schools to lead the process themselves), there was the expectation that teachers would help to embed some of what they were learning into the curriculum and engage their students. For this reason, a teacher was also required to be on the committee.

3.3.4 Program Structure

The program comprised of two phases. The first phase was five months of monthly workshops for school stakeholders about five carbon reduction themes and how schools could implement initiatives in each. Schools were provided with a carbon emissions template to allow them to document and monitor their electricity, gas and water consumption and costs from their bills from 2015 to 2017. They were also provided with a template to keep track of their low carbon initiatives on an ongoing basis. The second phase of the program involved monthly meet-ups where participants of the program met to provide updates about their school's low carbon initiatives. Each school took a turn in hosting the meet-up sessions at their campus. Figure 2 shows the structure of the program and the components of the program are discussed in more detail below.

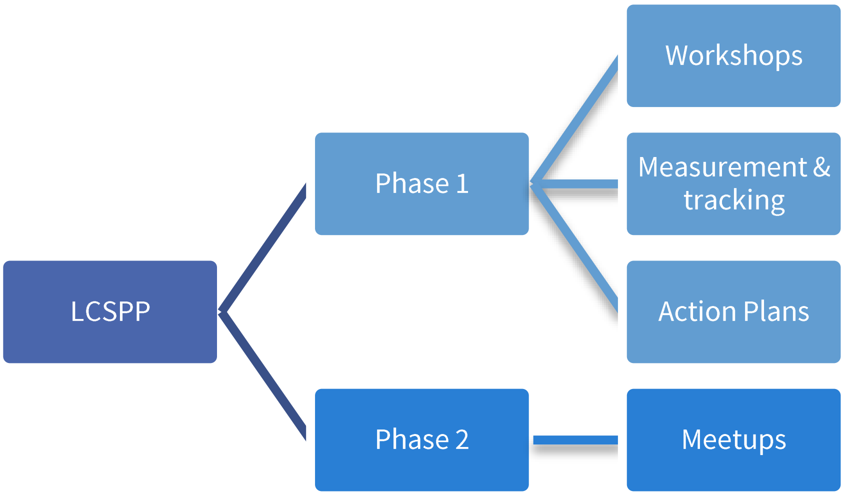


Figure 2: Low Carbon School's Pilot Program (LCSPP) structure.

3.3.4.1 *Workshops*

During this first phase, five workshops were held on the last Wednesday of every month in Fremantle, Western Australia. Each workshop went for approximately three hours. Five topics were covered in the workshops:

1. Policy and Getting Started;
2. Energy;
3. Waste & Well-being;
4. Water & Transport;
5. Implementation.

The format for each workshop included a presentation from the LCSPP team on that month's topic. Then, guest speakers from industry and government gave presentations on specific areas to provide important information about what schools might potentially put in their action plans. Stakeholders from the existing government-led sustainability programs, such as Waterwise, Wastewise, and TravelSmart were also invited to provide information on their programs.

3.3.4.2 *Carbon Spreadsheets & Action Plans*

To track the progress of the program, schools completed carbon emissions spreadsheets for the two years of the program (2016 and 2017), in addition to their baseline year (2015). The spreadsheets tracked their consumption, costs and carbon dioxide emissions from electricity, gas and water. These were selected because schools receive utility bills for each of these, which makes it relatively easy to calculate their carbon footprint. The program chose to only capture emissions from those three sources to make it less onerous for schools.

Schools were required to complete a Carbon Emissions Reduction Action Plan that identified and tracked the initiatives each school intended to implement during the program. The first four workshops provided ideas they could incorporate into their plan.

3.3.4.3 *School Meet-ups*

The second phase commenced in August 2016 and focused on support for the implementation of the initiatives. Participating schools met monthly to share progress, challenges and foster a low carbon community. The meet-ups were held at each of the schools on a rotating basis, allowing each school to showcase their sustainability progress to the rest of the group, celebrate achievements and discuss challenges. Industry specialists were often invited to these meet-ups to further clarify and explain low carbon initiatives and options. Between meet-ups, the schools were sometimes asked to count specific appliances (i.e. fridges, toilets, etc.), which were then discussed at the following meet-up. This process often involved schools sharing interesting things they learned about their school.

3.4 Participants

The schools were located in six different council areas and all schools, except one primary school, were government-funded. The school campus sizes varied in size and density of students and the number of students at each school ranged from as few as 93, to as many as 1700. The ICSEA values of the schools ranged from below average, to one school sitting within the top 10 highest ICSEA values in Western Australia. The ICSEA value was developed by the Australian Curriculum, Assessment and Reporting Authority (ACARA) and was designed to allow fair comparisons between schools with similar students by providing insight into the socio-educational backgrounds of students (Australian Curriculum Assessment and Reporting Authority (ACARA), n.d.). The ICSEA value is calculated using information about the parents' occupation, parents' education, geographical location and proportion of indigenous students. The average ICSEA value was 1000 and the maximum value was 1212 in 2017. A higher value indicates a higher level of educational advantage of the students attending the school, while a lower ISCEA value indicates a lower educational advantage of students attending that school. Table 5 shows the school sizes, student numbers and ICSEA scores.

Table 5: Participating schools student numbers, square meters, square metres per student, ICSEA values for one year, and number of transportable classrooms installed between 2015 and 2017. Average ISCEA value across all Australian schools is 1000.

School	Students	Square Metres	Square Metres per Student	Number of Transportables	II CSEA Value
Glenview PS	93	1663	17.9	0	1108
Sierra PS	125	788	6.3	0	1194
Vista PS	214	4038	18.9	1	1136
Hill PS	276	4542	16.5	0	1027
Madison PS	345	4647	13.5	1	1056
Crestmore PS	361	5484	15.2	0	1137
Newbury PS	459	10960	23.9	1	1057
Oak Grove PS	465	3954	8.5	0	1093
Acacia PS	602	5864	9.7	14	1008

Eastwood HS	845	17210	20.4	0	960
Magnolia HS	1485	24180	16.3	0	1103
Wattle SC	1597	27902	17.5	3	1126
Banksia SC	1738	23916	13.8	13	994

4 Research Design, Methodology & Theoretical Framework

4.1 Introduction

This research uses a mixed-methods research approach, combining both qualitative and quantitative data collection and analysis methods. Multiple-case studies of schools participating in the Low Carbon Schools Project were conducted to gain a deeper understanding of each school's carbon reduction journey. The epistemology, context of the research and details about the methodological approach are discussed further in the following sections.

4.2 Mixed-Method Research Design

This research uses a mixed-method approach "which integrates techniques from quantitative and qualitative paradigms"(Pinto, 2012, p. 813). A mixed-method research design allows the researcher to look at different aspects of the same phenomenon, allowing for a more nuanced understanding of the research topic (Morse & Niehaus, n.d.). The study uses a concurrent triangulation design where quantitative and qualitative methods are used simultaneously and assessed for their convergence (Robson, 2011).

Surveys and spreadsheets were used to collect quantitative data and the primary qualitative data came from a multiple-case study design approach, where four schools were selected as case studies to gain a deeper understanding of the factors that lead to successful carbon reduction. Interviews and focus groups took place at each case study school. Figure 3 illustrates the overall research design and approach.

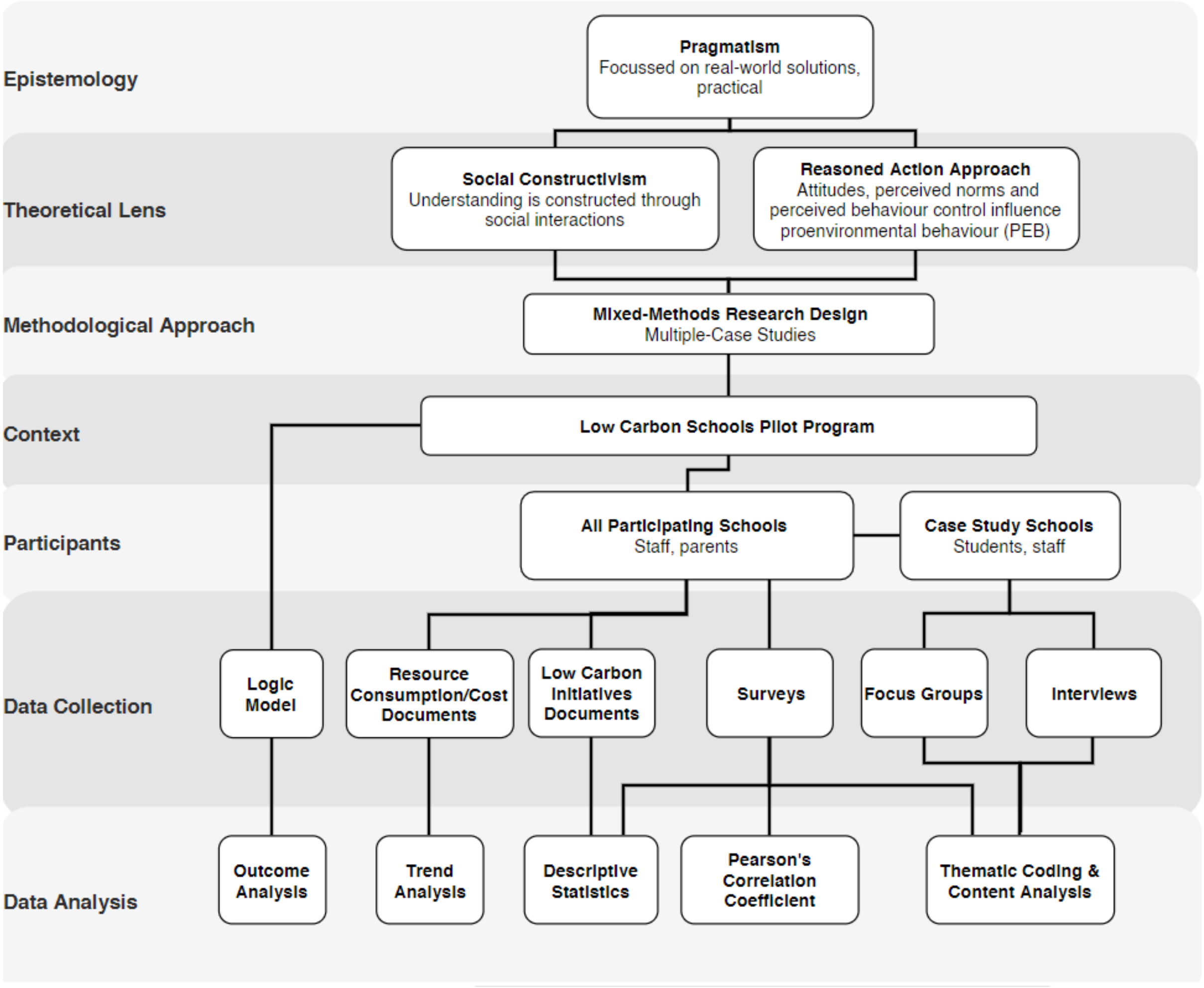


Figure 3: Illustration of the structure of the research.

4.2.1 Multiple-Case Studies

This research uses a multiple-case study design, which can be defined as the examination of multiple case studies where the individual cases may have more than one unit of analysis and can incorporate both quantitative and qualitative analysis (Scholz & Tietje, 2002; Yin, 2006). This study involves the evaluation of a program. Case study inquiry can be useful in evaluation research as it helps explore the situations of an intervention being studied where outcomes are not clear (Yin, 2006). Within qualitative research, particularly in case study research, the iterative process requires constant evaluation of what information is important and what should be explored further. This process can be accompanied by a series of questions, where the difference between a single case study and a multiple case study goes from asking what helps to understand the case, to what helps understand the overarching theme or concept (Stake, 2006).

Four schools that were highly involved in the LCSPP were selected to participate in the case study research. The purpose of the case studies and the subsequent cross-case analysis was to gain a deeper insight into the similarities and/or differences between the case study schools' carbon reduction journey. This analysis primarily took an explanatory approach that aimed to answer the "how" or "why" about a case. However, it also adopted a slightly exploratory approach looking at the "what" or "who" of a case. Using four case studies allowed for a deeper understanding of the unique situations at hand. The empirical data provided by the case studies also aided in supporting or denying the outcomes and impacts defined in the LCSPP logic model and helped shed light into externalities that might have contributed to the measured outcomes (Yin, 1994).

4.3 Epistemology: Pragmatism

Pragmatism is used as the theoretical underpinning of the research as it brings together both qualitative and quantitative methods for a mixed methods research design. Pragmatism can be viewed as bringing together the scientific enquiry process and qualitative research methods and acts an appropriate framework for mixed-methods research (Tashakkori, Teddlie, & Biesta, 2015). Pragmatism does not seek to apply or develop complex theory, but postulates that research should be conducted and designed in a way that achieves practical outcomes for society (Robson, 2011). Unlike other theories such as post-positivism, where the researcher maintains an objective stance, pragmatists accept that the research is both biased and un-biased in the collection and analysis of the research (Creswell & Plano Clark, 2007).

4.4 Theoretical Lens – Social Constructivism & A Reasoned Action Approach (RAA)

Within the qualitative aspects of this research, the creation of reality and construction of knowledge is viewed through the lens of social constructivism, as this lens recognises the importance of social interactions and relationships. Social constructivism is a theory of learning that suggests that individuals construct their understandings of the world through social encounters (Driver, Asoko, Leach, Mortimer, & Scott, 1994). Social constructivism differs from traditional constructivist approaches because rather than focussing on the generation of reality purely through an individual's perspective, social constructivism explores how individuals create reality together through discourse (Maréchal, 2010; McNamee, 2004). The importance of relationships in creating and maintaining reality is a key theme in this research, as it is accepted that the relationships between school stakeholders play a large role in a school's carbon reduction journey. Social constructivism is a dominant theory informing teachers' approach to working with students and the way they design and deliver learning experiences.

This research also uses a Reasoned Action Approach (RAA) as a framework for understanding and predicting proenvironmental behaviour (PEB). As shown in the literature, an individual's intention to perform a behaviour has been identified as a successful predictor for PEB, which is a crucial component of the RAA. Behaviour can be defined as a single act (e.g. switching off lights) or a category of behaviours (e.g. improving energy efficiency in the home with LED purchases and energy efficient appliances). While these behaviours can be distinguished from each other, for the purpose of this research, the term "behaviour" is used for both. It is also important to distinguish between measuring *intended* behaviours and *actual* behaviours. In other words, behaviours that an individual says they plan to perform versus behaviours they actually perform. For this study, *intended* behaviours are measured because the measurement of *actual* behaviours is beyond the scope of this research. Attitudes on the other hand are defined as a person's favourable or unfavourable disposition towards something and can be considered as a precursor of PEB under the RAA. In other words, a change in proenvironmental attitude is a step towards a change in proenvironmental behaviour. A third key concept is that of awareness, which for the purpose of this research is defined as the knowledge or perception of something that exists. Awareness can also be seen as a step towards building an attitude about a situation or fact (Steg & Vlek, 2009). An individual who becomes aware that climate change is happening then forms an attitude towards climate change (such as concern or worry) which then influences the potential for changes in their PEB.

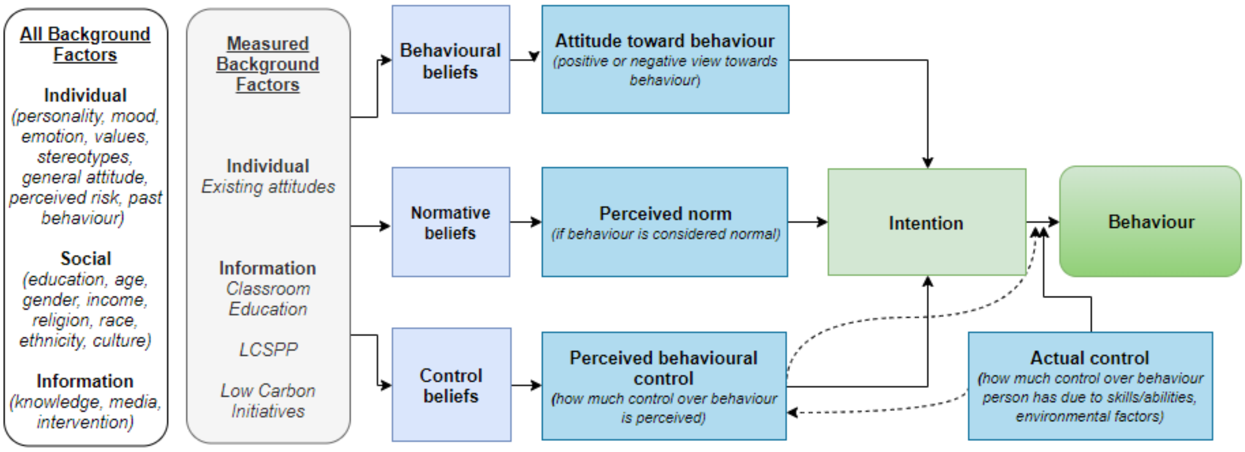


Figure 4: The Reasoned Action Approach (RAA) adapted from Fishbein & Azjen, 2010 and the background factors measured for this research.

4.5 Participant Selection

The Low Carbon Schools Pilot Program (LCSPP) was used as the context for this study and all fifteen schools participating in the LCSPP were invited to participate in the research. Each Principal was sent detailed information and consent forms and all except one primary school agreed to participate. Each school was asked to nominate a staff member who would serve as the primary point of contact for the research. A total of 13 schools agreed to participate.

4.5.1 Case Study Schools

Four schools participating in the LCSPP – two primary schools and two high schools – were selected to participate as case study schools in the research. Following the WA Department of Education’s research guidelines, when all schools in the LCSPP were sent information and consent forms to participate in the research, schools had the option to indicate if they would like to be considered to participate as a case study school if they met the research criteria. The research criteria for being chosen as a case study school required that the school was implementing a large-scale low carbon initiative (e.g. LED lights or solar PV) and that students were actively engaged in their initiatives. The cases were selected to produce contrasting results to enable a more nuanced understanding of the different ways schools can approach school carbon reduction. For example, one small and one large school were chosen for both the primary and high schools, as the size of the school would affect utility consumption and available resources.

4.5.2 Student Focus Groups

A random selection of students who were involved in each case study school's version of a sustainability team provided the basis for selection of students participating in the focus group. The students on the "green teams" were chosen because they were considered more aware of all the low carbon initiatives of the school and, presumably, were more likely to discuss these initiatives and low carbon living topics with their peers and family. The students were aged between eight and 18 years of age and there were between three and five students in each group, with a maximum of two years age difference between students in each focus group.

To select the students for the focus group, a teacher working with the student green teams at each school was asked to send an information and consent form to all students participating in their green team. The information and consent form also included a student consent form that students were required to complete. A final anonymous list of students who had completed information and consent forms was provided by the teacher, along with each student's grade and age. A random selection from each list was made, and those students participated in the focus groups.

4.5.3 Interviews

Interviews were conducted with the Principal and two other key stakeholders driving low carbon initiatives at each of the case study schools. The selection of interviewees involved asking the Principal to put the researcher in contact with the staff member most involved in their low carbon initiatives. That staff member was invited to participate in an interview and then asked to recommend one other person at the school who would be the most relevant to be interviewed about the school's low carbon initiatives. All recommended staff received an ethics information letter and signed a consent form showing they agreed to be interviewed.

4.5.4 Surveys

The staff at the LCSPP administered two surveys during the program. These included one baseline survey to Principals and one end-of-year survey to all the people listed on each school's low carbon committee at the end of the first year in 2017. Each participating school consented to the release of this survey data for research purposes. An additional committee member survey was sent to each school's research contact to distribute the survey among the school's low carbon committee members. A final research survey was sent to all parents of students through methods of each school's choice. Schools sent surveys to parents through online communication platforms, social media posts and both physical and electronic newsletters.

4.6 Quantitative Data Collection

Most quantitative data collection, such as utility data and action plans, took place upon the completion of the LCSPP, from late 2016 onwards. Surveys were sent between February and March 2018.

4.6.1 Utility Consumption & Costs

As part of their participation in the LCSPP, each school was provided with a Microsoft Excel spreadsheet that enabled them to enter utility bill data on their school's consumption and costs for electricity, gas and water to calculate their carbon emissions. The spreadsheet was created by a carbon consultant commissioned by SimplyCarbon and was updated annually to reflect changing emissions factors. The spreadsheets were filled in by various stakeholders at the school and most were completed by either a teacher or the registrar/business manager, with some spreadsheets being completed by parents or even students. When the initial spreadsheets were received from the schools, it was discovered that a significant number of schools had major errors in their spreadsheets, such as incorrect number entry (reversing numbers), leaving sections incomplete, reading bills incorrectly or using incorrect figures from bills.

To ensure spreadsheets were filled out correctly and without errors, copies of the bills for 2015, 2016 and 2017 for electricity, gas and water were requested from all schools. Each line on the spreadsheet was checked against the corresponding bill. When errors or gaps in the spreadsheets were identified, these were documented and addressed. With permission from schools, water and gas providers were contacted directly for 2017 missing data. Complications arose around obtaining all the required utility bills from the schools, and several attempts were made to contact each school to locate missing bills. However, in some cases, bill data could not be retrieved by the school and therefore estimates were made based on the consumption and costs from the same period in earlier years where data was available. Over 90% of the utility consumption and cost data was obtained from verified sources (i.e. directly from the utility provider or as a copy of the physical or electronic utility bill that the school received). One secondary school that agreed to participate in the research was omitted from the consumption, cost and emissions calculations due to extreme fluctuations in utility consumption and cost because of the construction of a new major building on site, as well as significant restructuring of the school facilities.

All schools also provided permission to obtain their electricity interval data at five-minute intervals for 2015, 2016 and 2017 from the Western Australian energy distribution company. The approximate square metre of each school’s total building space and green space were also calculated using Google Earth historical satellite data and the Google Earth Polygon tool. This method was chosen as there was no record of square metre data available for use by the schools or the WA Department of Education. The Building Management Works (BMW) Department that manages all government-run buildings (and therefore schools) for Western Australia also provided a numerical table of the transportable classrooms installed and removed between 2015 and 2017 for all the schools participating in the research. This information provided by BMW included the average square metres of transportable classrooms.

4.6.2 School Action Plans

At the beginning of the LCSPP, each school was provided with an action plan template where they kept track of the low carbon initiatives they planned and implemented throughout their participation. During the program, schools were given ideas about the no cost, low or high cost initiatives they could pursue. The schools chose initiatives that were most relevant to their school and added to their action plans on an ongoing basis. The action plan was provided with the sections: electricity, gas, water, transport and other. These categories were chosen by the LCSPP because these were areas that the program discussed in their information workshops.

4.6.3 Surveys

An online survey using Qualtrics was sent to all the LCSPP low carbon committee members at all participating schools. It asked questions about each school’s low carbon committee dynamics, their perceptions on various elements of the carbon reduction process and any enablers or barriers the school encountered on their carbon reduction journey. Roles at the school and name of school were captured to allow for analysis at a school level.

An online survey using Qualtrics was also distributed to the parents of the participating school's students to determine their environmental attitudes and whether their children had influenced them as a result of the school's low carbon initiatives. The survey was sent out via the preferred method(s) the school used to communicate with parents, such as school newsletters, assemblies, events, etc. All case study schools except Banksia SC had parent survey responses.

Both the parent and committee member surveys also included a Low Carbon Readiness Index (LCRI) and associated proenvironmental attitude measurements developed by researchers at the University of Melbourne measuring individuals' readiness to transition to low carbon living (see Table 6). Each of the proenvironmental attitude measurement questions used a 5-point Likert scale (Strongly disagree; Disagree; Neither agree nor disagree; Agree; Strongly agree).

Table 6: Low Carbon Readiness Index (LCRI) and associated proenvironmental attitude measurements.

Survey Questions		Attitude/Behaviour Measure	Calculation of Responses
Q15	I work hard to reduce my current energy use whenever possible	Energy efficient goal	Mean of items
Q16	I feel very good when I am successful in reducing my energy use		
Q17	I would feel very bad if I failed to reduce my energy use		
Q18	I work hard to reduce my greenhouse gas emissions wherever possible	Low carbon goal (LCRI)	Mean of items
Q19	I feel very good when I am successful in reducing my greenhouse gas emissions		
Q20	I would feel very bad if I failed to reduce my greenhouse gas emissions		

Q22	Most people work hard to reduce their greenhouse gas emissions whenever possible	Descriptive norm for low carbon behaviour	Mean of items
Q23	Most people think it is very important to reduce their greenhouse gas emissions		

Surveys also included questions about the types of initiatives pursued and the factors that lead to the success of their school's low carbon initiatives. It should be noted that while using self-reports to measure attitude and behaviour is common, some studies suggest that self-reported actions may not always be congruent with observed behaviours (Steg & Vlek, 2009). However, despite the flaws with self-reported attitudes and actions, they can still predict proenvironmental behaviour (PEB) with some degree of accuracy (Fielding & Head, 2012). This research acknowledges the limitations of self-reported attitudes and behaviour.

An online survey was also sent to 30 of the key program stakeholders (e.g. school principals, local council representatives) to assess the accuracy of the outcomes, impacts and indicators outlined by the LCSPP logic model and to determine if any additional outcomes, impacts or indicators were identified by the stakeholders. All stakeholders approved of the logic model outcomes and impacts.

Table 7: Summary of quantitative data collected for all schools.

Type of Data Collection	**Data Collected**
Research Data Collected	
Committee Member Survey	• types of partnerships formed & experiences • new initiatives the schools implemented • if the LCSPP has influenced knowledge • role of committee & meet-ups – what worked, what didn't • key success factors and elements of failure • existing proenvironmental attitudes

Parent Survey	• existing proenvironmental attitudes • if/how children changed LCL attitudes or behaviour • if/how their children influenced parent LCL attitudes or behaviour • if/how children influenced household LCL practices
Electricity Interval Data	• electricity consumption on 15-minute intervals for 2015, 2016 and 2017
Data collected from LCSPP	
Carbon Spreadsheets	• resource consumption and cost for electricity, gas and water (2015, 2016 & 2017) • yearly carbon emissions
Action Plans	• types of low carbon initiatives implemented by schools • cost of initiatives and number that engaged students
End of Year Survey	• organisational dynamics • size of committees and level of committee member involvement • level of principal support • feedback about the LCSPP
Baseline Survey	• school facility features (e.g. presence of solar PV, LEDs etc.)

4.7 Qualitative Data Collection

All interviews and focus groups took place with all four case study schools over the span of one week in March 2018. All data was de-identified and pseudonyms were given to each school and its stakeholders.

4.7.1 Focus Groups & Interviews

A total of six focus groups took place. One high school and one primary school had two focus groups and the other two schools had one focus group each. The purpose of the focus groups was to gain a deeper understanding of how students perceive the role young people can play in decarbonisation and the level of intergenerational influence that occurs between students and their family members around low carbon living. The focus groups took between 20 and 30 minutes and were audio recorded and transcribed. While the aim was to conduct two focus groups at each school, two schools (one primary and one secondary) were only able to do one focus group each because of the number of signed student and parent consent forms that were returned.

Three school stakeholders at each case study school were also interviewed, equalling a total of twelve interviews. Each case study school's Principal was interviewed, along with two other staff members who were most heavily involved in the school's low carbon initiatives. Section 4.5 describes the selection process for these interviews. The interviews were conducted using a semi-structured format to allow for consistency in the types of questions asked, as well as providing flexibility for respondents to provide additional information and insights (See Table A1 and Table A2 for questions). The interviews took approximately 40 minutes and consisted of questions about the types of initiatives the school implemented and the successes/barriers of each, as well as the role they perceive students play in the process. The interviews were recorded and transcribed and took place either at the school or over the phone. Table 8 shows a summary of the qualitative data that was collected for each case study school.

Table 8: Summary of qualitative data collected for case study schools.

Type of Data Collection	Who	Information Collected
In-Person Interviews	Principal & Two School Key Stakeholders	• types of partnerships formed & experiences • the school's most effective carbon reduction strategies • barriers or enablers to carbon reduction • perception of the role students can play in school carbon reduction
Focus Groups	Students in School Green Teams	• perceptions of role students can play in school carbon reduction • whether they discussed low carbon living with parents • if they were exposed to any carbon reduction initiatives

Table 9: Summary of qualitative data collection across the case study schools.

School	Interviewees	Focus Group Participants
Hill PS	• Principal • Teacher • Canteen Manager	• 1 focus group • 5 students (aged 9 – 11)
Acacia PS	• Principal • Teacher • Gardener	• 2 focus groups • 10 students (aged 9 – 13)
Wattle SC	• Principal • Teacher • Parent	• 1 focus group • 5 students (aged 13 – 14)
Banksia SC	• Principal • Sustainability Coordinator • Facilities Manager	• 2 focus groups • 12 students (aged 13 - 18)

4.7.2 Memos & Experiential Data

A series of memos, or introspective records, were kept throughout the research process to document research reflections on methods, findings and analysis relating to the research. Memos can act as an important data source for insights made by the researcher, allowing for further examination of the research topic (Maxwell, 2012) and can help the researcher identify biases, feelings or thoughts that may be influencing the research (Watt, 2007).

While traditionally, research has sought to separate the researcher from the work at hand, views are changing towards a more holistic approach that sees the experiences and existing knowledge of the researcher as important aspects of the research (Robson, 2011). Experiential data, which is “the researcher’s technical knowledge, research background, and personal experiences” (Maxwell, 2012) (Strauss, 1987) is an important component of the research process, with the researcher themselves becoming an instrument of the research (Watt, 2007). Strauss, (1987), argues that experiential data should not be ignored in research as there is potentially significant value within these experiences. This research takes into consideration these factors when analysing the research by acknowledging the PhD student’s own set of knowledge, experiences and assumptions that are brought to the research.

4.8 Data Analysis

This research used mixed-method data analysis, including analytical induction, case study writing, and cross-case analysis. The processes used are explained in the sections below.

4.8.1 Quantitative Data Analysis

4.8.1.1 *Resource Consumption Trend Analysis*

After all utility bills provided by schools were checked for accuracy, consumption and costs for electricity, gas and water for 2015, 2016 & 2017 were analysed. The total consumption and costs for each year were compared across all schools and each school was observed for any anomalies in consumption or cost. When anomalies were discovered, the school's data was first checked to ensure there were no data entry errors, and if no errors were found, the anomaly was investigated to determine what factors contributed to it (e.g. a water leak or installation of LEDs).

To most accurately compare consumption, costs and carbon emissions between schools, the extraneous factors that could significantly influence the overall carbon footprint had to be accounted for. However, there were challenges with how to approach this. The schools all had vastly different building compositions and conditions on anything from hours of usage (if the school is used by the community after school hours), to the density of students or amount of technological equipment (i.e. number of computers or presence of an advanced science lab). Each of these factors could greatly influence energy consumption. However, it was impossible to account for all of these variables (Filippín, 2000; TaeHoon Hong et al., 2012a; Ji, Hong, Jeong, & Leigh, 2014).

In energy efficiency literature, it is common to use consumptions per square metre (m^2) (Dias Pereira et al., 2014). Other studies have highlighted the importance of using other metrics that take into account the population density of the classroom (Sekki et al., 2016). However, this research did not have access to the detailed data required to calculate population density. Therefore, to gain additional insights into the data, consumption, cost and carbon emissions were calculated across several metrics: total, per student and per square metre (m^2).

Weather is a variable that can also greatly influence energy consumption, and studies have explored the role of weather, such as the influence of ambient air temperature on energy consumption (Eto, 1988; Psiloglou, Giannakopoulos, Majithia, & Petrakis, 2009). There are various ways to calculate the effect of weather on energy consumption, with one of the most common being Heating Degree Days (HDD) and Cooling Degree Days (CDD) (Christenson, Manz, & Gyalistras, 2006). While using degree days to normalise consumption for weather can be challenging in some contexts, such as commercial buildings and the complexities of large-scale HVAC systems, the smaller size of school buildings allows a greater deal of thermal comfort control that can be exercised by the school (Zomorodian, Tahsildoost, & Hafezi, 2016). Given that there is a great opportunity for control (and often poor thermal comfort levels in their buildings), it could be argued that schools are likely to react more to temperature fluctuations, making their consumption more closely correlate with HDD.

When total gas consumption was observed across the schools, 2016 showed a significant difference in consumption than 2015 (the baseline year) and 2017 for all schools. When the number of HDDs was observed for each year (2015 – 2017), it showed that 2016 had the most HDDs than in the last 10 years for the Perth Metropolitan region, making it an unusually cold year. 2016 had 18% more HDDs than the 10-year average whereas 2015 and 2017 had 8% and 1% less HDDs, respectively.

When a regression analysis was performed between average Heating Degree Days (HDD) and gas consumption for each year, there was a significant relationship between gas consumption and HDD (see Figure B1). However, when a regression was performed between CDDs and electricity consumption, consumption patterns did not align with HDD or CDD patterns (see Figure B2). This weak relationship indicates that there are many other factors that came into play with the schools’ electricity consumption. Therefore, it was determined that to better understand school gas consumption patterns, a weather normalization technique would be applied, which is described in more detail in the following section.

4.8.1.2 *Weather-normalisation of Gas Data*

A key aspect of calculating HDD or CDD relates to the base thermal comfort range for indoor environments, which is between 12 and 18 degrees Celsius for heating and 18 and 24 degrees Celsius for cooling. The upper limits of these ranges (18 degrees and 24 degrees) were used, as this is what is recommended by the Bureau of Meteorology (Australian Government Bureau of Meteorology, n.d.). The HDD and CDD figures from 2005 to 2017 were obtained from DegreeDays.net, which uses weather data from the Perth Airport weather station. The method used to calculate the HDD and CDD took the average temperature for each day in the year and for each day when the temperature was above or below the base thermal comfort range (18 degrees in winter and 24 degrees in summer) it was counted as a heating degree day (HDD) or cooling degree day (CDD) (BizEE, n.d.). The equations used for the calculation of weather-normalised gas consumption can be seen in Eq(1) and Eq(2) where HDD_m^{ref} is the 10-year average of HDDs, P is gas consumption in kWh and $Q_{m,y}$ is the weather-normalised gas consumption (kWh). Gas consumption and costs for each school from 2015 to 2017 was adjusted using the below formula. The adjusted consumption and costs were used for analysis.

$$HDD_m^{ref} = \frac{1}{n} \sum_{y\,=\,2005}^{2005\,+\,n} HDD_{m,y} \qquad (1)$$

$$Q_{m,y} = HDD_m^{ref} \frac{P_m}{HDD_{m,y}} \qquad (2)$$

4.8.1.3 *Survey Analysis*

Before any analysis took place, all survey data was cleaned of incomplete or invalid responses. The parent survey responses about the changes in attitude or behaviour reported by parents at the child, personal or home level were categorised. They were categorised by type of action using categories from an adapted version of Stern’s (2000) Types of Environmentally Significant Behaviours and O’Brien & Kashima's (2019) Taxonomy of Environmentally Significant Behaviours, level of influence (e.g. personal or family). Table 10 below shows the adapted LCL behaviour taxonomy.

Table 10: Low Carbon Living behaviour taxonomy. Adapted from Stern (2000) and O'Brien & Kashima (2019).

Broad domain	Context of behaviour	Type of behaviour	Examples
1. Private Sphere Behaviours	a. Household	i. Infrastructure	LED bulbs; Reverse cycle heating/cooling system; Solar hot water system; Efficient home appliances; Buying a more efficient car (hybrid, electric); Low-flow shower heads; Low-flow taps; Dual-flush toilet; Increased home insulation; Double glazing on windows; Increased shade for home; Weather sealing draughts in windows and doors
		ii. Energy Source	Installation of photovoltaic solar PV; Using sustainable power source from energy provider
		iii. Use of Infrastructure/ Energy Use	Only heating/cooling the rooms of home that are used; Using the cold wash setting; Switching off appliances instead of leaving them on standby; Turning off lights; Only run dishwasher when it is fully loaded; Shortening shower time; Turning taps off; Wearing seasonal clothing to keep warm/cool; Using windows and doors to cool/warm house; Using curtains for shade
		iv. Recurrent Purchase	Purchasing local and/or in-season food; Avoiding meat or dairy consumption; Purchasing biodegradable bin bags or other environmentally friendly household products; Buying less & second-hand; Avoiding plastic packaging; Growing own food
		v. Waste Management	Composting; Recycling; Using re-usable shopping bags; Using own reusable cup; Not wasting food
	b. Transportation	i. Alternative Transportation	Walking, riding bicycle or using public transport instead of a private vehicle; Carpooling
2. Public Sphere	a. Community	i. Active Citizenship	Voting; Conversations with others (community members) about low carbon living or sustainability topics; Picking up litter in public spaces
		ii. Family Engagement	Discussions with family members about low carbon living topics
		iii. School Involvement	Joining school green team; Participating in school events

		iiii. Activism	Political demonstration; Participating in environmental organisations/events; Petitioning on environmental issues; Calling political representatives about sustainability issues

In addition, parent responses about the types of topics their children discussed with them, changes in their own attitudes/behaviour, changes in their child's attitudes/behaviour and changes in household practices were classified by emissions category (e.g. electricity, transport, waste). To better understand the relationship between the intergenerational influence variables, a series of correlation analyses took place between the intergenerational variables and preoenvironmental attitudes data from the parent surveys. Table 11 shows the variables that were analysed. The correlation coefficient values and corresponding strength of relationship that were accepted were:

- 0.0 – 0.2 = Very weak
- 0.3 – 0.4 = Weak
- 0.5 – 0.6 = Moderate
- 0.7 – 0.8 = Strong
- 0.9 – 1.0 = Very strong

Table 11: Intergenerational influence variables and proenvironmental attitude measurement variables from survey data.

Category	IV #	Variable	Variable Type
Parent LCL Attitudes/Behaviour	P1	LCRI	Nominal
	P2	Household Goals and Support	Nominal
	P3	Descriptive Norm for Low Carbon Behaviour	Nominal
	P4	Energy Efficient Goal	Nominal
Intergenerational Influence	B1	Parent Changed Behaviour	Binary
	B2	Parent Changed Behaviour (Because of Child)	Binary
	B3	Children Changed Behaviour	Binary
	B4	LCL Topics Discussed	Binary

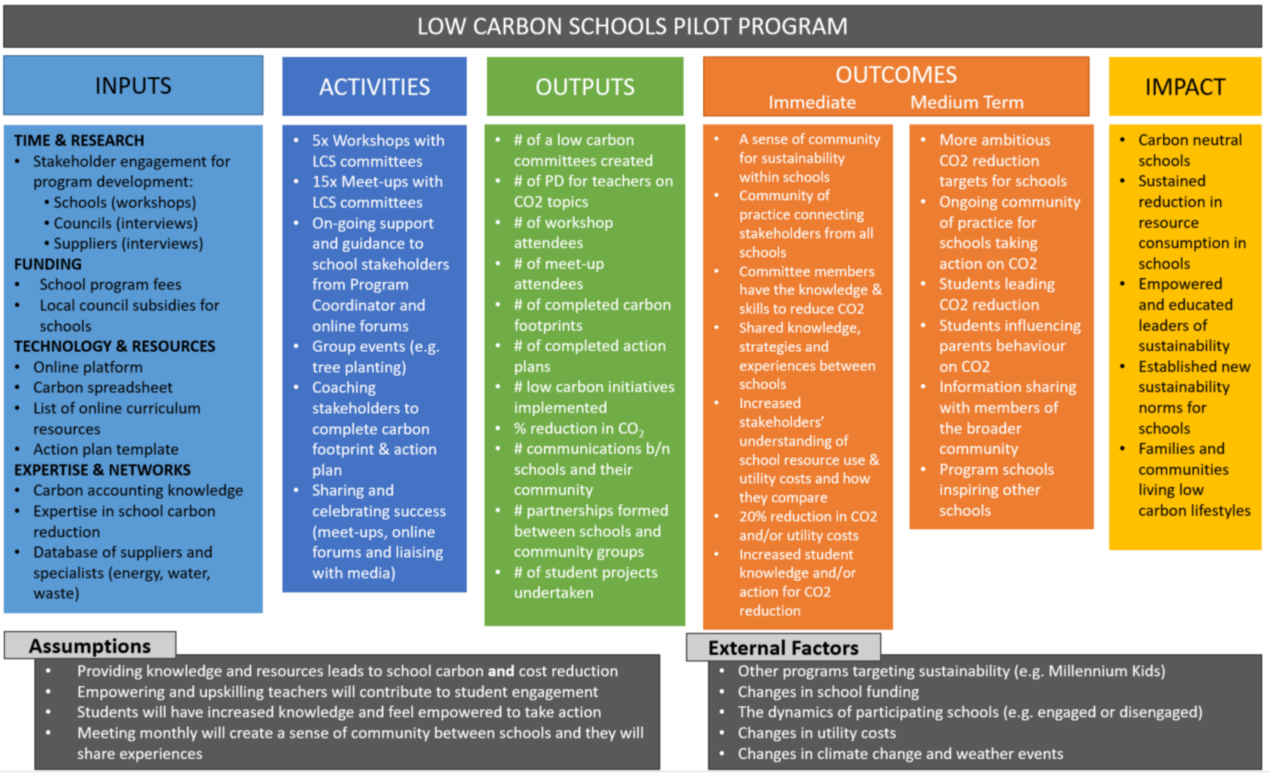
To calculate the amount of Principal support for each school, the responses from each school’s committee members about the level of principal support were assigned a numerical value (highest amount of support = 5, lowest amount = 1). If a school had more than one committee member survey response, the numerical values were averaged to provide a principal support value.

4.8.1.4 *Logic Model*

This research adopted an implementation approach of theory-based evaluation and focussed on examining the interventions and outputs for the participating schools and developed a logic model (i.e. a theory of change) for how and why the program could achieve its goals (Chen, 2011a). The facilitators of the LCSPP were consulted to develop a program logic model that formed the basis from which the indicators of social impact for the program were developed. Figure 5: Logic Model for the Low Carbon School's Pilot Program (LCSPP) shows the logic model for the LCSPP.

When evaluating any program or intervention, it is important to not only maintain scientific credibility but also stakeholder credibility. In other words, the extent to which stakeholders of a program believe the evaluation takes into consideration their perspectives and feelings (Chen, 2011b). Thus, to further refine the outcomes identified by the LCSPP logic model, this research used a participatory method where discussions took place with the LCSPP program providers and the LCSPP steering committee to provide guidance about how to incorporate the input of various program stakeholders to finalise program outcomes and impacts. Combining stakeholder views with that of the program providers and researchers helps mitigate the risk of missing major outcomes or impacts and can improve the overall accuracy of the outcomes and impacts (Nicholls, 2015). Developing quality indicators is an important component of the evaluation as it shows the progress being made on the outcomes or goals (Muir & Bennett, 2014).

Additional outcomes identified by program stakeholders not already outlined in the completed LCSPP logic model were included in the evaluation methodology. The final set of outcomes underwent materiality, or the process of determining what to include and exclude for the evaluation by way of significance and relevance to stakeholders (Bennett, Muir, Marjolin, & Jenkins, 2014).



LOW CARBON SCHOOLS PILOT PROGRAM

INPUTS

TIME & RESEARCH
- Stakeholder engagement for program development:
  - Schools (workshops)
  - Councils (interviews)
  - Suppliers (interviews)

FUNDING
- School program fees
- Local council subsidies for schools

TECHNOLOGY & RESOURCES
- Online platform
- Carbon spreadsheet
- List of online curriculum resources
- Action plan template

EXPERTISE & NETWORKS
- Carbon accounting knowledge
- Expertise in school carbon reduction
- Database of suppliers and specialists (energy, water, waste)

ACTIVITIES
- 5x Workshops with LCS committees
- 15x Meet-ups with LCS committees
- On-going support and guidance to school stakeholders from Program Coordinator and online forums
- Group events (e.g. tree planting)
- Coaching stakeholders to complete carbon footprint & action plan
- Sharing and celebrating success (meet-ups, online forums and liaising with media)

OUTPUTS
- # of a low carbon committees created
- # of PD for teachers on CO2 topics
- # of workshop attendees
- # of meet-up attendees
- # of completed carbon footprints
- # of completed action plans
- # low carbon initiatives implemented
- % reduction in CO_2
- # communications b/n schools and their community
- # partnerships formed between schools and community groups
- # of student projects undertaken

OUTCOMES

Immediate
- A sense of community for sustainability within schools
- Community of practice connecting stakeholders from all schools
- Committee members have the knowledge & skills to reduce CO2
- Shared knowledge, strategies and experiences between schools
- Increased stakeholders' understanding of school resource use & utility costs and how they compare
- 20% reduction in CO2 and/or utility costs
- Increased student knowledge and/or action for CO2 reduction

Medium Term
- More ambitious CO2 reduction targets for schools
- Ongoing community of practice for schools taking action on CO2
- Students leading CO2 reduction
- Students influencing parents behaviour on CO2
- Information sharing with members of the broader community
- Program schools inspiring other schools

IMPACT
- Carbon neutral schools
- Sustained reduction in resource consumption in schools
- Empowered and educated leaders of sustainability
- Established new sustainability norms for schools
- Families and communities living low carbon lifestyles

Assumptions
- Providing knowledge and resources leads to school carbon **and** cost reduction
- Empowering and upskilling teachers will contribute to student engagement
- Students will have increased knowledge and feel empowered to take action
- Meeting monthly will create a sense of community between schools and they will share experiences

External Factors
- Other programs targeting sustainability (e.g. Millennium Kids)
- Changes in school funding
- The dynamics of participating schools (e.g. engaged or disengaged)
- Changes in utility costs
- Changes in climate change and weather events

Figure 5: Logic Model for the Low Carbon School's Pilot Program (LCSPP).

4.8.2 Qualitative Data Analysis

4.8.2.1 *Coding and Data Condensation*

All interviews and focus group transcripts were imported into NVivo software to assist with the qualitative data analysis process. Exploratory analysis was conducted to identify common or contrasting themes and theoretical underpinnings. An initial descriptive coding took place where the attributes of each source of data were identified (e.g. school, stakeholder role). Thematic and analytic coding guided by broad research questions subsequently took place. The coding process was iterative and compounding, with new categories and themes emerging as each interview and focus group transcript was analysed. If a new theme emerged, the previous transcripts were reviewed for content fitting in that theme. After the coding process was completed, it was reviewed for accuracy using a matrix coding query across all four case study schools. This was used to understand the distribution of the coding to help identify if there were any significant errors or gaps in the coding process.

Each case study school underwent an analytic process to gain insight into the emerging themes for the school. It was approached using the steps below:

1. Conduct a word frequency query for the 50 most common words of 4 characters or more long for both interviews and focus groups. Stemmed words were searched.
    a. Adverbs that were identified as irrelevant were removed from the word frequency summary.
2. Explore keywords identified in the word frequency query with a text search query to understand the broader context and sentiment.
3. Conduct coding matrix query for the school (one for interviews, one for focus groups) for additional insight into themes.

In addition, a cross-tabulation was performed for each school to compile the total number of times a theme (e.g. student empowerment) was referenced in the interview or focus groups at each of the schools. The themes were separated by relevance to the appropriate research question. The distribution of the number of times (i.e. number of codes) for each theme was observed across all four case study schools. The themes with the highest and most evenly distributed number of codes across all schools were considered the primary themes for each research question.

4.9 Measures of Research Quality

To ensure both the qualitative and quantitative data was collected and analysed with rigour, the research sought to achieve a high level of research quality through several methods. For both quantitative and qualitative data collection and analyses, triangulation of methods and data sources were used to answer the research questions, which helps to establish rigour in mixed-method studies and establish validity and trustworthiness (Creswell & Plano Clark, 2007). In addition to triangulation, Table 12 below describes the methods used in the research to establish research quality and rigour for case studies.

Table 12: Case study research quality table adapted from (Yin, 2006).

Tests	Case study tactic	Research phase in which tactic occurs	Action taken in this research
Construct validity	*Use multiple sources of evidence*	Data collection	Use of interviews, focus groups, surveys in conjunction with quantitative data for triangulation
	Establish chain of evidence	Data collection	Appropriate documentation of research process maintained
	Have key informants review draft case study report	Composition	All case study reports were provided to the case school for review
Internal validity	*Do pattern matching*	Data analysis	Patterns identified as part of the coding and analysis process
	Do explanation building	Data analysis	Identified
	Do time series analysis	Data analysis	Achieved through the action plans in comparison to the overall carbon emissions
	Do logic models	Data analysis	A logic model was created for the LCSPP and evaluated with the defined indicators
External validity	*Use rival theories within single cases*	Research design	Achieved throughout the discussion of research findings
	Use replication logic in multiple case-studies	Research design	Two high achieving primary schools and two high achieving secondary schools were selected to enable like-for-like comparisons
Reliability	*Use case study protocol*	Data collection	A protocol was created a reviewed and approved by two PhD supervisors
	Develop case study database	Data collection	All transcriptions, notes and relevant information was entered into a database

4.10 Ethical Considerations

This research was approved for conduct with humans by Curtin University (RDHU-57-16) and was also approved for research activities with government schools by the WA Department of Education (DoE) (D170471707). There were no significant risk in participating for school stakeholders, parents or children. No sensitive information was collected and all information was de-identified.

Each school was provided with a detailed information sheet that described all areas of the research project and what involvement entailed. All schools who agreed to participate in the research returned a signed consent form that stated they understood the requirements of participation. In addition to detailed information and consent forms, all schools and stakeholders were kept anonymous. The only identifying factor of interviewees was their role at the school. The committee member survey also collected the role of each respondent as well as the school they were involved with, however no names were collected. Case study schools were also given copies of their school’s case study reviews for assessment of accuracy and were provided with the option to accept, modify or reject the case study. This ensured all school information was discussed accurately and discretely.

4.11 Limitations

4.11.1 Obtaining Accurate Data

One of the major issues faced by the LCSPP and this research was the availability of electricity, water, gas usage and cost data for the participating schools. While every school received bills for each of these resources, many schools did not keep the bills stored in an easily accessible way. There were challenges obtaining this data from each school’s Business Manager/Registrar, either because the data was difficult to locate, or the Business Manager did not see it as a priority to provide this data to the program or for the research. Other studies have raised concerns about the availability of data from schools, noting the importance of hybrid approaches to data collection whereby data is collected both from top-down sources (government or suppliers) as well as bottom-up sources (directly from the schools) (Global Action Plan et al., 2006). In addition, while each school was encouraged to complete and update their action plan monthly, two of the schools did not populate their action plans, despite several reminders and prompts. This is likely due to the schools not having an individual willing or able to complete this task.

4.11.2 Research Design

Due to the reliance of this research on an external organisation's timeline and research requirements from the Western Australia Department of Education (DoE), the design for this research was constrained. Measuring changes in individuals over time because of an intervention is best measured before and after the intervention. For this research, however, this was not possible. In addition to time constraints imposed by the program provider, there was a nine-month delay in research ethics approval from the DoE, which caused delays in the research timeline. In addition, the DoE also influenced the ability of this research to collect additional data from school students and parents, as outlined in the initial research design. There were also restrictions from the DoE research protocol that limited the ability for this research to publish in journals during the LCSPP. Examples of these restrictions included amendments that reduced the amount of data collected to reduce the number of requests needed from school staff.

4.12 Chapter Summary

This chapter has described the mixed-method research design pragmatic approach to the research. It outlines the theoretical lens' of social constructivism and the Reasoned Action Approach (RAA) and describes the qualitative and quantitative data collection methods and analyses. The methods used for this research include interviews and focus groups with four case study schools and surveys, utility consumption and cost data and action plan data collected for all 13 schools in the study.

The following two chapters describe the results from all participating schools and the results from the four case study schools to answer the research questions.

5 Results – All Schools

5.1 Introduction

As discussed in Chapter 3, utility bill data from electricity, gas, water was collected for all thirteen schools for 2016 & 2017 to track their consumption/costs and calculate their carbon emissions during their participation in the LCSPP. Their 2015 utility bill data was also collected to establish a baseline. In addition, each school filled out a low carbon action plan during the program where they kept track of their initiatives and progress. In this chapter, the consumption, costs and carbon emissions for all schools is analysed and an overview of the types of low carbon actions schools undertook is provided. Each school's parent survey and low carbon committee survey results is also discussed.

5.2 Low Carbon Initiatives Implemented

A total of 636 actions were identified by 12 schools (one school did not complete an action plan) and the biggest area initiatives targeted was energy, with waste forming the second largest category, despite utility bill data not being collected from waste. The rest of the actions fell into water, transport and other categories. The number of initiatives in each category is shown in

Figure 6 below.

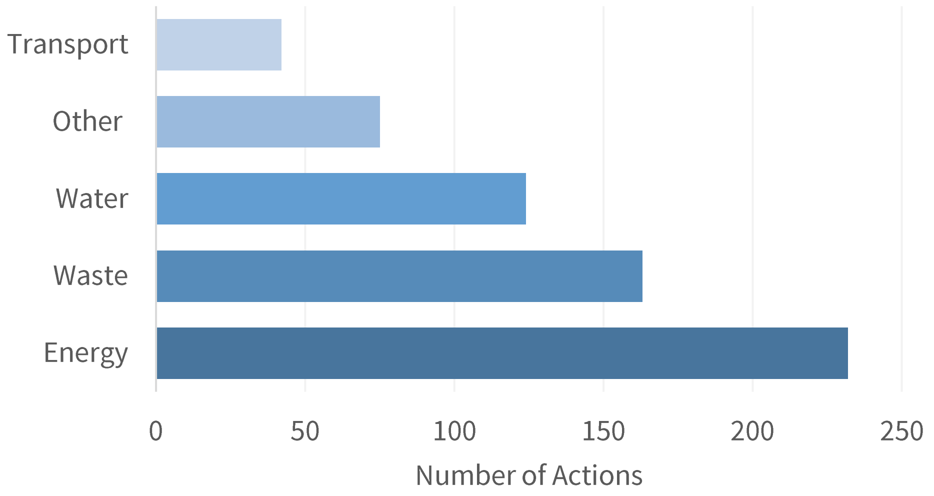


Figure 6: Total number of actions in each emissions area across all school low carbon action plans.

Over 60% of the actions the schools identified involved no cost, with another 10% of initiatives involving a low cost (under $1,500). Nearly half of actions identified also actively involved students.

The actions were also categorised according to the type of action. For example, the largest category of actions were those focussing on implementing tangible infrastructure changes at the school, such as retrofitting taps, adding new recycling bins or switching to LED lights. The second biggest category of initiatives were classified as "investigation", involving activities that gathered more information, such as investigating resource consumption, conducting audits or getting quotes for solar PV. Behaviour change initiatives were also common at the schools (20%), with about half of the behaviour change initiatives focussing on changing the behaviour of staff (e.g. using less paper), and the other half focussing on changing the behaviour of students (e.g. improving recycling habits). Educational activities were those that were specific to educating students, such as a classroom activity on water conservation. Figure 7 shows all initiative categories and the percentage of the total for each category.

Key Finding 5-1: Over 70% of all low carbon initiatives schools identified involved no or low cost.

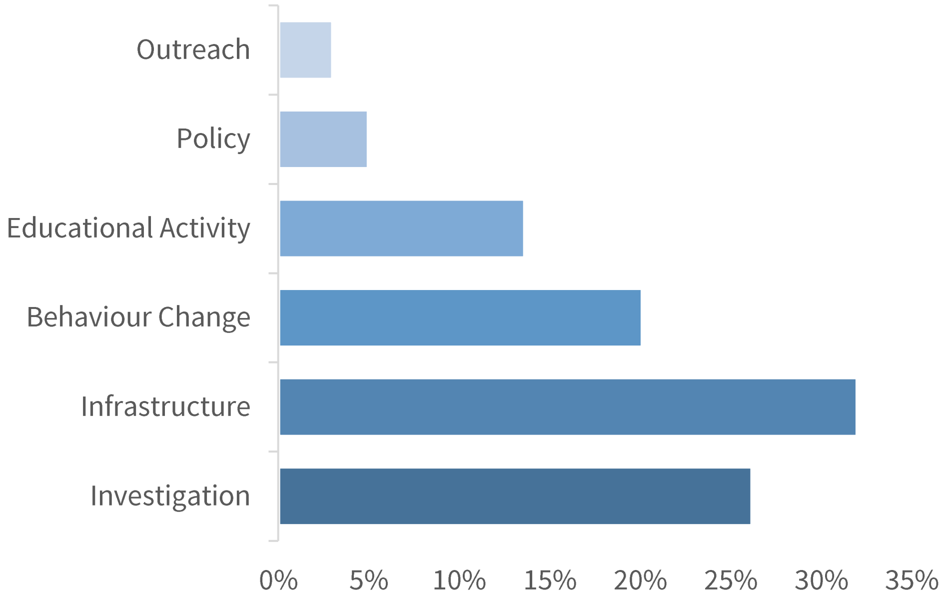


Figure 7: Total percentages of each low carbon action category for all schools.

The following sections discuss each emissions category area (energy, water and waste) in more detail. Zero-cost initiatives were those that involved no cost to implement. Low-cost initiatives cost less than $1,500, and medium-cost initiatives cost up to $5,000. High-cost initiatives were those that cost from $5,000 upwards.

5.2.1 Energy

There were 226 energy actions listed by schools, and almost half were ongoing or completed by the end of the LCSPP (December 2017). The rest were still under investigation or not yet started. There were several electricity initiatives that were commonly implemented or explored across the schools. These are summarised in Table 13. The majority of the energy initiatives most commonly implemented involved no cost.

5.2.2 Zero Cost Initiatives

One of the initiatives that had the highest impact that most schools implemented was a “switch off” protocol. The switch off protocol was a process schools followed to ensure no energy consuming devices were left on while no one was at the school once school concluded each day, and during school holiday periods. Most switch off protocols involved turning off air conditioners, lights, printers, computers, hot water urns and refrigerators. The results of the switch off protocols for all schools are shown in Section 5.3.3. As will be discussed in Section 6.4 concerning Wattle Secondary College, some schools also saw significant changes in staff behaviour after these protocols were implemented.

Key Finding 5-2: The most common energy initiative schools implemented was a switch-off protocol.

Eastwood HS investigated consumption and identified that they had several refrigerators throughout the school campus that were completely or mostly empty, but were still plugged in and running all year. This investigation led to the removal of several refrigerators. This measure, combined with other small behavioural change initiatives targeted at staff, enabled the school to save over 25,000 kWh between 2015 and 2017. After Eastwood HS shared with other participating schools how many empty fridges they discovered at a monthly LCSPP meeting, many other schools followed suit and investigated the fridges at their schools. Eastwood HS also discovered that pilot lights for heaters across the school were lit by

Department of Education (DoE) staff several weeks before they were needed and left on throughout a school holiday, without the school's knowledge. Turning these off resulted in approximately $3,000 in savings for the school.

All schools implemented some behaviour change initiatives, such as getting students to create signs to remind staff and students to turn off lights and placing stickers next to computers and lights as reminders. A few schools also unplugged their water cooler fountains from power and reported no staff or students noticed the change. Four primary schools also started a "switch-off award" where classrooms were encouraged to turn off their lights during lunch and the classrooms with the greatest number of days with no lights on throughout the school term received an award.

Key Finding 5-3: One school investigating the number of empty fridges at the school inspired several other schools to do the same.

5.2.2.1 *Low/Medium Cost Initiatives*

Many schools investigated the feasibility of timers on electronic devices, such as computers, which only one school implemented. However, half the schools did install timers on the hot water urns in their staff rooms, which involved minimal cost outlay. Around half the schools were also in the process of changing their fluorescent tubes to LEDs as the old light bulbs expired. While all schools wanted LEDs across their school, most lacked the upfront funds to replace all lights at the same time, so the most cost-effective way to approach the replacement of LEDs was incrementally as lights needed to be replaced. Seven schools also participated in a Type 1 energy audit that was provided free of charge by a partner of the LCSPP, which gave them insight into their highest energy consumption areas.

Another example of a high impact area that many schools investigated, but were unable to pursue for financial reasons, was the replacement of outdoor security lighting to LED security lights (which can use upwards of 4,000kW), which use significantly less energy. Most schools investigated how to replace their security lights and received quotes, however the majority could not afford the cost associated with replacing them. Only one school (Madison PS) could switch their security lights to LEDs.

Most schools also wanted to install solar PV. However, like LEDs, the cost was prohibitive. Only one primary school, Oak Grove PS, was able to install solar PV. They funded their panels partly through their own budget and ran a community fundraiser to obtain the remaining funds. Eastwood HS was also in the process of installing solar PV and was in the unique position of having enough upfront capital to purchase them outright. However, once the school started the process of obtaining approval for their solar PV from the Department of Education (DoE) in 2017, there were significant delays due to a lack of DoE policies around school solar installation. At the time data collection concluded (December 2018), there had still been no progress with Eastwood HS's solar installation.

Key Finding 5-4: A lack of processes and policies from the State Government prevented a school from installing solar PV.

Table 13: Most common energy actions listed on all school low carbon action plans.

Initiative	**Number of Schools Implemented**	**Cost**
Implement switch off protocol for end of school day and school holidays	10	None
Investigate timers on devices	8	Low
Change fluorescent lighting to LEDs as lights blow	7	Medium
Conduct type 1 Energy Audit	7	Low
Investigate/change electricity tariff	6	None
Investigate electricity bill consumption & ongoing monitoring	5	None
Put switch off stickers near lights and computers	5	None
Conduct fridge audit	5	None
Create low carbon/renewable energy policy	5	None
Implement computer auto-shutdown	4	None
Colour code electronics that can be turned off	4	None
Start "switch off award" for classrooms during lunch	4	None
Unplug water cooler fountains	4	None
Make reminder signs for staff/students to turn off lights	4	None
Audit all energy consuming devices	3	None
Remove lighting in refrigerators	3	None

Reduce temperature of hot water	2	None
Investigate eco-switches	2	Low

5.2.3 Water

The schools listed 119 actions in the water category, with nearly half of their actions involving students. Unlike the energy category, which involved largely zero-cost initiatives, most water saving initiatives involved a low to medium cost investment, which is further described below.

5.2.3.1 *Zero Cost Initiatives*

While most water initiatives involved some cost, the most common initiative did not involve any upfront cost, which involved initiatives around engaging students in water conservation activities. For example, Newbury PS held an activity where they taught years 3 to 6 how to first put soap in their hands and lather before turning on the water and rinsing for only a few seconds, to help them use less water. Other schools had incursions talking about water conservation at the school, and two primary schools held International Water Day events for the students.

Two schools (Madison PS and Eastwood HS) also got free data loggers installed at the school from WA’s Water Corporation, the State-owned water company. These two schools were identified as the highest users of water in the cohort and Water Corporation agreed to closely monitor their consumption to determine whether the schools had leaks. All the schools listed their participation in the Waterwise program. Waterwise is a water conservation initiative for schools that is run by the Water Corporation in Western Australia. The Waterwise program provides free curriculum resources, such as detailed lesson plans, which makes integrating the Waterwise activities into the classroom easier. It also provides free professional development (PD) opportunities for teachers, and also pays for relief teaching, making PD more accessible. Despite all schools noting their participation in the program, there were varying levels of actual participation with each school.

5.2.3.2 *Low/Medium Cost Initiatives*

Just under half of the schools participated in a water audit that was provided at low cost by a partner of the LCSPP. Through this partner, four schools installed flow restrictors on their bathroom taps. Some schools also investigated the installation of a water tank to capture rainwater to water gardens. Others planned on pursuing options for expanding automatic irrigation on school gardens and ovals.

Key Finding 5-5: The most popular way to address water conservation in schools was through educational activities with students.

Table 14: Common water actions listed on all school low carbon action plans.

Initiative	Number of Schools Implemented	Cost
Student waterwise activities	8	None
Investigate water bills for usage/leaks	6	None
Water audit	5	Low/Medium
Signage around school to conserve water	5	None
Install flow restrictors in taps	4	Low/Medium
Investigate bore use	3	None
Check bathrooms for leaks	3	None
Change toilets to low flush	2	Low
Replace bathroom taps with push-activated	2	Low
Investigate automatic irrigation for ovals	2	Low/Medium
Investigate water tank	2	Low
Install water data logger (from water company)	2	None

5.2.4 Waste

Waste formed the second largest category of actions across the schools, though this study did not track waste consumption. Most of the primary schools started or improved an initiative to reduce waste at lunchtime. However, none of the secondary schools pursued waste-free lunch initiatives. This might have been due, in part, to the larger number of students, which made it harder for the school to monitor such actions. Improving paper recycling and hosting recycling drives for uncommonly recycled items (e.g. hygiene products, batteries, mobile phones) was common among the schools, and several primary schools switched to reusable or biodegradable containers and/or cutlery in their canteens. The majority of schools also participated in the Waste Wise program; a program by WA State Government's Waste Authority which provides lesson plans, activities and paid professional development for teachers to engage students about minimising waste to landfill. Table 15 shows a summary of the most common waste initiatives across the schools.

Key Finding 5-6: Waste free lunches was the most common initiative amongst primary schools to address waste.

Table 15: Common waste initiatives on low carbon action plans for all schools.

Initiative	**Number of Schools Implemented**	**Cost**
Waste free lunches	9	None
Improvement in paper recycling	7	None
Recycling drive/station for students/parents	6	Low
Student-conducted waste audit	5	None
Reusable containers/cutlery in canteen	5	Low/Medium
Educational activity about reducing waste	5	None
Investigate costs of introducing recycling and green waste streams	4	None
Improve staffroom recycling	4	None
Improve worm farms	4	None
Promote Plastic Free July or plastic free days	3	None
Improve food composting	3	None
Reusable items fundraiser	3	None
Use rubbish to create art installation	3	None
Photocopier waste reduction	3	None
Investigate current waste stream consumption/costs	2	None
Recycling classroom materials	2	None
Sustainable procurement policy	2	None

5.2.5 Transport & Other Initiatives

Most schools only had around two actions in the transport section of their low carbon action plan as this was not an area the LCSPP focussed on. However, most schools did list a walk or ride to school initiative. Other initiatives schools listed included building nature play areas for students, sending students to environmental leadership events and establishing sustainable procurement policies. All except two schools also participated in a tree planting event organised by one of the parents at a primary school. Some schools also participated in the TravelSmart program by the WA Government's Department of Transport which provided resources to help schools encourage students to take alternative forms of transport to school, such as public transport, bicycle riding or walking.

5.3 Utility Consumption, Cost and Carbon Emissions

This section examines the results of all school's carbon emissions and utility consumption and costs from electricity, gas and water. To better understand the schools' usage, it is important to note some school differences, such as student numbers and size.

Some schools had as few as 90 students, with other high schools having as many as 1,700 students, as seen in Figure 8. Two schools increased their student numbers between 2015 and 2017 by over 50%. However, the average across all schools was a 15% increase, with only one school decreasing their number of students.

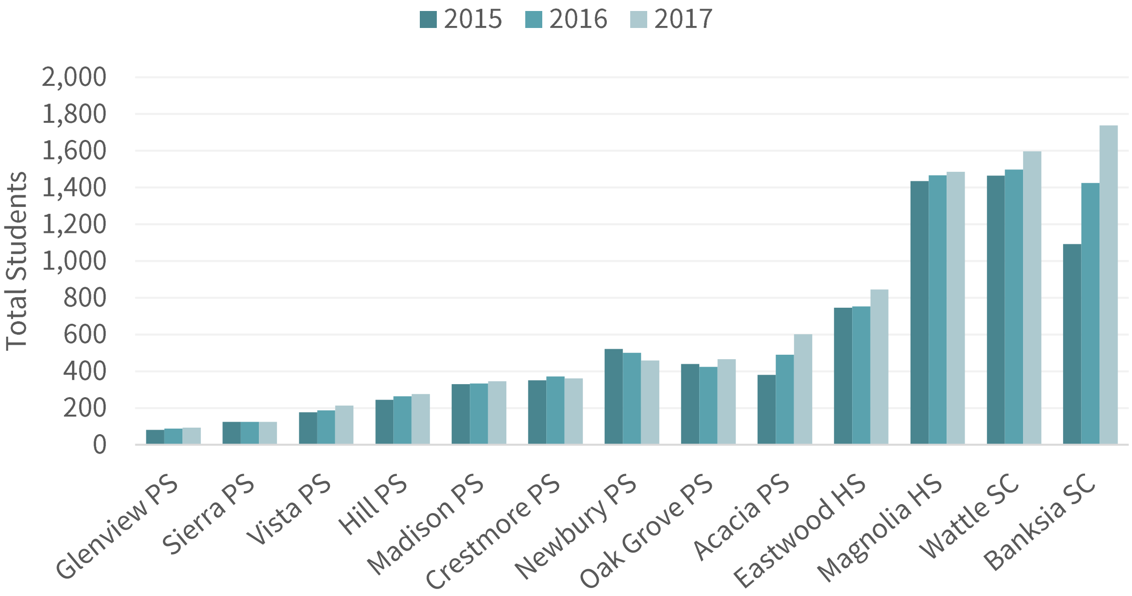


Figure 8: Total student numbers for all schools (2015 - 2017). Schools are ordered left to right from least to most number of students.

The schools had varying proportions of building sizes and green space, as shown in Figure 9. Five schools increased in total square metres (m^2), with two schools with the largest increases in student numbers (Acacia PS & Banksia SC) installing at least 12 transportable classrooms each to accommodate additional students. There were also significant differences in the density of students in their school buildings (i.e. number of square metres per student). Some schools had a large number of square metres in relation to their number of students (25 m^2 per student), whereas one of the smallest schools had the highest density of square metres per student (6 m^2 per student) as seen in Figure 9.

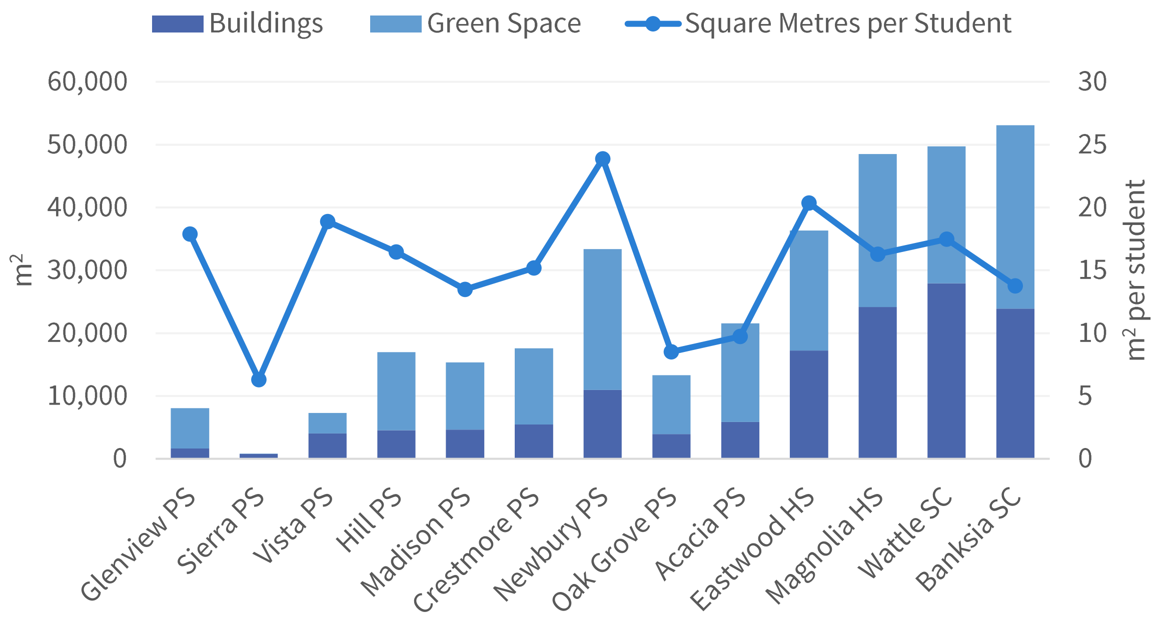


Figure 9: Total building and green areas in square metres (m^2) and square metres per student (m^2/student) for 2017 for all schools. Schools are ordered left to right from least to most number of students.

Considering the varying student and campus sizes, several metrics are considered for carbon emissions and utility consumption and costs. The per student metric is primarily used for this research as it is especially relevant to schools since they receive their funding on a per student basis. It is also a useful metric when comparing schools to understand whether a school has high carbon emissions, consumption or costs relative to its student population. This is a common approach when discussing carbon emissions on a global scale between countries. For example, while Australia is the 16th largest carbon emitter of all countries, it is the 2nd largest emitter of carbon emissions per capita, representing a high carbon emissions intensity (Union of Concerned Scientists, 2018). However, total and square metre metrics are also discussed if additional insights can be gained. Within energy efficiency literature, it is common for electricity consumption to be analysed on a per square metre basis (Dias Pereira et al., 2014). The following sections discuss the carbon emissions, electricity, gas and water consumption and cost in more detail using a variety of metrics.

5.3.1 Carbon Emissions

Between the baseline year (2015) and the end of the LCSPP (2017), 10 of the 13 schools reduced their total carbon emissions (see Table C4 for exact emissions for each school). This represented a total carbon emissions reduction across all schools of 8%, which saved 266 tonnes of CO_2-e, as shown in Figure 10.

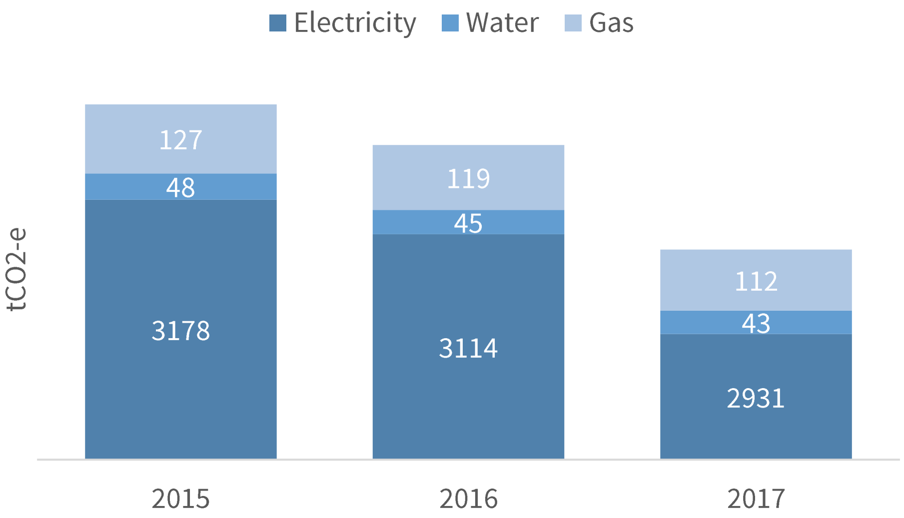


Figure 10: Total carbon emissions for all participating schools (2015 - 2017).

Considering electricity accounted for most of the carbon emissions, it is unsurprising the schools that saved 15% or more on their carbon emissions (shown in Table 16) are also the schools that had the largest reduction in total electricity consumption.

Table 16: The schools with the largest reduction in total carbon emissions of at least 15% between 2015 and 2017.

School	Percentage Difference (2015/2017)
Madison PS	-27%
Hill PS	-20%
Crestmore PS	-18%

On a per student basis, all thirteen schools reduced their carbon emissions (see Table C5 for the exact carbon emissions per student numbers for each school). Figure 11 shows the carbon emissions per student for all schools for each year. The primary schools, despite their differences in student numbers, generally had similar carbon emissions per student. However, the smallest high school (Eastwood HS), had the highest carbon emissions per student than any other high school, both in terms of student population and school square metres, indicating their school buildings are far less efficient than other schools.

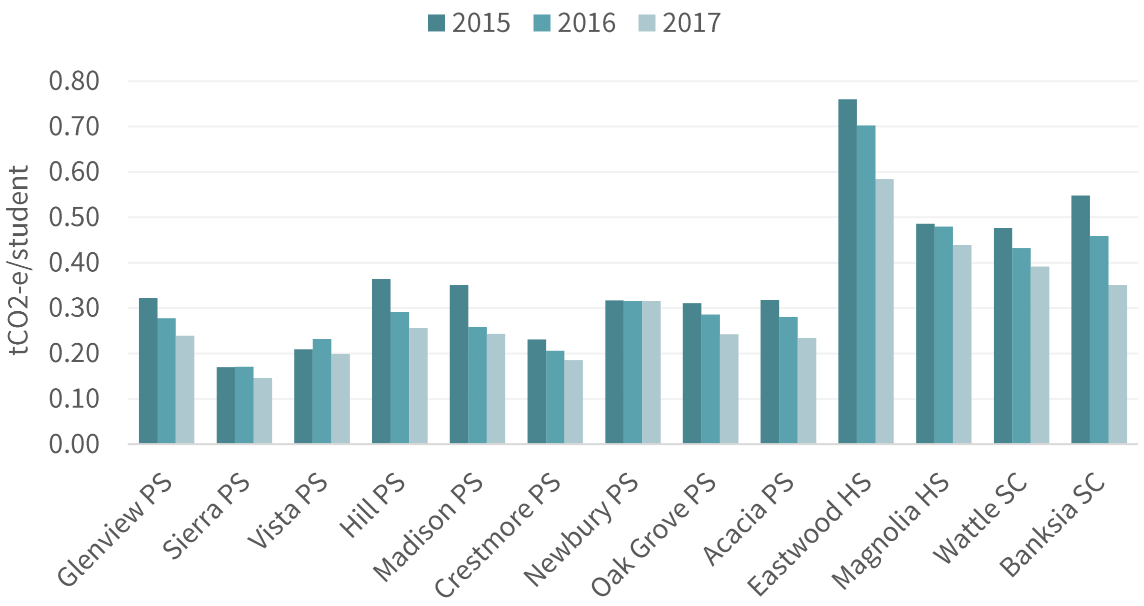


Figure 11: Carbon emissions per student (tCO_2-e/student) for all schools (2015 -2017). Schools are ordered left to right from smallest student numbers to largest.

Lastly, it should be noted that there are several reasons why a school's carbon emissions may fluctuate year to year, which are not always correlated with consumption or growth in students. In addition to influences from weather, the carbon intensity of the electricity grid changes yearly depending on the energy sources feeding into the grid. This affects the emission factors associated with electricity, which can lead to a situation where a school's consumption stays the same, but their emissions decrease due to a lower grid emission factor for that year (or vice versa). For example, in Western Australia, the electricity grid provided for all the participating schools (Southwest Interconnected System (SWIS)) had more renewable energy in the grid in 2017 than in 2015, resulting in an 8% decrease in the carbon emissions factor for indirect emissions from purchased electricity (Department of Environment and Energy, 2017). Therefore, a school that used exactly the same amount of energy in 2015 and 2017 would have lower carbon emissions in 2017 because of the lower emissions factor.

5.3.2 Total Utility Costs

From a cost perspective, nine of the thirteen schools increased in **total** utility costs by the end of the LCSPP, as shown in Figure 12. All the schools that increased in overall utility costs also saw increases in electricity costs. As will be discussed in later sections, both electricity and water costs increased by at least 15% between 2015 and 2017, which played a significant role in the schools’ total costs. In addition, over half of the schools increased in student numbers, which for some meant the installation of additional transportable classrooms, causing an increase in resource consumption and subsequently costs.

On a **per student** basis, however, most schools decreased utility costs from electricity, water and gas, as shown in Figure 12, at an average of 15%. Of the nine schools that decreased, they saved an average of $31.49 per student on their utility bills. The largest reduction in average cost per student came from gas, followed by electricity, then water, as shown in Figure 13.

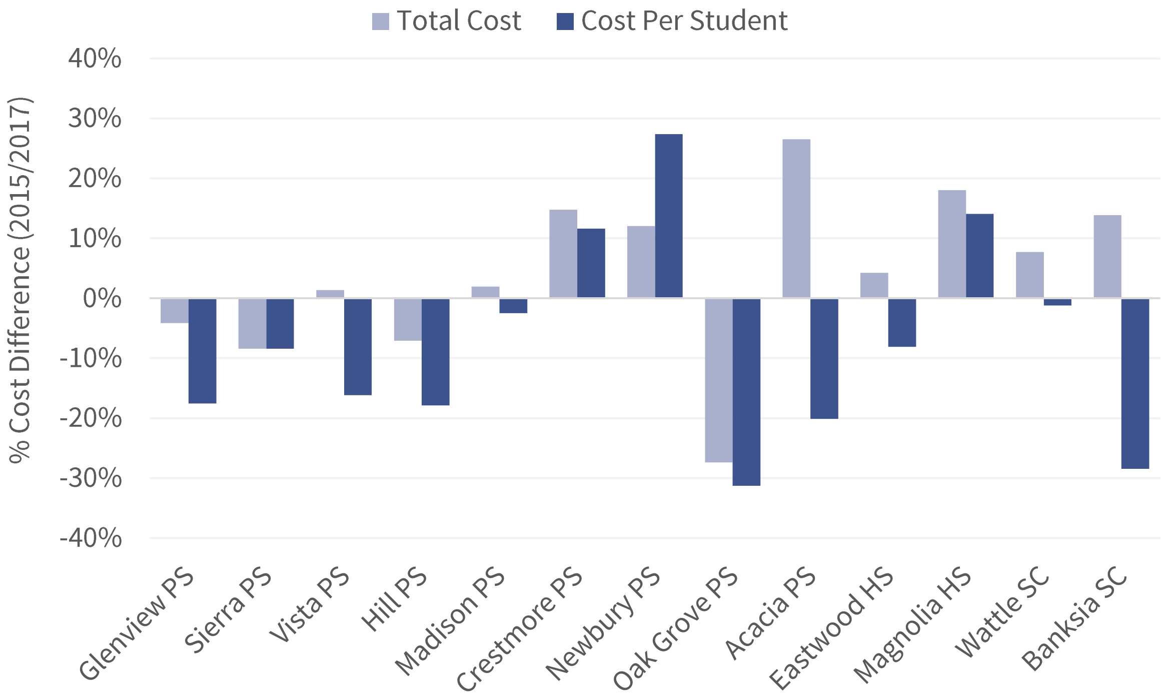


Figure 12: The percentage difference between 2015 and 2017 of each school's total utility costs (electricity, gas and water) and utility cost per student ($/student). Schools are ordered left to right from least to most students.

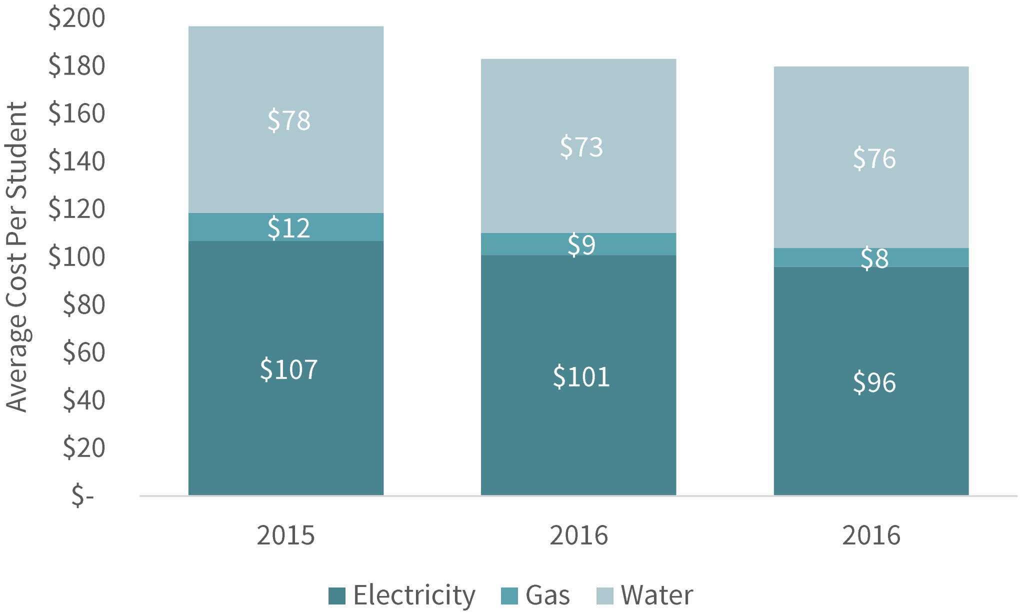


Figure 13: Average cost per student for each utility across all schools (2015 – 2017).

Key Finding 5-7: Schools that decreased their utility costs per student saved an average of $31 per student across electricity, gas and water over a two-year period.

5.3.3 Electricity Consumption & Costs

When the total electricity consumption for each school is compared from their baseline year to the end of the LCSPP, nine of the schools reduced their electricity consumption while four schools increased their consumption (see Table C1for exact consumption in kWh).

Figure 14 shows each school's yearly consumption from 2015 to 2017, with the differences in consumption between primary schools and high schools highly evident. The school that had the largest reduction in total electricity consumption was Madison PS. They were the only school that switched all their external security lighting on all buildings to LEDs and were in the process of installing LEDs throughout the school. It is evident that these two initiatives alone were highly impactful on their consumption and saved the school over $7,000.

Per student, 11 of the 13 schools reduced their electricity consumption at an average of 16%, with the largest reduction seen by Banksia SC (see Table C2 for exact electricity consumption per student numbers). As shown in Figure 15, while Eastwood HS used the least amount of electricity out of all the high schools, they had the highest electricity consumption per student than any other school. Further, some of the smallest primary schools used the same amount of electricity per student than schools over three times their size. This could be due to inefficiencies at the schools or the use of school facilities by other community organisations outside of school hours. However, it is evident in Figure 15 that by calculating electricity consumption per student, the differences between each of the schools is less, allowing for a better basis to compare consumption between schools.

Figure 16 shows each school's electricity consumption per square metre and shows that several primary schools used a considerable amount of electricity per square metre compared to other schools, even those that were significantly larger (see Table C3 for kWh/m^2 for all schools). Oak Grove PS used the most electricity per square metre, which could indicate some inefficiencies with their lighting and use of electricity. However, Oak Grove PS was also the only school that installed a solar PV system.

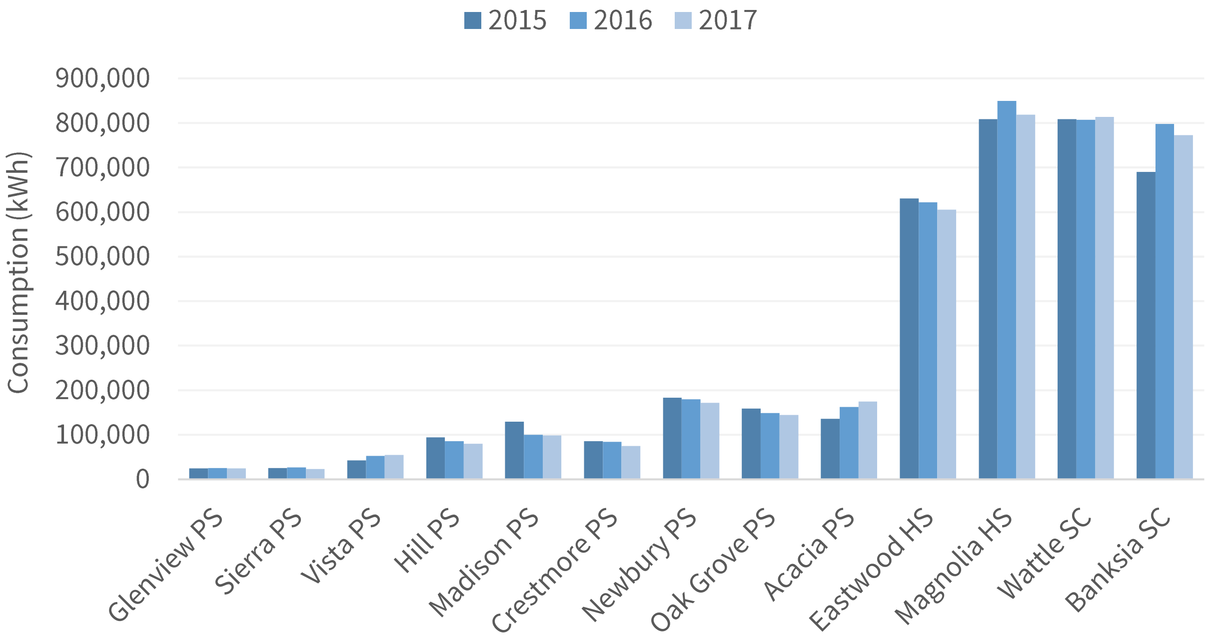


Figure 14: Total electricity consumption (kWh) for all participating schools (2015 - 2017). Schools are ordered left to right from least to most students.

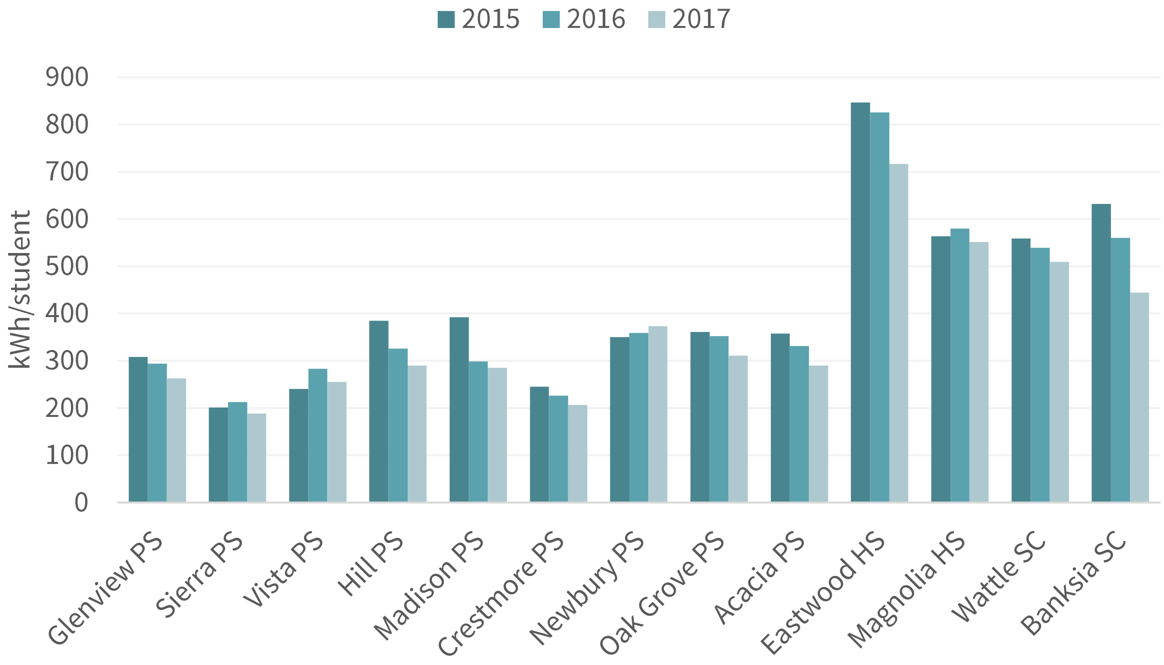


Figure 15: Electricity consumption per student (kWh/student) for all participating schools (2015 – 2017). Schools are ordered left to right from least to most students.

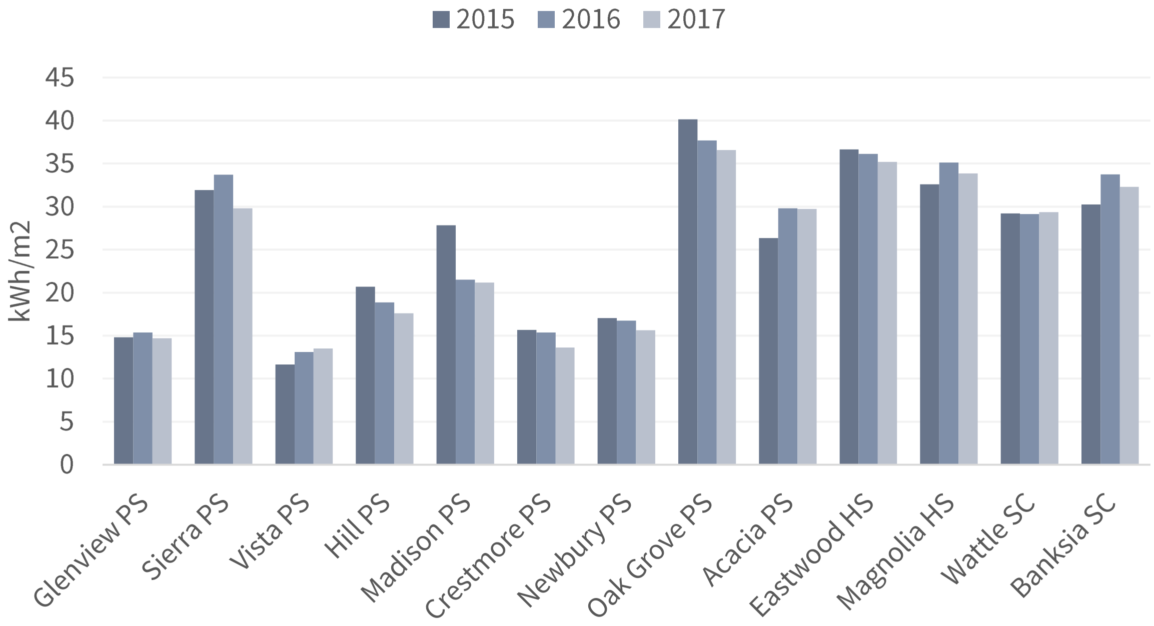


Figure 16: Electricity consumption per square metre (kWh/m^2) for all participating schools (2015 - 2017). Schools are ordered left to right from least to most students.

Key Finding 5-8: Calculating emissions and consumption per student provided a basis for comparing schools.

Nine schools reduced their electricity cost per student at an average of 19%, saving them an average of $21 per student on their electricity. Oak Grove PS saved the most on utility costs than any other school, saving over $18,000 on their total electricity costs by switching electricity providers and renegotiating their electricity tariff alone.

Key Finding 5-9: Schools that reduced their electricity costs saved an average of $21 per student.

However, as shown by Figure 17, a decrease in consumption was not followed by a proportional decrease in costs for most schools. This can be explained by the energy retailer imposing a 20% average increase in cost per kWh for all except one school (they were contracted with a different retailer). In addition to this higher electricity rate, the schools with the largest difference between their consumption and costs also had changes in their consumption patterns, where they used more on-peak electricity, which is charged at nearly double the standard electricity rate.

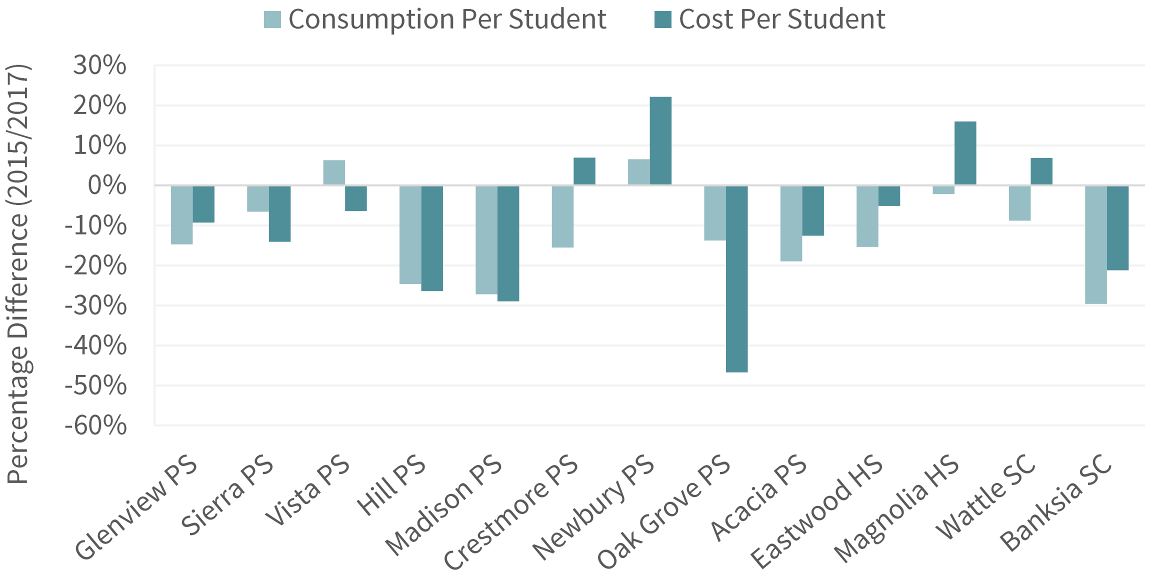


Figure 17: The percentage difference between 2015 and 2017 for electricity costs and consumption per student for each school. Schools are ordered left to right from least to most students.

Key Finding 5-10: Schools that decreased their electricity consumption did not have proportional decreases in cost due to increased energy prices from their energy retailer.

5.3.3.1 *Weekly Electricity Consumption*

Figure 18 shows the total weekly electricity consumption for all primary schools and Figure 19 shows the weekly electricity consumption for three of the high schools (Magnolia HS was not included due to corrupted interval data). The times of the year where the schools were on school holidays are circled in yellow. With the exception of Acacia PS and Newbury PS, all schools showed a general decreasing trend in consumption compared to their baseline year (2015) and it can be seen that most primary schools showed a decreasing trend during school holiday periods with a smaller baseline load during those times.

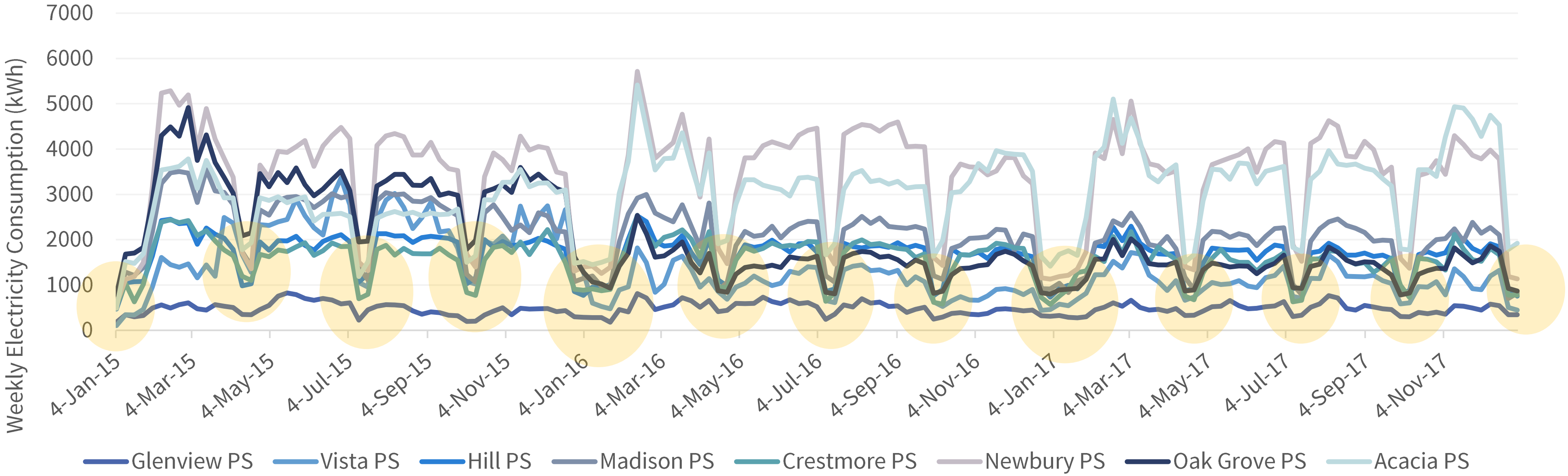


Figure 18: Weekly total electricity consumption (kWh) for all primary schools (2015 -2017). Areas circled in yellow are school holiday periods.

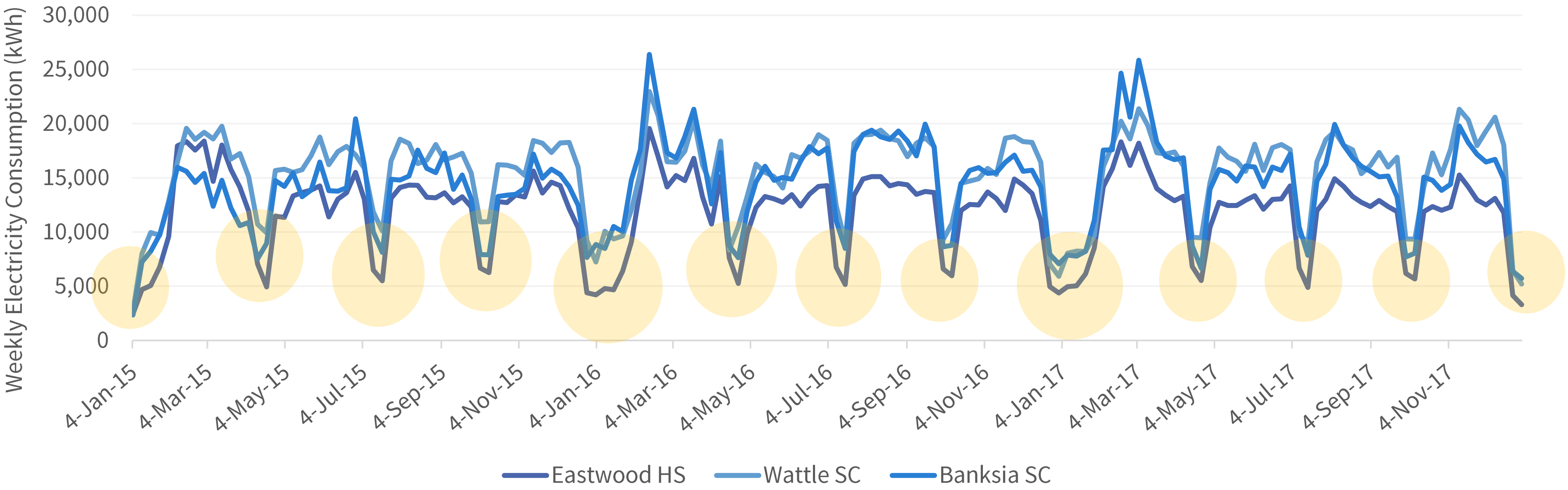


Figure 19: Total weekly electricity consumption (kWh) for three high schools (2015 - 2017).

The majority of schools implemented a switch off protocol by mid-2016 upon recommendations from the LCSPP. For most schools, they focussed largely on a switch off process for the school holiday period, aiming to reduce the number of electronics left on when no one was at the school.

The total electricity consumption during school holiday periods between 2015 and 2017 reduced on average by 12% for all schools. All schools reduced their consumption during the October school holiday period at an average of 28% (see Figure 20 & Figure 21). However, only three schools saved money, at an average of $1,104. This can largely be attributed to the increased energy prices by retailers. Of the schools that reduced their costs in any school holiday period, they saved an average of $994, with two schools saving over $2,000 over a single school holiday period.

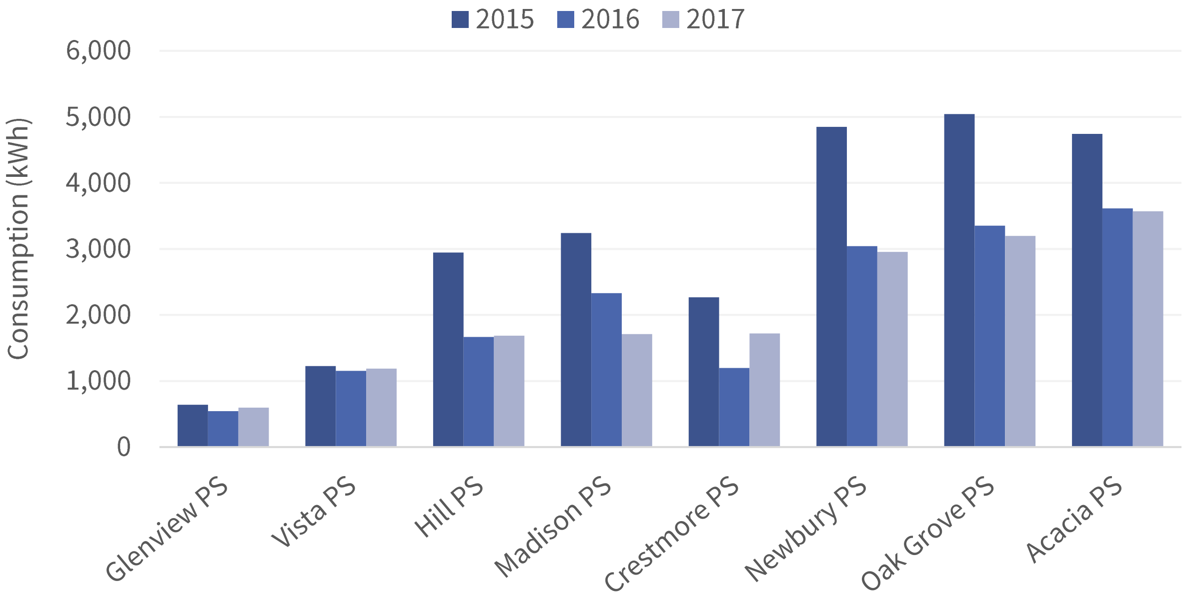


Figure 20: Total electricity consumption for the two-week October school holiday periods for all primary schools (2015 – 2017). Schools are ordered left to right from least to most students.

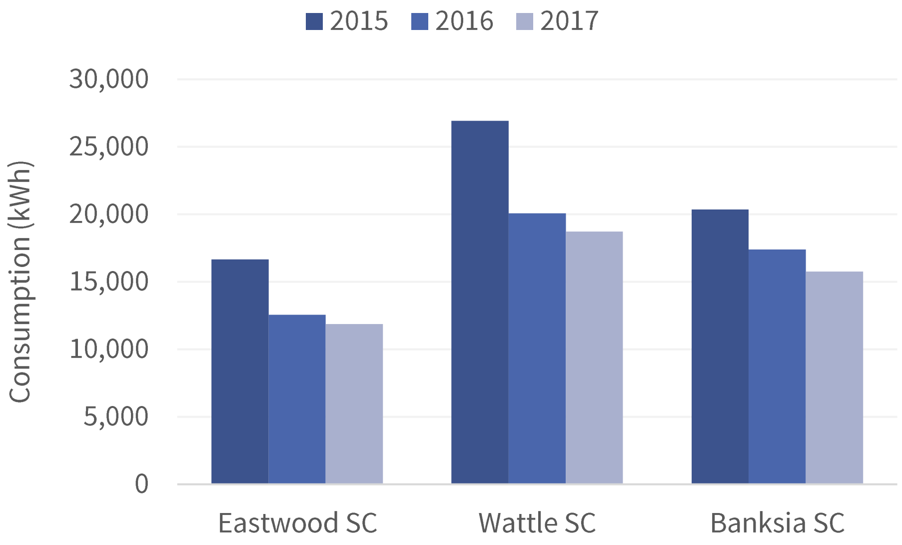


Figure 21: Total electricity consumption for the two-week October school holiday periods for three high schools (2015 – 2017). Schools are ordered left to right from least to most students.

Key Finding 5-11: The implementation of a school holiday switch-off protocol can reduce school electricity consumption during all school holiday periods by an average of at least 12%.

5.3.4 Water Consumption & Costs

Total water consumption decreased for half the schools at an average of 46%, with the remaining schools increasing their consumption. Figure 22 shows the yearly total water consumption for each school, with the areas circled being suspected water leaks due to a significant change in consumption. Only Madison PS confirmed a water leak in 2017. Wattle SC saw the largest decrease in water consumption at 72%, which is further discussed in Section 6.4.

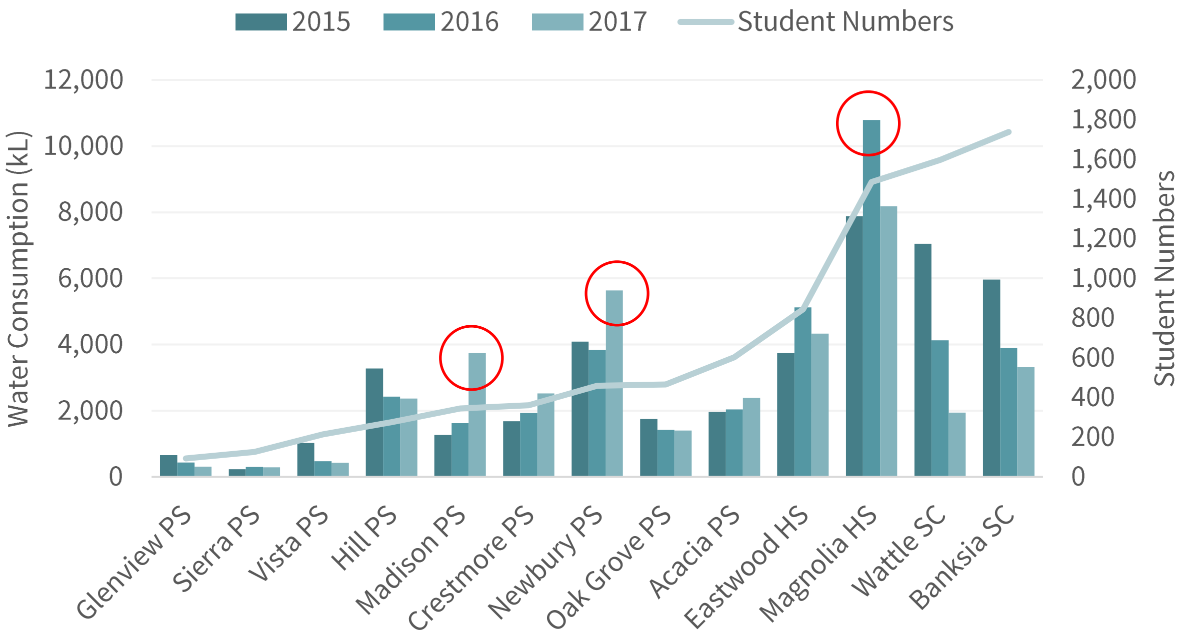


Figure 22: Total water consumption for all schools (2015 - 2017). Areas circled in red are years where the school experienced a known water leak. Schools are ordered left to right from least to most students.

Water consumption per student also only decreased for half the schools (see Table C6 for water consumption per student for all schools). The schools with the largest student numbers showed the largest reduction in water consumption per student. However, some primary schools, such as Newbury PS and Hill PS, showed a high amount of water used per student (see Figure 22). This could be due to their relatively large amount of green space requiring watering and maintenance. When each school's total water consumption was divided by the total square metres of green space, it showed the primary schools were generally less efficient with their water use than secondary schools.

Key Finding 5-12: Secondary schools' water consumption per student was generally more efficient than primary schools'.

Like electricity consumption, water costs did not also decrease proportionally to decreases in consumption, as shown in Figure 23. The comparatively modest decrease in water costs compared to larger decreases in consumption was due to fixed service charges for each school's toilets and urinals (i.e. water fixtures). The Water Corporation charged a fixed cost per water fixture and these fixed costs could represent over 80% of a school's water bill.

Most schools paid around $90 per fixture. The Water Corporation raised prices per fixture by 17% and the cost per kL by 14% between 2015 and 2017, meaning fewer schools saw the financial benefits of their water conservation initiatives. For one primary school, there were also discrepancies between how many fixtures the school had on site and how many they were being charged for by the Water Corporation. The Water Corporation amended the error and the school saved $1,904 per year just from these revised fixture charges alone.

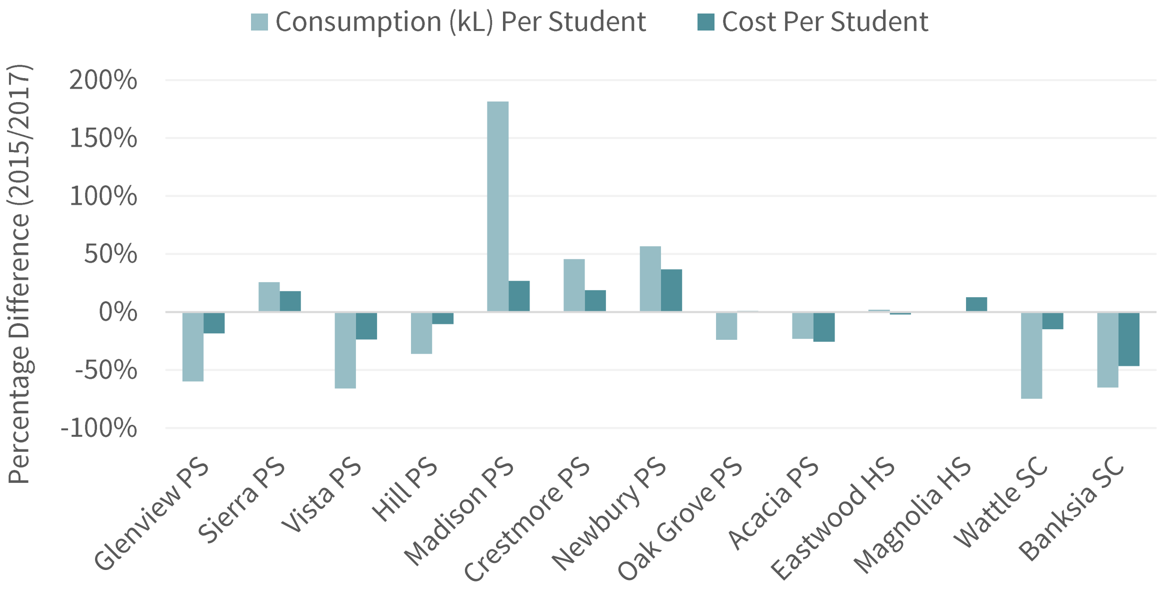


Figure 23: The percentage difference between 2015 and 2017 of water consumption per student and water cost per student for all schools. Schools are ordered left to right from least to most students.

Key Finding 5-13: Most schools did not see a significant cost savings from their water initiatives due to fixed water charges and increased water costs.

5.3.5 Gas Consumption & Costs

All except two schools reduced their gas consumption per student, at an average of 31%. Figure 24 shows the amount of gas per student each school used varied significantly, with the smallest school using the most gas per student. The number of gas versus electric heaters in each school played a significant role in their gas consumption in addition to the potential presence of any unknown leaks. Eastwood HS showed a substantial 30% reduction in their gas consumption per student, which can be largely attributed to their staff turning off pilot lights for heating that were turned on before it was necessary. Table C7 shows the gas consumption per student for all schools.

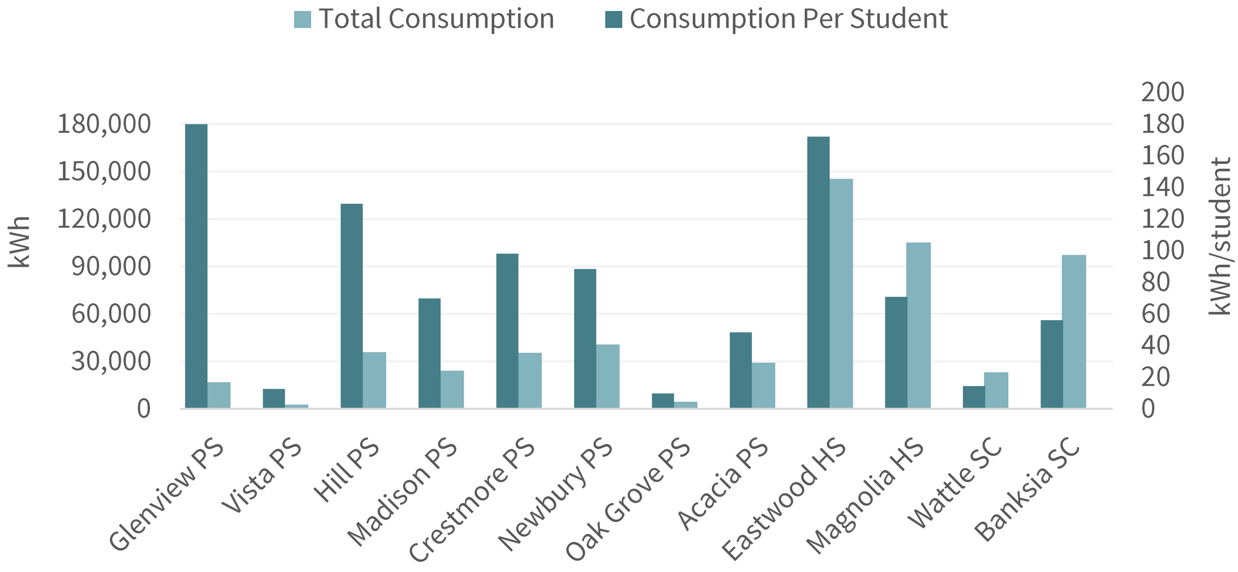


Figure 24: Total gas consumption (kWh) and gas consumption per student (kWh/student) for all schools (2017). Schools are ordered left to right from least to most students.

5.4 Low Carbon Committee Survey

The low carbon committee survey invited people participating in their school’s low carbon committee to comment on the enablers and challenges to their school’s carbon reduction journey, as well as the most successful strategies the school implemented. The survey aimed to answer the following research questions:

1) *What are the barriers and enablers for schools to reduce their carbon emissions?*
2) *What effective strategies are used to implement low carbon initiatives in schools?*

The survey had 21 responses from 12 of the 13 schools and most people who filled out the survey were teachers. Half of the schools had one committee member complete the survey and the other half had at least 2 members of their committee complete the survey.

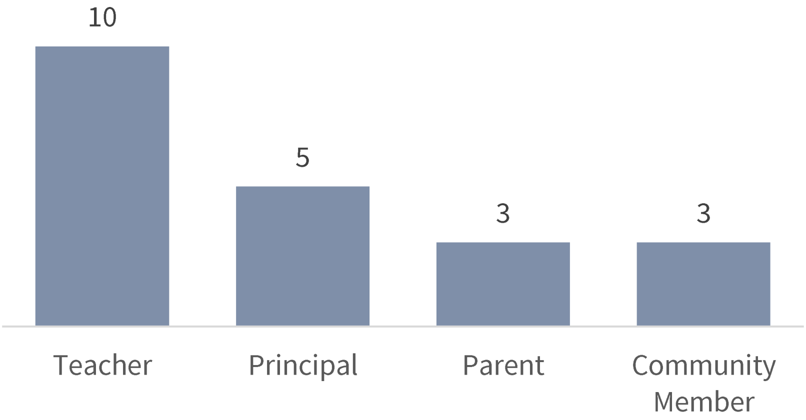


Figure 25: Total committee member survey responses for all schools by role.

5.4.1 Barriers & Enablers

Committee members were asked questions about their school’s barriers, enablers and strategies to answer the following research questions:

- What are the barriers and enablers for schools to reduce their carbon emissions?
- What effective strategies are used to implement low carbon initiatives in schools?

Barriers were defined as any event or situation that slowed or prevented a low carbon initiative from proceeding. Enablers were considered any factor that contributed to the success of their initiatives, and strategies were defined as deliberate actions or approaches the schools used when implementing low carbon initiatives.

Committee members from ten of the twelve schools said their school encountered a significant barrier when implementing carbon reduction initiatives. Over half of committee members who encountered barriers talked about the difficulty in getting other staff members at the school to be interested or participate in low carbon initiatives (see Table D6). Two primary schools and one high school specifically talked about difficulties associated with changes in their administration (e.g. new Principal) or low support from their Principal and other administrative staff members.

> *“Four different Principals in two years means lack of continuity in application of leadership policies. Lack of knowledge of the subject of sustainability and see no particular reason to learn about it.” – Community Member, Crestmore PS*

Committee members also described issues such as a lack of staff interest in initiatives, teacher resistance and difficulty changing the behaviour of staff. A lack of time was discussed by four primary schools, with some respondents specifically referencing a crowded curriculum as an explanation for why there was no time for extra initiatives.

> *"Lack of interest by other staff, time involved in implementation of projects with students takes away time on curriculum needs mandated by department." – Teacher, Newbury PS*

Two committee members from high schools also brought up policy issues, such as difficulty getting increased recycling on campus or challenges faced with the Department of Education when attempting to implement large infrastructure initiatives (e.g. solar PV).

Key Finding 5-14: School stakeholders identified difficulty engaging staff as a primary barrier to their low carbon initiatives.

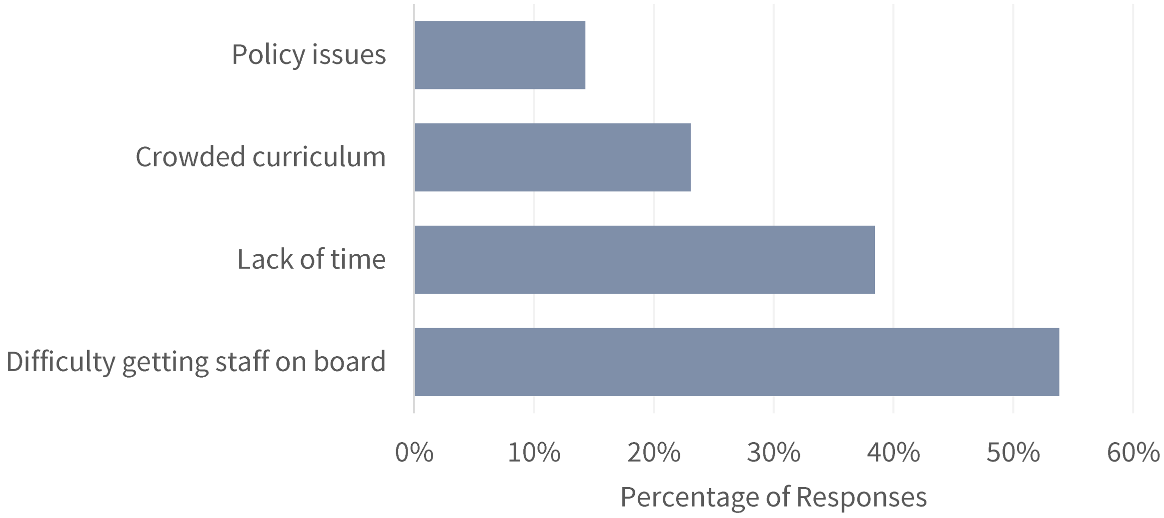


Figure 26: Committee member responses (n=13) about the types of barriers faced in schools.

When the school committee members were asked what they thought the biggest enablers were to their school's low carbon initiatives, almost half said the passion of staff members was a major contributor to success. Six members said having one or two champions within the school driving initiatives was a major factor, with one respondent specifically mentioning the importance of involving the Business Manager. Several people placed high importance on the support of the Principal and other administrative staff. Four people from primary schools also mentioned the full support from the whole school community was a major success factor. Figure 27 shows these three main enablers identified. Table D7 shows all the committee survey open-ended responses about barriers and enablers.

> *"Having the Principal, Deputy Principals and Business Manager supporting carbon reduction and cost saving initiatives. It is only their support that makes the initiatives sustainable." – Community Member, Crestmore PS*

Key Finding 5-15: Passionate staff acting as champions and a supportive administration are key enablers to the success of school low carbon initiatives.

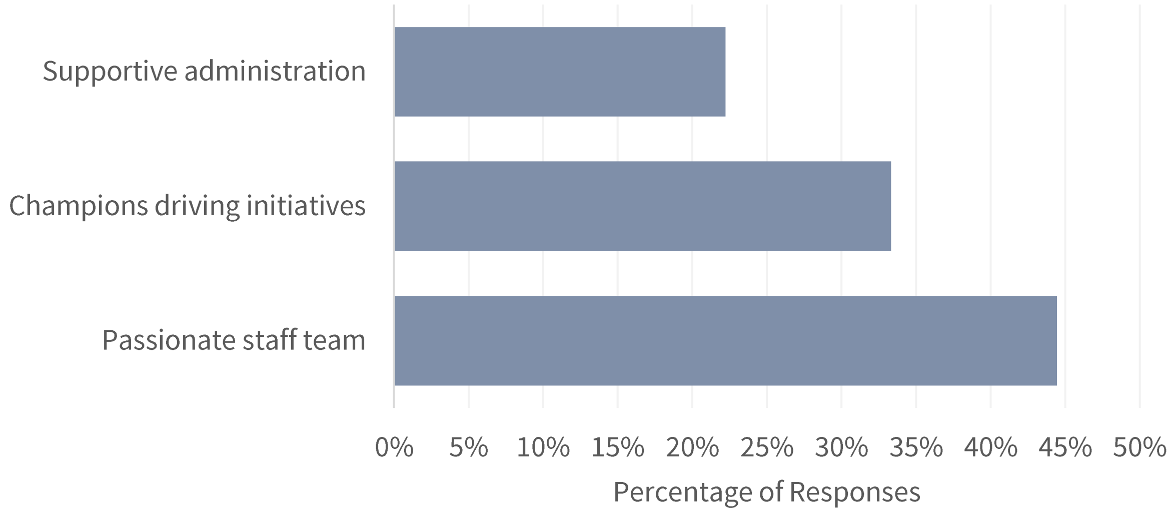


Figure 27: Committee member survey responses about the key enablers for their school's low carbon initiatives.

5.4.2 Strategies for Initiatives

School low carbon committee members were asked which strategies were the most and least effective to achieve carbon reduction initiatives at the school. Committee members at five primary schools talked about the success of educating students and involving students in the carbon reduction process.

Key Finding 5-16: Primary school stakeholders identified involving students in carbon reduction initiatives as their most successful strategy.

Several schools also mentioned initiatives like investigating bills and calculating payback periods for infrastructure, such as LED lighting, were successful strategies.

> *"Looking at bills and doing audits and linking carbon savings to cost savings." – Teacher, Wattle SC*

> *"Getting students to be involved in reducing the carbon footprint of the school in water and electricity and taking the skills and messages home." – Teacher, Crestmore PS*

Three respondents said getting involvement and buy-in from staff members at the school was an important approach for the school, and both committee members from one high school said their best strategy was regular communication with staff about the low carbon initiatives. One primary school also talked about the success of the LCSPP strategy requiring each school to be accountable for their low carbon initiatives at the monthly meetings.

Table D1 shows all survey responses about the most successful strategies used by schools.

When it came to strategies that were less successful, some respondents highlighted problems of lack of communication regarding initiatives within the school, and getting support from other staff before implementing an initiative. An example given was a staff member liaising with kitchen staff to turn off the cool room at certain times without checking the times when other staff members used it. Another high school committee member noted issues with creating new sustainability rules at the school without appropriate communication about the new rules with the rest of the school.

> *"Assuming that the rest of the school community knows what a good job is being done to reduce carbon emissions and wholeheartedly supports you. If they don't know, the majority won't make an effort to find out and won't think that your activities have any relevance to them." – Community Member, Crestmore PS*

Key Finding 5-17: Communication with the entire school about new sustainability initiatives was highly important to success.

Committee members at two primary schools also said having negative reinforcement around low carbon initiatives, such as creating penalties for not following a new rule at the school, discouraged people from participating. Another two respondents described how expecting parents to participate in initiatives, such as waste-free lunches, was not the most successful activity because parents were not passionate about the initiative and were time-poor.

> *"Any strategy that relies on parent participation to be successful, because for many of the parents in this area it is not a concern and they will keep doing what is convenient and easiest for them now."* – Teacher, Acacia PS

Key Finding 5-18: Relying on parent participation in initiatives, such as waste-free lunches, was not the most successful strategy.

Two respondents noted that some initiatives were not working well, but the school was still determining what needed to be amended. A Principal at a primary school highlighted that ad hoc and inconsistent sustainability approaches were the least effective initiatives. Table D2 shows all responses to questions about the least effective strategies to school carbon reduction.

5.4.3 Intra and Inter-School Dynamics

While every school's Principal had to sign a letter of commitment to support initiatives as part of a requirement for participating in the LCSPP, there were varying levels of reported Principal support by committee members. Only one school reported their Principal as extremely supportive. The majority said their Principal was supportive or very supportive. No one indicated their Principal was not supportive of initiatives (see Table 17). While a lack of time was cited by many schools as an ongoing issue, about half the schools provided paid time for staff to work on initiatives.

The number of people on each school's low carbon committees varied from as few as three, to as many as nine, with the average being around five members. Most schools reported that their committee was comprised of about half teachers and half committee members or students. Committee members were asked how many of the people on their school's low carbon committee were "active". In other words, how many people provided time or resources to help with initiatives on a regular basis. There was an average of three active committee members per school and most schools said around a quarter to half of their committee members were active. Three schools reported that everyone on their committee actively participated in initiatives. In addition, two schools said that there was only one active committee member, demonstrating a reliance on a sole sustainability champion in the school. These two schools also identified that a major enabler for their school was the presence of a sustainability champion.

Table 17: Committee member survey responses to school dynamic questions about level of principal support, amount of teacher relief time provided, and the number of active committee members.

School	Level of Principal Support for Initiatives	Relief Time Provided for Staff	Active Committee Members
Banksia SC	Very Supportive	Yes	Less than a quarter
Madison PS	Very Supportive	Yes	About half
Hill PS	Very Supportive	Yes	Everyone
Acacia PS	Extremely Supportive	No	About half
Glenview PS	Supportive	Yes	About half
Eastwood HS	Very Supportive	No	Less than a quarter
Crestmore PS	Supportive	Yes	Everyone
Wattle SC	Very Supportive	Yes	Less than a quarter
Sierra PS	Supportive	No	More than two-thirds
Magnolia HS	Somewhat Supportive	No	More than two-thirds
Vista PS	Somewhat Supportive	No	Everyone
Newbury PS	Supportive	No	About half

Nearly all committee members (95%) said they shared advice or experiences with other schools in the program and learned something from other schools. All committee members also agreed they thought sharing experiences and forming relationships with other schools was important, as shown in Figure 28. The primary reasons they thought sharing with other schools was important was because it allowed for a sharing of ideas and solutions between each other and that it enabled conversation with like-minded people. Most committee members also said knowing how their school's utility consumption and costs compared to others was valuable. Some examples of how committee members described their experiences at the school meet-ups are shown below.

"Hearing how others tackled problems. Especially convincing Business Managers and Principals to take action."- Teacher, Crestmore PS

"I liked to see what other schools are doing and hear first-hand their passions and challenges."- Teacher, Wattle SC

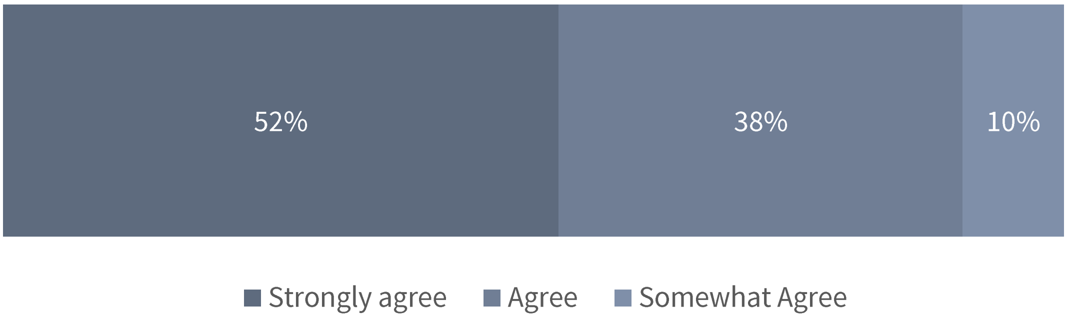


Figure 28: Committee member survey responses: "Sharing experiences and forming relationships with other schools is important".

Key Finding 5-19: Sharing experiences and comparing consumption with other schools was highly valuable for participants.

In addition, 71% of committee members said their own LCL attitudes or behaviour changed because of their school participating in the LCSPP. The changes they described included increased knowledge about how to reduce carbon emissions and an increased motivation to address climate change. From a student engagement perspective, almost 90% of committee members said their school actively engaged students in their low carbon initiatives as part of the LCSPP. Most of the activities described focussed on areas such as waste and recycling. None of the schools involved students in investigating utility bills or filling out the carbon emissions spreadsheet. However, nearly all committee members (95%) said they thought there was potential for more engagement of students in this process.

Key Finding 5-20: School stakeholders think students should be more involved in the carbon reduction process.

5.4.4 Perceptions of the Carbon Emissions Process & Program Structure

The survey to committee members also included questions investigating school stakeholder perceptions of the carbon emissions reduction process. A primary component of the process for each school involved the collation of school electricity, gas and water bills from 2015 to 2017 and entering this data into an excel spreadsheet provided by the program. The school business manager or registrar was typically responsible for finding bills to enter. Surprisingly, few schools had a process of filing their utility bills in a way that made them easy to access. Teachers or the business manager/registrar of each school were largely responsible for entering the utility consumption and cost data into the spreadsheets. When asked how they thought this process could be improved, examples of responses are included below.

> *"Anything that makes collecting the data simpler."*
>
> *"At a school level, ensuring time is given to front of school staff to collect and coordinate data to enter it [into the spreadsheet]."*

Many school participants regularly expressed difficulty regarding collecting the data and entering it into the spreadsheet. Despite this, all committee members thought the carbon spreadsheet and process of calculating emissions and costs was useful, with 68% of them saying it was extremely or very useful. Nearly three quarters (67%) also said they thought students could be involved in entering this data into the spreadsheet in future.

Key Finding 5-21: Many schools struggled with collating their utility bills in order to enter them into the carbon emissions spreadsheet.

Committee members were also asked to indicate how useful they thought various aspects of the LCSPP program were. As shown in Figure 29, committee members reported the carbon spreadsheet as the most useful aspect of the program, with workshops and meet-ups also stated as very or extremely useful by most respondents.

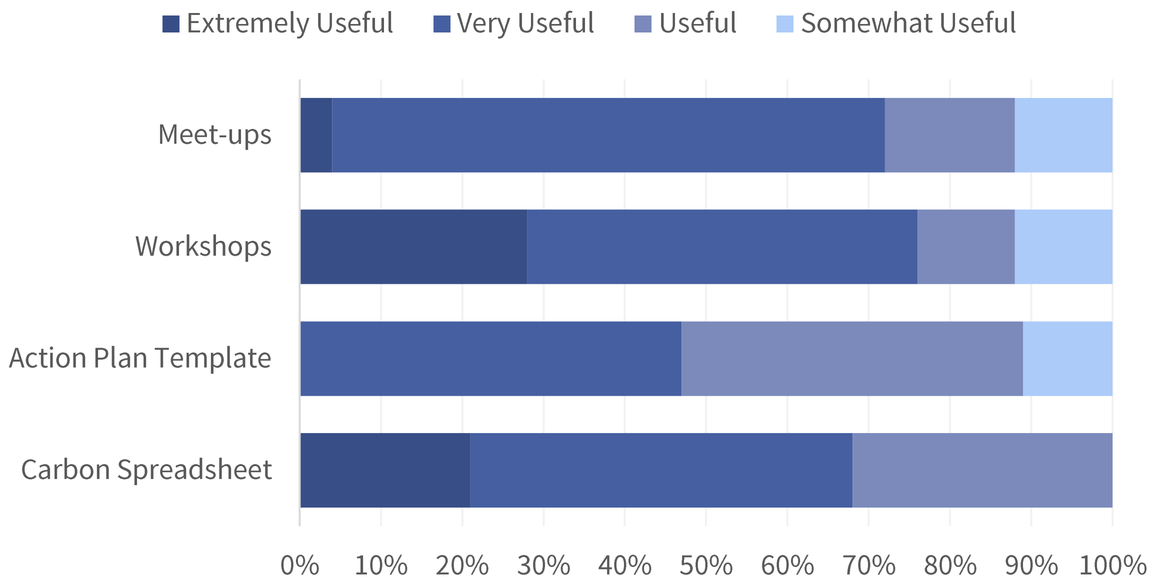


Figure 29: Committee member survey responses about how useful they thought certain aspects of the LCSPP were: meet-ups, workshops, action plan template and the carbon emissions spreadsheet.

Key Finding 5-22: Most committee members thought the carbon emissions spreadsheet, the workshops and meet-ups were very or extremely valuable components of the LCSPP.

5.5 Parent Survey

A survey was sent to all parents/guardians of students of the schools participating in the LCSPP to answer the following research question:

'Can students influence family attitudes or behaviour around low carbon living?'

A total of 294 responses were received from 12 schools (one school had no responses) and the survey was largely completed by students' mothers. The number of parent survey responses varied significantly for each school (as few as 3 for one school, and as many as 61 from another). When the percentage of responses as a total of the student body was calculated, as seen in Table 18, the average percentage of parent responses across all schools was 7%.

Table 18: Summary of responses to parent survey as total and responses as a percentage of total students per school. Schools are ordered largest to smallest from top to bottom.

School	**Students (#)**	**Parent Survey Responses (#)**	**Responses (#) as Percentage of Total Students**
Banksia SC	1738	6	0.3%
Wattle SC	1597	61	3.8%
Magnolia HS	1485	21	1.4%
Eastwood HS	845	25	3.0%
Acacia PS	602	23	3.8%
Oak Grove PS	465	41	8.8%
Newbury PS	459	2	0.4%
Madison PS	345	24	7.0%
Hill PS	276	39	**14.1%**
Vista PS	214	15	7.0%
Sierra PS	125	14	**11.2%**
Glenview PS	93	24	**25.8%**

5.5.1 Intergenerational Influence

Parents were asked four main questions to measure the level of intergenerational influence occurring between their child, themselves and their household activities over the last 12 months. These questions included:

1. *Did your child mention or speak with you about climate change or carbon reduction topics?*
2. *Did you notice any changes in your child's attitude or behaviour around low carbon living?*
3. *Have there been any changes in your own attitudes or behaviour around low carbon living?*
4. *Has your child encouraged your household to adopt any new or additional practices around low carbon living?*

Nearly half of all parents said their child talked to them about low carbon living topics, as shown in Figure 30 .Waste topics were the most commonly discussed, along with electricity and recycling. 13% of parents said their child discussed climate change topics specifically (see Table D12 for a summary of responses).

For each school, there was some consistency between the low carbon living topics children discussed with parents and the types of initiatives that were pursued at the school. However, in addition to the low carbon initiatives they implemented, each school also had varying levels of broader sustainability and climate change-related education in classrooms, which could also influence the topics children discussed with their parents.

More than one third of parents said they noticed changes in their child's attitude or behaviour around LCL within the last 12 months. Most parents described behaviours that fell into waste, electricity or recycling categories. Over half of parents attributed their child's change in attitude/behaviour to the child's school, such as the school classroom, school culture of sustainability or the participation of their child in a school green team. Around 20% said that the changes in their child's behaviour was due to family member encouragement or an already existing culture of sustainability within the family.

When it came to the household, 30% of parents said their child had influenced their household to adopt new LCL practices. While nearly half of parents said they experienced a change in their LCL attitudes or behaviour, only 13% attributed this change to their child. Some responses about how parents personally changed related specifically to initiatives taking place at the school, with two parents specifically noting the important role the school played in their personal behaviour (see Table D4 for all responses).

> *"Feeling more supported by my children in my actions at home to save the environment."- Parent, Glenview PS*
>
> *"Having the school be involved in the change is a great help in reinforcing my goals at home." – Parent, Hill PS*
>
> *"From their plastic free Tuesdays I now try and avoid any plastic wrap etc in their lunch boxes."- Parent, Sierra PS*

Key Finding 5-23: Some parents indicated their child's school plays a large role in influencing their own LCL attitudes and behaviour.

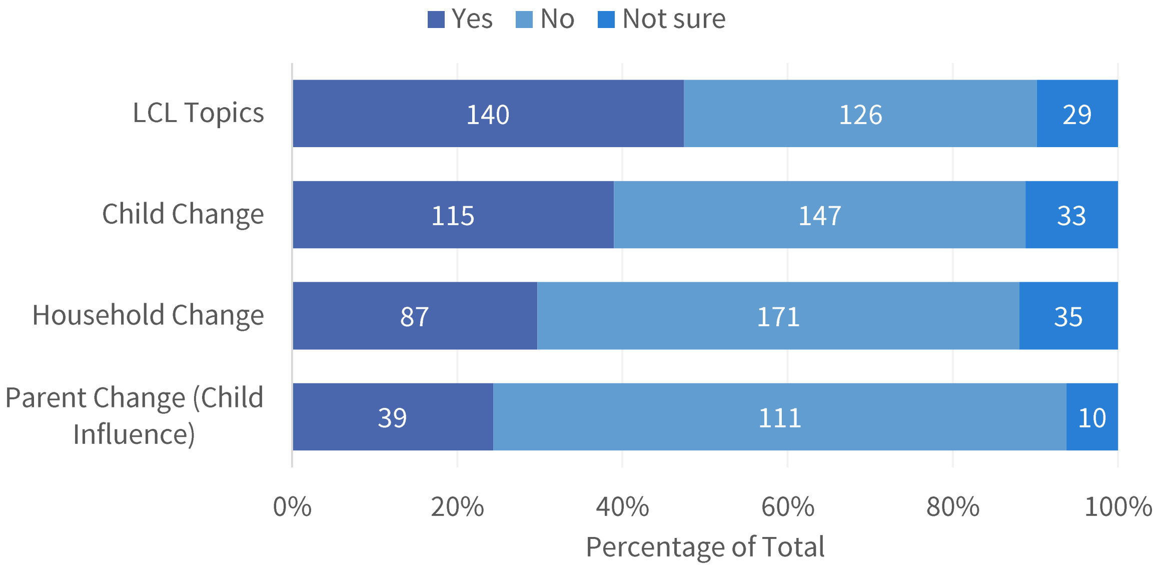


Figure 30: Parent responses for each of the four intergenerational influence questions in the parent survey.

When looking at the percentage of “yes” responses in relation to each of the four intergenerational influence questions, the data showed that parents that said their children spoke to them about LCL topics were three times more likely to say their child influenced their household’s LCL practices. In addition, parents that said their child’s LCL attitudes or behaviour changed were six times more likely to say their child influenced their household’s practices. Correlation analyses confirmed this as shown in Table D12. This demonstrates that discussions about LCL topics can lead to student influences in the home, and an even more powerful indicator of students’ influence in the home are changes in their own attitudes or behaviour.

Key Finding 5-24: A child who changes their LCL attitude or behaviour is six times more likely to influence their household’s LCL practices.

There were also similarities in how many of the responses from all four questions were classified into sustainability categories. As shown in Figure 31, all intergenerational influence questions focussed primarily on the waste category. Considering that most schools had a significant number of actions relating to waste, it is unsurprising that parents reported waste-related topics and actions.

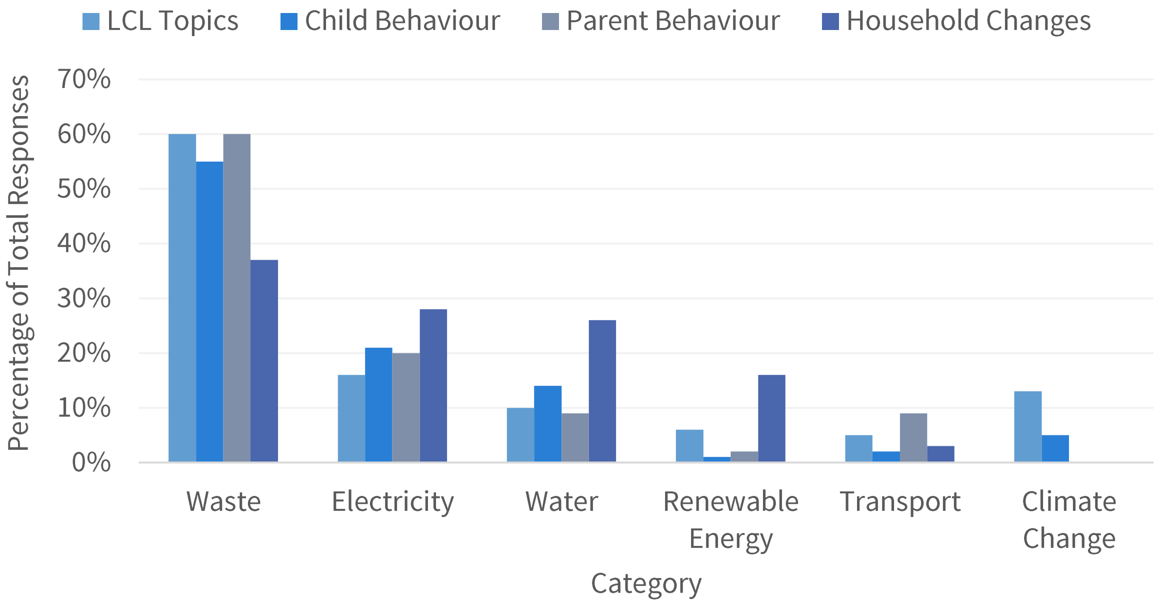


Figure 31: Percentage of responses in each sustainability category across all intergenerational influence survey questions.

Key Finding 5-25: Waste is the most common topic discussed and change in behaviour for children, parents and households.

There were also similarities in the behaviours that parents described seeing in their children, parent changes in behaviour, and the ways children influenced their households. The most common behaviour change identified in the household was children encouraging family members to turn lights and appliances off. This was also the second most common behaviour parents said they saw in their children's behaviour. Improvements in recycling practices, such as increasing the amount of recycling or number of different items to be recycled was also commonly described in child behaviours and household changes, as well as reducing plastic consumption. Table 19 shows all the common behaviours across the intergenerational influence survey questions and the number of behaviours falling into each category.

Table 19: Common behaviours by children and parents and changes encouraged by children in the household.

Action	Household Changes	Child Changes	Parent Changes

Turning lights & appliances off	22	12	2
Improved recycling	17	17	6
Reducing plastic use	14	7	15
Taking shorter showers	9	4	2
Turning water taps off	5	4	0

Key Finding 5-26: Turning off lights was the most common change in behaviour for children, parents and in households.

In addition to similarities in the changes in behaviour that were described by parents, there were also overlaps between the responses received for each question. For example, several parents described changes in their child's behaviour when they described the LCL topics their children discussed with them, and many parents described the changes they saw in their children as those that involved influencing family members to be more sustainable. Some examples that parents gave about how their child influenced others are included below. Table D5 includes all responses from parents.

> *"Reminds us to turn off lights and close the fridge door and to recycle"- Parent, Hill SC*
>
> *"Exploring ideas, suggestions to reduce wastage at home in terms of food, electricity and water"- Parent, Acacia PS*
>
> *"Making the household more aware of the reasons for recycling and the items that can be recycled" – Parent, Hill PS*
>
> *"Just openly reminding the family and myself as a parent where we can reduce, reuse or recycle!"- Parent, Wattle PS*
>
> *"Encouraging others to buy less and use less plastic" – Parent, Sierra PS*
>
> *"She is always keeping our family accountable for our carbon generating actions"- Parent, Hill PS*
>
> *"More attention paid to others' behaviours in the household, reminding extended family members etc"- Parent, Hill PS*

When the behaviours and practices that children influenced in the household were categorised by type, most behaviours were related to changes in infrastructure or energy use, as shown in Figure 32. This included things like turning off lights and taking shorter showers. The waste management category had the second largest number of behaviours. These behaviours were specifically related to waste reduction, such as increasing recycling and composting. "Recurrent purchase" also included behaviours in the waste category. However, behaviours in this category were related to influences in purchasing decisions that would take place more than once, such as avoiding products with excess packaging or purchasing used clothing instead of new. Section 4.8.1.3 provides additional examples of behaviours that are classified under each category.

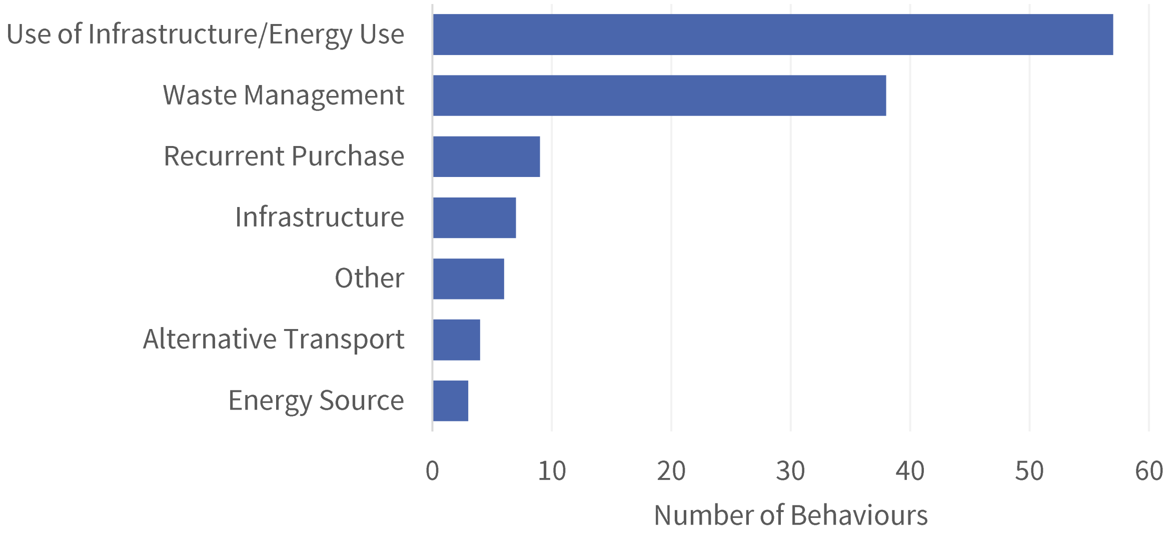


Figure 32: Changes in low carbon living practices that children encouraged in their household by type.

Key Finding 5-27: Most of the changes children influenced in their household related to a change of infrastructure use, such as tuning off lights or taking shorter showers.

5.5.2 Proenvironmental Attitude Measurement

Several questions designed to measure proenvironmental attitudes were included in the parent survey to understand the relationship between parent attitudes and student attitudes, behaviour or influence. These measurements included the LCRI, which included three questions about attitudes towards greenhouse gas emissions reduction, and additional questions measuring energy efficiency attitudes, and perceived social norms about carbon reduction, which helped provide a context for the LCRI results. This research focussed primarily on the three questions that form the LCRI, which are:

- “I feel very good when I am successful in reducing my greenhouse gas emissions”
- “I work hard to reduce my greenhouse gas emissions wherever possible”
- “I would feel very bad if I failed to reduce my greenhouse gas emissions”

Figure 33 illustrates the results from all parent surveys, showing the majority of parents reported that they feel very good when they successfully reduce their greenhouse gas emissions, and just over half reported that they worked hard to reduce their greenhouse gas emissions wherever possible.

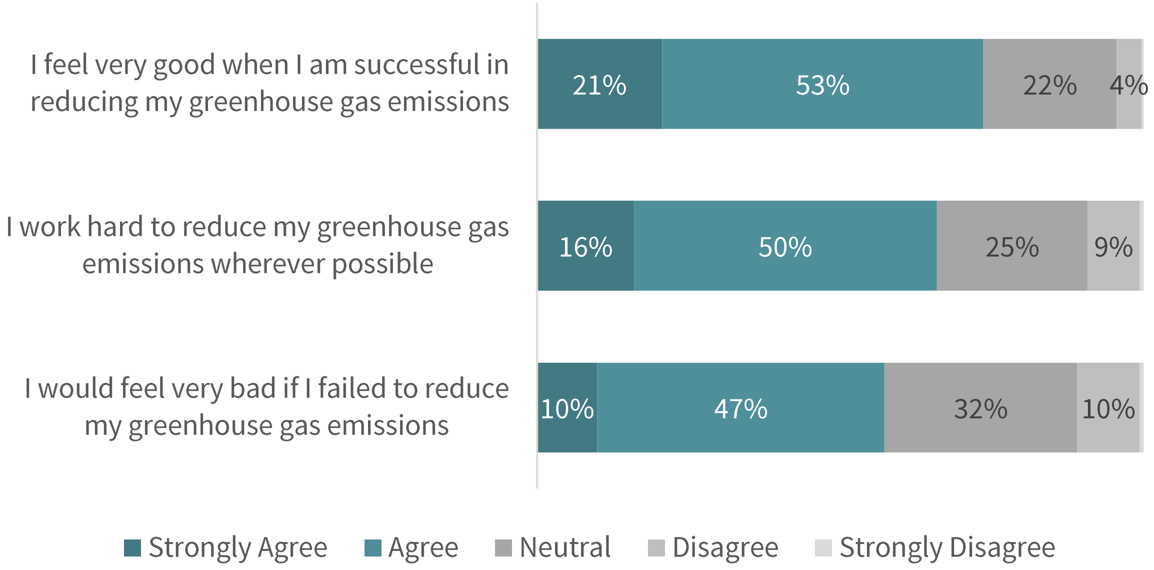


Figure 33: Low Carbon Readiness Index (LCRI) Likert scale results from the parent survey (n=294).

How parents responded to the LCRI questions was examined in relation to each of the four intergenerational influence questions. Parents who said their child influenced household behaviour had 15% more “strongly agree” or “agree” responses to one of the three LCRI questions: “I feel very good when I am successful in reducing my greenhouse gas emissions” than parents who said “no” or “not sure”. In addition, parents who reported changes in their child’s attitude or behaviour also had 16% more “strongly agree” or “agree” responses. The other two LCRI questions did not show any differences between the answer of question (yes, no, not sure) than the total positive parent responses. This could indicate that there is a relationship between a child’s proenvironmental attitudes/behaviour and increased likelihood of parents feeling positively about reducing greenhouse gas emissions.

However, considering this study was unable to measure parent changes in attitude or behaviour or time, these assumptions about the relationship between child proenvironmental attitudes/behaviour and parent perceptions of greenhouse gas emissions reduction are speculative. When all other parent attitude measurements where analysed for their relationship with other variables, there were no moderate or significant relationships to note (see Table D12). Figure 34 shows a path analysis, with the primary proenvironmental attitudes measurement variables and the intergenerational influence variables.

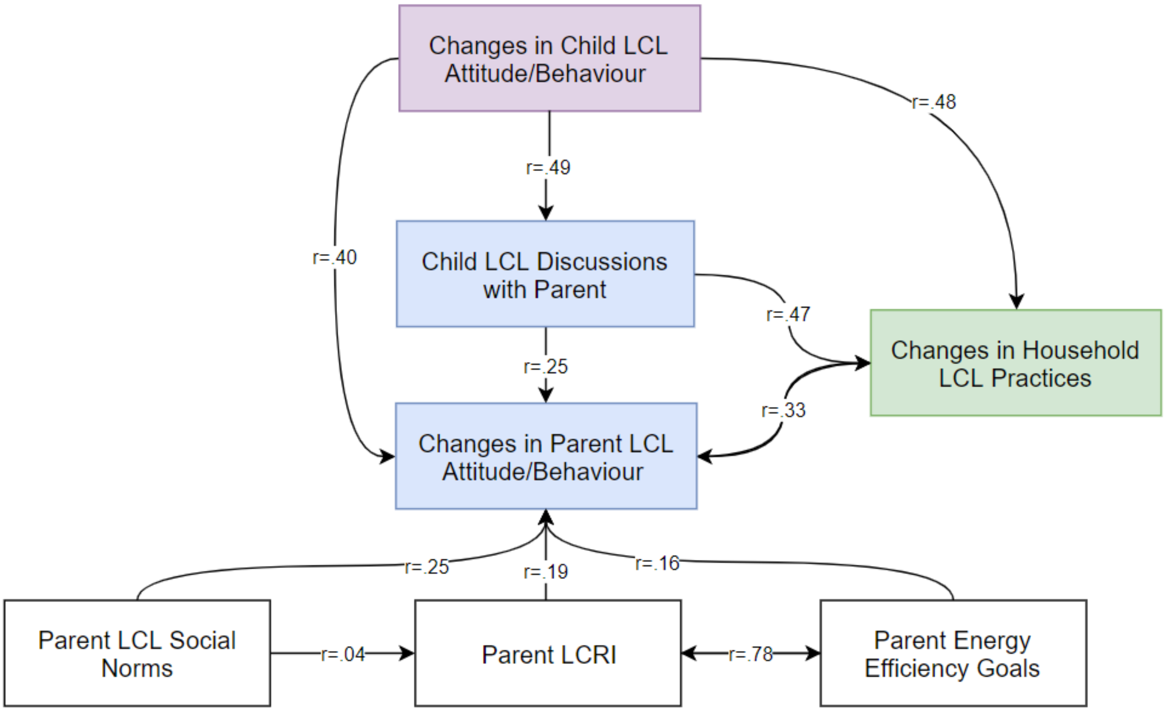


Figure 34: Path analysis showing the relationships between the primary proenvironmental attitude variables and intergenerational influence variables.

5.6 Program Evaluation

This research also sought to determine the efficacy of the Low Carbon Schools Pilot Program in achieving its aims. To determine the success of the program, a logic model was developed for the LCSPP (see Section 4.8.1.4) to track and evaluate its outcomes. The short-term (immediate to 2 years) and medium-term (2 to 4 years) outcomes were measured using the results of the two surveys administered to each school's low carbon committee, as well as the carbon emissions data collected. The program achieved all short-term outcomes that were identified in the logic model, as shown in Table 20.

Table 20: Short-term (immediate to 2 years) outcomes for the LCSPP and the evidence supporting the achievement of each outcome.

Outcome	Evidence
A sense of community for sustainability within schools	- The creation of a low carbon committee within each school as required by the LCSPP
Community of practice connecting stakeholders from all schools	- 100% of school stakeholders said their school shared advice or experiences with other schools in the LCSPP
Committee members have the knowledge and skills to reduce CO_2-e	- 84% of school stakeholders said they had increased knowledge about how to reduce school carbon reduction through their participation in the LCSPP
Shared knowledge, strategies and experiences between schools	- 72% of school stakeholders said they had learned from the experiences of other schools implementing low carbon initiatives - 88% said they learned something from other schools - 72% said they thought sharing knowledge between schools was extremely or very useful
Increased stakeholders' understanding of school resources use & utility costs and how they compare	- 84% of school stakeholders said they have an increased understanding of school resource use - 54% of school stakeholders thought knowing how their school compared to other schools was extremely or very valuable
20% reduction in CO_2-e and/or utility costs	- Overall all 13 schools reduced their carbon emissions per student by 20%
Information sharing & knowledge influence with members of the broader community	- 60% of schools formed new partnerships with businesses or community organisations because of the LCSPP - 53% said their partnerships contributed a lot to the success of their school's low carbon initiatives - 50% of parents said they were aware of the low carbon initiatives taking place at their child's school
Increased student knowledge and/or action for CO_2-e reduction	- 80% of schools said they actively engaged their students in the carbon reduction process

5.7 Chapter Summary

This chapter summarises all quantitative and qualitative results from all schools participating in the LCSPP. The schools listed hundreds of initiatives on their action plans and there were several initiatives that were commonly implemented amongst the schools. A switch off protocol for the end of the school day and school holiday periods proved to be a successful initiative in terms of energy consumption and cost. All schools reduced their carbon emissions per student, and it was evident that this was an important metric to use when comparing school data.

School stakeholders identified several common barriers to reducing carbon emissions, such as policy-related barriers, a lack of staff time to work on initiatives. When it came to enablers, they highlighted the importance of having a passionate staff team to work on initiatives and having the support of the Principal and other administrative staff. Stakeholders found the carbon reduction process challenging yet valuable, and most thought there was scope to involve students more in this process in the future. They identified the sharing of knowledge between schools and the monthly meet-ups as a highly valuable aspect of the LCSPP.

Lastly, this chapter concluded with the results from the parent survey, which showed that students spoke to their parents about low carbon living topics and influenced their household behaviour. There were striking similarities between child behaviour changes, topics discussed with parents and how children influenced their households. An evaluation of the LCSPP against the outcomes it defined in the program logic model also shows the program was highly successful in achieving its goals.

The next chapter dives deeper into the carbon reduction journey of four case study schools, exploring the intricacies of their initiatives, organisational dynamics, challenges and successes.

6 Results - Four Case Studies

6.1 Introduction

This chapter describes the carbon reduction journey of the four case study schools. The primary schools are discussed first, followed by the secondary schools. Each case study follows a similar structure where the school context is introduced, and the key initiatives or unique aspects of the school are described. The utility consumption, costs and carbon emissions are described, followed by the results from the student focus groups, then each schools' challenges and key success factors are explored.

6.2 Hill Primary School

6.2.1 School Overview/Background

Hill Primary School is a coastal school 20 minutes south of the Perth CBD in Western Australia that caters to children from Kindergarten to Year 6. The school was built in 1967 and has four teaching blocks: a visual arts centre, performance art centre, library and staff room. There is also a large outdoor garden where produce is grown to be used in the canteen, and a nature playground made of natural materials exists. The school had just under 300 students in 2017, which is a 13% increase in student numbers since 2015.

In 2015, the school had an Index of Community Socio-Educational Advantage (ICSEA) ranking of 1020, with 17% non-English speaking students and 8% Indigenous students. The state average is 1000 and their ICSEA ranking indicates that that the students do not have an educational advantage over other schools. Hill PS's student achievement testing scores (NAPLAN) showed scores for Years 3 and 5 that were generally 84% above national minimum standard (NMS) levels in 2017 (Department of Education, 2019).

The school receives students from two council areas and both are considered progressive local governments around sustainability. The City of Fremantle is committed to the 10 One Planet Living principles, which includes commitments to zero carbon energy and zero waste (City of Fremantle, 2019) and the City of Cockburn addresses multiple sustainability areas, with plans outlining their commitment to areas such as climate change mitigation and adaptation (City of Cockburn, 2019).

In addition to their participation in the Low Carbon Schools Pilot Program (LCSPP), Hill PS participates in several different programs that target waste, water and sustainable transport. The LCSPP acts as the umbrella program under which other programs fall. They have a Low Carbon Committee comprised of the principal and four teachers that lead the different sustainability programs. Each of these programs have a student team component, with an overarching student Green Team that works on broader sustainability and carbon reduction at the school.

The Principal, a teacher and the school Canteen Manager – who were all on the Low Carbon Committee – were interviewed, and six students who were involved with the school's student Green Team also participated in a focus group to better understand the school's carbon reduction journey.

6.2.2 Low Carbon Committee

6.2.2.1 *Lee - Principal*

Lee has been the Principal at Hill PS since 2006. He plays an active role in advancing sustainability at the school and provided support to teachers and staff members implementing sustainability initiatives at the school.

6.2.2.2 *Freya – Teacher*

Freya is a teacher at the school and started in 2011. She started leading the school's TravelSmart program a few years after she started teaching at Hill PS and then joined the Low Carbon Committee when the school joined the LCSPP.

6.2.2.3 *Asha – Canteen Manager*

Asha has managed the canteen since 2000 and works part-time. She actively works to reduce waste in the canteen while providing healthy food options that utilise the school's garden. She was also a primary school teacher for many years and her own children attend Hill PS.

6.2.3 The Beginning: Fixing 28 Gas Leaks

Investigating the school's consumption and reducing carbon emissions first started for Hill PS when a secondary school in their local area started the process to become carbon neutral. The secondary school held meetings with their local “feeder” primary schools to share their knowledge about sustainability and help them implement initiatives in their own schools. During one of these meetings in 2009, Principal Lee compared his school’s gas bills with the other primary schools.

> *“... I can remember sitting in the staff room at Bakersfield Primary and somebody looked across my gas bill and...one of the [other] principals, and went, ‘Wow. My school's bigger than yours and mine's a third of yours.’ I didn't know, because we never compared notes.” – HPS Principal (Lee, interview, 25 March 2018)*

Realising that their gas consumption might be unusually high prompted Principal Lee to investigate. He contacted Building Management Works (BMW), the WA state agency which manages and maintains all the government-owned buildings, to have someone come and check the school for gas leaks.

> *“So, I actually brought in BMW to do a survey, and there were 28 gas leaks in my system. And they spent tens of thousands of dollars fixing it all up and now my gas is normal again.” – HPS Principal (Lee, interview, 25 March 2018)*

Principal Lee estimates that the school saved approximately $10,000 over the course of a year from fixing these gas leaks. However, while the school saw first-hand the tremendous benefit of investigating their resource consumption, Principal Lee said that carbon reduction became less of a focus for the school for the years following. However, when he learned about the LCSPP in 2015, he saw the opportunity to address this again.

> *“When LCSPP came along, I just thought that was a good reason to re-invent ourselves a little bit.” – HPS Principal (Lee, interview, 25 March 2018)*

Key Finding 6-1: Comparing utility consumption with another school helped the school realise their consumption was too high and prompted further investigation. This led to maintenance and repairs, which reduced costs.

6.2.4 Aligning with Community Values

Hill PS resides in a community that is known for its culture of sustainability and many of the school's parents are sustainability-minded.

> *"We're [a] mung bean. You know? They're interested…There's lots of community stuff around here that's just along the lines of sustainable practice." – HPS Principal (Lee, interview, 25 March 2018)*

This community of sustainability means parents are very supportive of the school's low carbon initiatives. Principal Lee talked about an example of when two of the teachers from the Low Carbon Committee presented at a P&C meeting and they had huge success in getting buy-in from parents, with half of the parents in the room volunteering to help.

> *"[They] did a…presentation, said 'We'd like to get a parent group to help support the school's Low Carbon image...' Yeah, six [volunteered]…There were only 12 people in there." – HPS Principal (Lee, interview, 25 March 2018)*

The school also receives support from parents in other ways. One of the parents of a student at the school is an Australian renowned environmentalist and gardener. Every year he hosts an open event at his house where all gold coin donations are given to the school (approximately $1,000).

When it comes to school carbon reduction specifically, Principal Lee sees it as a way to participate in the values of their community. He thought if they were not pursuing sustainability on some level, the community would notice.

> *"So, we're kind of aligning with our community, if you like. That is a value that our community holds, and we know it…I think our community would be unimpressed if our school was deliberately and overtly not sustainable for fun. You know? That wouldn't be what our community would want to see. I think they'd speak up." – HPS Principal (Lee, interview, 25 March 2018)*

Key Finding 6-2: The school pursuing sustainability is a way of aligning with community values.

Principal Lee also said he saw one of the school's responsibilities as helping to reduce the carbon and environmental footprint of the community through educating their students about environmental issues.

> *"So, I think our job is most important with the younger kids...You can't get a four year old in kindy and talk to them about sustainability. But, you can talk to them about the really tiny little things...and you can just quietly build that student each year."– HPS Principal (Lee, interview, 25 March 2018)*

Asha, the Canteen Manager, also saw the potential for the school to be even more involved with the community through their low carbon initiatives.

> *"I think it's a great opportunity to reach the community. It definitely boosts our brand as a school, and an attraction of the school if it has a particular bent, whether that be science and technology or sustainability." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Freya, a teacher, saw the school potentially playing a larger role in the community through initiatives such as offering on campus recycling and informing the community in other ways, such as workshops. While Freya thought there is potential for the community to be more involved in these ways, she agreed with Principal Lee and believed the bigger opportunity, and the responsibility of the school, lies in educating the students and encouraging them to take that knowledge home.

> *"...I think most importantly is educating the kids and hoping or encouraging and finding ways for them to take that home and teach their family about it." – HPS Teacher (Freya, interview, 25 March 2018)*

On a personal level, Principal Lee believed integrating sustainability into the school was fundamentally important. He highlighted that while sustainability is not *the* focus of schools, it is still important to integrate it throughout all aspects of the school.

> *"It's the right thing to do. That's me personally leading the school. It's not all-encompassing, it's not the be-all, end-all. Reading is still more important, but if you can drive reading through a sustainability focus...It's the right thing to do for the kids of the future." – HPS Principal (Lee, interview, 25 March 2018)*

6.2.5 A Whole-School Approach

In addition to a focus on community values, Hill PS strives to integrate a whole-school approach to carbon reduction at the school-level and used the LCSPP as an umbrella program overarching all the school's sustainability efforts. There is a Low Carbon Committee that brings together all the components of sustainability and it is primarily comprised of four highly passionate teachers who are each responsible for a different area of sustainability, such as water, waste and transport.

The Low Carbon Committee meets regularly to discuss the sustainability areas they each work on, as well as the broader low carbon goals for the school. They also work closely with the P&C Committee and the Canteen to ensure everyone at the school is on the same page with low carbon initiatives. Asha, the Canteen Manager, says she has a lot of communication with the Committee and stays up to date with overarching sustainability goals.

The Principal and the teachers on the Committee noted that they often do not have much difficulty getting other staff involved in initiatives, which is indicative of school culture and their ability to bring other people on board.

> *"…they're well respected...So, you know, people listen to them. And they will pick up and run with their initiatives A: because they're right. You know, I don't think you can argue that the values are correct. But B: [they] do it well. They understand the teachers. They understand teacher workload, so they can minimise it to bring people on board." – HPS Principal (Lee, interview, 25 March 2018)*

Within each of the sustainability programs that the school runs (Waterwise, Waste Wise, TravelSmart and LCSPP), there is a group of students that help work on initiatives. The student sustainability groups are very popular in the schools, with a lot of interest from students wanting to participate.

> *"We had to rotate the kids' committees, because we had too many kids that wanted to be on the committees." – HPS Principal (Lee, interview, 25 March 2018)*

Principal Lee also explained how the school tries to increase the students' understanding of sustainability as they get older. They start with basic concepts in kindergarten and as they get older, they provide opportunities to do more advanced activities, like exploring school waste consumption.

> *"...our little kids don't understand what happens or the theory behind it, but they understand that you can put different rubbish in different bins. That's a good starting point." – HPS Principal (Lee, interview, 25 March 2018)*

Principal Lee said he had also noticed changes in school staff attitudes towards sustainability since the school started their carbon reduction journey.

> *"I think the staff, generally, are more savvy about how we can save the planet, you know?...it's filtered right throughout the whole school." – HPS Principal (Lee, interview, 25 March 2018)*

6.2.6 A Green Canteen

Hill PS has a canteen that is very active in addressing sustainability at the school and has made big strides in implementing sustainability initiatives. Asha has run the canteen since 2010 and is employed by the P&C Committee. She brings her own personal knowledge about waste minimisation from her home life with her, as well as her unique set of skills and previous experiences as a teacher to the role. She had worked to integrate low carbon initiatives and sustainability messages as much as possible in the canteen.

> *"I'm a parent of kids at this school and I work here, but I'm employed by the P&C, not the school. I've got a lot of different hats and I can see I'm in a unique position. I get to see a lot of what the school wants to do and how they want to approach things, and then I'm in a really unique position to actually implement it through the canteen." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

The school has a sizeable garden where they grow a range of fruits and vegetables. The teachers typically take turns each semester working in the garden with their students and Asha used to liaise with these teachers to grow food in the garden for the canteen, which helped students understand the process of food production.

> *"...they'd ask "what do you want in the canteen?", we'd say "lettuce", and so they'd plant a big crop of lettuce. Then I would pay them back in seeds. "Okay, well that would cost this much money. This is how much money I would spend at the shops to buy this lettuce. Here's that much worth of seeds to go plant*

> *something again." The kids in the pre-primary could see, "we do this work, this grows, Asha uses it in the canteen, we all eat it"." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Asha sees the potential to utilise the garden more fully for the canteen, though to do this would require more time and energy to increase the productivity of the garden. There is a possibility of incorporating the garden more into the curriculum. However, the school was not able to qualify for programs that help provide lesson plans in this area, such as the Stephanie Alexander Kitchen Program.

Waste is a big focus of the canteen and, in 2017, they began exploring ways to introduce more reusable cutlery and containers for the students to use. However, introducing reusables is not always straightforward, and there were many things they had to consider with these decisions.

> *"It's tricky, because serving soups and milos in cups, we need to make sure that the kids don't have any risk of burning themselves…because they are such great thermal containers, the food stays hotter." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Asha mentioned that managing risks, such as hot cups, is challenging because there are not enough teachers to monitor students at lunchtime. When they tried to implement reusable cutlery, they encountered issues with most students forgetting to return the cutlery. For their summer menu, they bought second-hand reusable spoons for students to eat their yogurt and fruit salad with and, by the end of the summer, they had no spoons left because students forgot to return them or threw them away. Asha thought this was primarily due to the increase in student numbers and not enough education for the new students about the procedure.

However, despite this initial challenge, the canteen wanted to try reusable forks again for winter meals. Asha thought that with enough education and announcements, they could get everyone to return the reusable cutlery. She said that getting the teachers to help spread the message about what to do helps.

> *"I think having more than one person telling you this is the process works really well. We've got our sustainability committee, they do run-throughs every so often of which bin do you put which packaging in, and they use the stuff from the*

> *canteen so they can see, you just had sushi in this box, it goes here." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Recycling at the school has also been challenging because of the different recycling systems students are used to. The students that attend Hill PS live in two council areas, with both having different recycling systems. This can make it difficult for the school to implement recycling systems that all students understand.

> *"Yeah, because some kids go, "you can't recycle that at my house", "you can recycle that at my house", and they're both in the same class, but they come in from different sides of the street and they've got different councils." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

To simplify things for students around recycling, the canteen introduced compostable packaging that could be put in the general rubbish bin, which was successful. Asha mentioned that while they have had some successes, such as with compostable packaging, there were still many disconnects between the sustainable initiatives the canteen wanted to implement and the practicalities of making it work for the students.

> *"We still have single use straws because the kids spill their choc milks all over themselves if they try and drink it any other way. Students don't bring a change of clothes to school anymore, so then the parents get mad." - HPS Canteen Manager (Asha, interview, 25 March 2018)*

The canteen had a large rotation of parents that volunteered and helped with anything from food preparation to serving at lunchtime, with some coming to volunteer only once a year and others multiple times a year. Asha said she noticed that the parents that volunteered in the canteen often took knowledge back home with them about waste minimisation and other sustainable practices the canteen does. However, she said it was harder to know whether students were taking that knowledge home.

> *"We only have one paid staff in the canteen, and the rest of it operates on volunteer parents. I've definitely noticed that the parents take on the message… they see the containers and things that we put in, "oh, I didn't know you could compost that. I didn't know that was recyclable." Yeah, that's been I think a really good thing." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Key Finding 6-3: While the school canteen has high ambitions about waste reduction, the practicalities of implementation can be challenging.

Asha said the canteen adopts a whole-school approach to everything they do, including clean-eating. This integration of the canteen into the broader low carbon initiatives and goals of the school enables a richer integration of the sustainability messages the school is pushing through their various initiatives.

Considering the canteen is also highly profitable, it also plays a role in helping the school through financial support.

> *"…it's a very profitable school canteen. I think part of that is because we are so ingrained in that whole school approach…Any money that we do raise above what we need to cover costs and things goes back to the P&C, which goes back to the school. It's all for the school." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Key Finding: The involvement of the canteen provides a holistic approach to the sustainability messaging the school teaches students.

6.2.7 Hill PS's Low Carbon Initiatives

During the LCSPP, which ran from 2016 to 2017, the school pursued a wide range of low carbon initiatives. They had a total of 21 actions listed on their low carbon action plan, which is nearly half the average number of actions taken by other schools in the LCSPP. In the interviews with the Low Carbon Committee at Hill PS, there were discussions about initiatives taking place at the school that were not listed on their action plan, indicating the plan was not always updated. Unlike the rest of the schools in the LCSPP whose action plans focussed primarily on energy then waste, the largest category of Hill PS's initiatives were focussed on water (34%), with waste and energy forming the second largest categories (25%). Hill PS's focus on water was due to their high water consumption. Investigations to decrease their water usage including identifying potential leaks. Figure 35 shows a breakdown of their actions by emissions category in comparison to all schools.

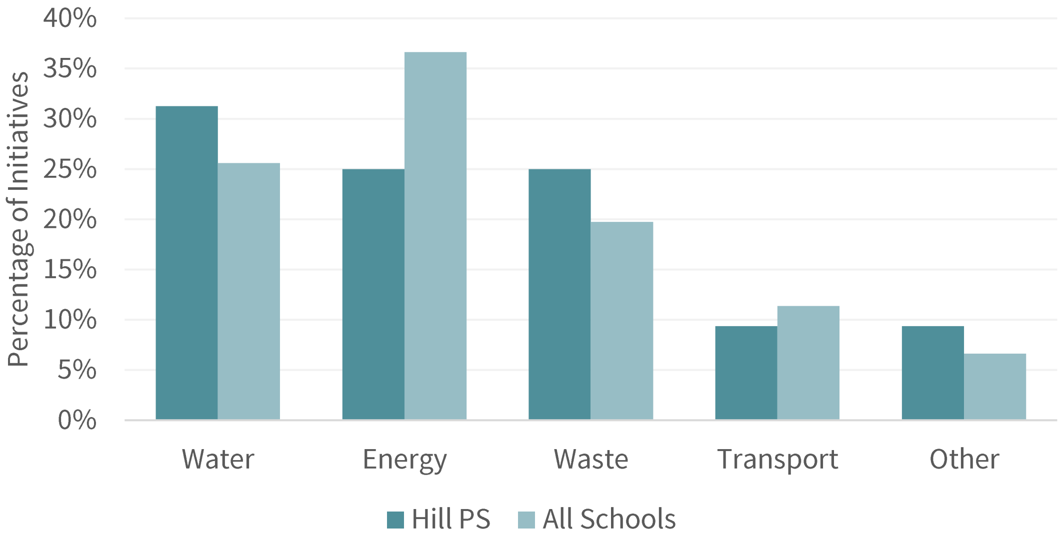


Figure 35: Hill PS percentage of actions by emissions category in comparison to the percentage of actions for all LCSPP schools.

Nearly half of the actions the school listed on their plan had a large focus on infrastructure upgrades, which was higher than the rest of the LCSPP schools (see Figure 36). Initiatives in this category included installing tap timers, light timers and compost bins. However, only about half of the initiatives in the infrastructure category were going ahead due to financial constraints. Around 20% of their actions focussed on changing the behaviours of staff and/or students to be more sustainable, such as reminders to turn off lights when leaving a room. A few actions specifically focussed on educational activities, like creating an activity to teach students about water consumption by checking the water meter.

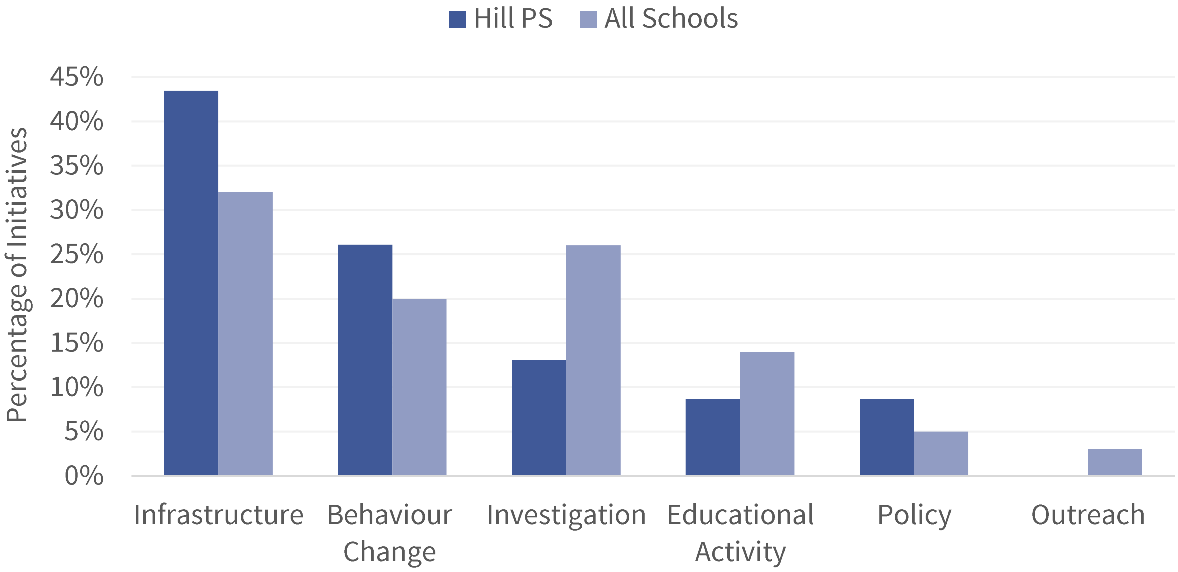


Figure 36: Hill PS percentage of types of initiatives compared with the percentages of type of actions across all schools.

Examples of the types of actions that Hill PS completed or were ongoing are shown in Table E9. The school had a small budget for low carbon initiatives which started in 2017. However, the budget was not big enough to fund building retrofits. It was available on an ad-hoc basis for the Low Carbon Committee if they needed to buy sustainability-related resources for classrooms or the library.

6.2.7.1 *Energy*

The school approached energy primarily through behaviour change initiatives, such as students making signs to remind people to turn off lights in classrooms, toilets and other communal areas. Based on one of the recommendations from the LCSPP, they also had students go around the school to count the number of security lights that could be transitioned to LED. However, the school did not proceed with replacing security lights with LEDs because of high associated costs. In 2016, however, construction took place in the staff room and during this time, internal LED light panels were installed. Shortly after construction was finished, the Low Carbon Committee also installed a timer on the hot water urn in the staffroom to save energy. Principal Lee is a personal fan of LEDs and explained how both his home and boat have LEDs. He said he would like to see LED lights all throughout the school and would like to implement other larger initiatives, but the high upfront cost is prohibitive. He sought the assistance of the Department of Education and Building Management Works (which oversees government buildings) to identify alternative funding arrangements for

LEDs. However, due to their policies, he was unable to sign any sort of leasing or funding arrangement to get LEDs installed throughout the school. The school is therefore currently not pursuing any additional LEDs lights because of these policy and financial barriers.

For similar reasons (i.e. procurement and financing), solar PV were also not being pursued at Hill PS at the time of the research. However, Principal Lee hoped that through small actions, the school could slowly save enough money to pursue bigger initiatives like solar and LED lights.

> *"So, I really want to but can't put in the timers or…put in taps in all the toilets. It's too expensive. 7.5 thousand bucks, and it's like, well, can't help. So, I'll do something else…by bringing the power bill down. If I could use that money, if I could do that with the spring taps, then I'd bring my water consumption down. Then I can use that money to [do] something else. And eventually…eventually, I'll get LEDs through my whole school." – HPS Principal (Lee, interview, 25 March 2018)*

6.2.7.2 *Water & Waste*

The school was an active member of the Waterwise program and one teacher regularly organised incursions and activities for the students. The school had participated in events such as International Water Day, and they had experienced success at the school with buy-in from all staff. The school collected rain water in large tanks that they used to water the garden beds and most of their toilets flushed with reclaimed water; a set-up the school implemented several years prior to the start of the LCSPP.

Infrastructure-wise, the school also wanted to install push taps on all their water taps in the bathroom, but the quote they received from a contractor totalled approximately $7,000, which was too costly for them to pursue. They want to pursue switching the taps, but this was unlikely to proceed until the school had the funds to do so.

Waste is also an area the school focusses on, particularly because each year, the school generates more waste costs than the Department of Education gives them money for. Principal Lee said that the school was slowly getting better at managing their waste, and he has large financial, as well as moral, incentives to reduce their waste.

> *"The department don't care. That's my job. My job is to care. Well, I care. I care that I don't want to generate more waste than [necessary], because I have an*

> *aversion to landfill… But also, I'll keep the money that we save and I'll use it for something far better than having a centre bin." – HPS Principal (Lee, interview, 25 March 2018)*

The school has a teacher that leads their Waste Wise initiatives and a Worm Warriors team, which is a group of students who collect all the fruit scraps at recess/lunch and deliver them to the worm farm. During the LCSPP they also installed a worm farm made of an old refrigerator.

In addition to the waste minimisation efforts made by the canteen and addressing organic waste through composting, the school was also trying to the address the large amount of paper waste they generate. To address paper wastage, the school implemented a system of collecting misprints to use again on the opposite side of the paper and late note slips were collected and reused where possible. They also engaged students to make notebooks with some of the misprinted paper.

6.2.8 Utility Consumption & Cost

In 2017, Hill PS had 276 students, which was a 13% increase in student numbers since 2015. The school occupies a land area of approximately 16,964 m^2, 27% of which are buildings, and the rest are grassy areas and garden spaces that the school maintains. They have the second highest amount of green space relative to their buildings than other schools in the LCSPP and an average amount of building square metres compared to the other primary schools with similar student numbers. Hill PS had no change in total square metres or any major infrastructure changes while they participated in the LCSPP. Overall, the school achieved a reduction in utility costs of $42 per student, which is higher than the average cost reduction across all schools (as discussed in Chapter 4). They also had a reduction in total utility consumption per student, which is further discussed below.

6.2.8.1 *Energy*

Between the final year of the LCSPP (2017) and their baseline year (2015), Hill PS's total electricity consumption decreased by 15% and showed an overall downward trend in usage, as shown in Figure 37. The school also successfully reduced their total average electricity consumption during all school holiday periods at an average of 18%, shown in Figure 38. Their largest reduction occurred during the October holiday period where they reduced their consumption by 23%. While the school did not specifically list a switch off protocol on their action plan, they did focus on behaviour change initiatives, such as posters, to remind staff to turn off lights and appliances and reminders at assemblies to turn off electronics when not in use. Their reduction in consumption indicates these behaviour change initiatives were successful.

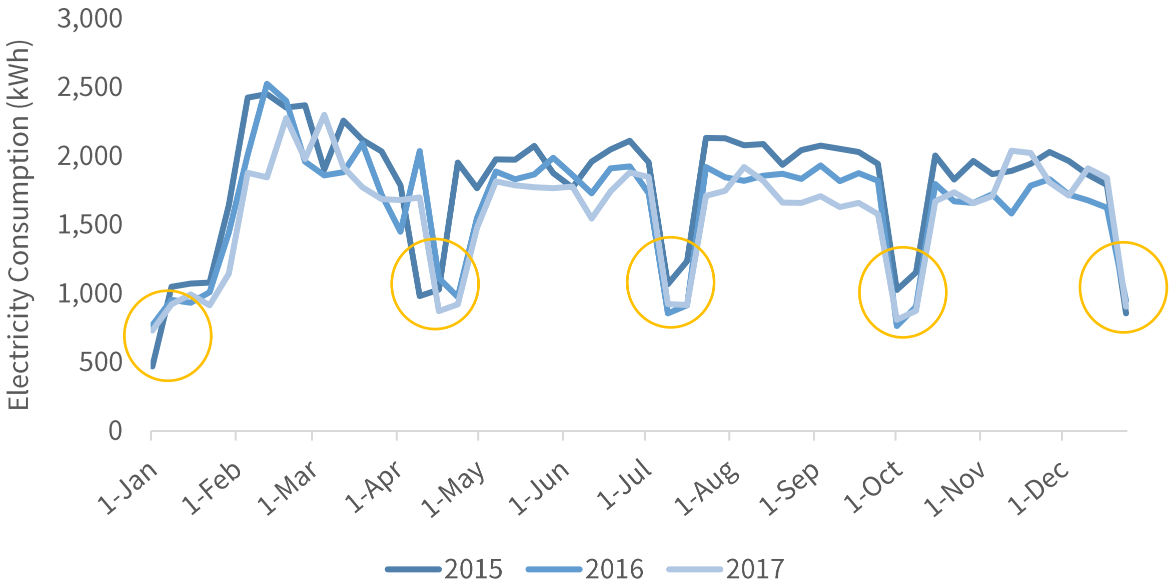


Figure 37: Hill PS total weekly electricity consumption (kWh) with school holiday periods circled in yellow (2015 - 2017).

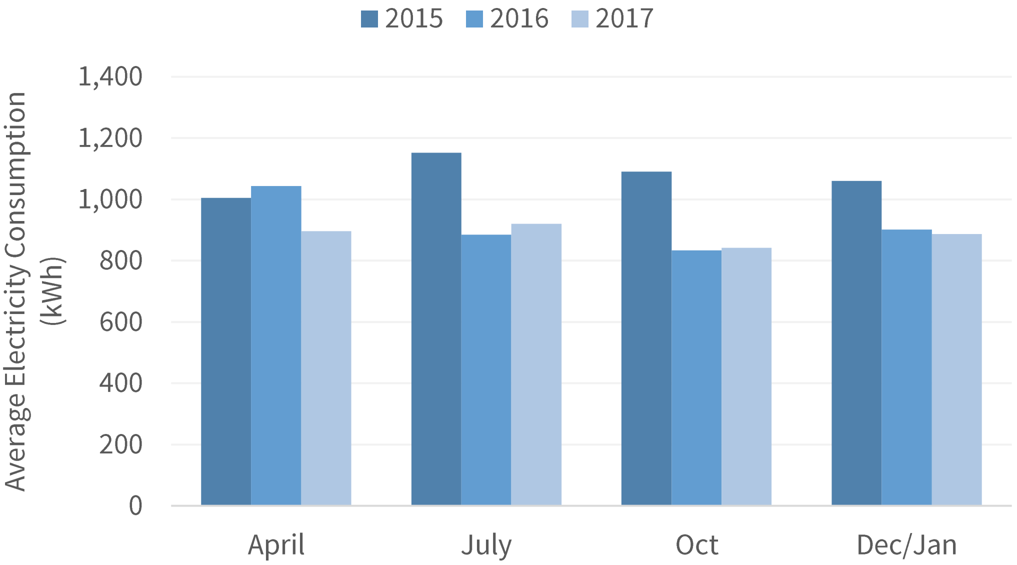


Figure 38: Hill PS average total electricity consumption (kWh) for each school holiday period between 2015 and 2017.

Per student, Hill PS saw a 25% decrease in both electricity consumption and cost between 2015 and 2017, as highlighted in Table 21. This reduction in electricity cost per student represented a $20 per student cost savings. However, between 2016 and 2017, the school's electricity cost per student **increased** despite **decreasing** in electricity consumption per student for the same period. As mentioned in Chapter 4, this was due to the over 20% increase in cost per kWh that the electricity provider implemented for the school in July 2017. In comparison, the school only saw a 2% increase in cost per kWh in the previous year (2015 & 2016) due to smaller increases in cost per kilowatt hour imposed by the energy retailer.

Total gas consumption for Hill PS experienced a minor increase (0.5%) between 2015 and 2017, while per student, gas consumption and cost both decreased by 11%, as shown in Figure 39. However, despite the school fixing many gas leaks throughout the years, Principal Lee said the school still struggled with keeping their gas consumption low.

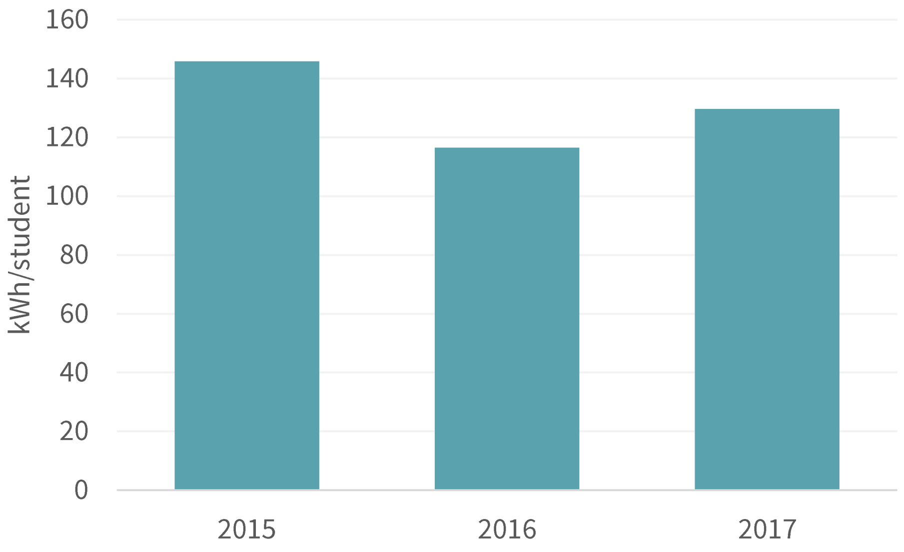


Figure 39: Hill PS gas consumption per student (kWh/student) (2015 – 2017).

6.2.8.1.1 Water

Water consumption per student had the largest decrease of the utilities at Hill PS, shown in Figure 40. The biggest decrease in consumption was observed between December and January, some of the hottest months of the year. This decline shows the success of some of the school's water savings initiatives during this time. It may also indicate there may have been a water leak, or sprinklers left on unnecessarily, for example, in early 2015 that was subsequently addressed. In July 2017, an increase is observed, with the following billing periods also demonstrating slightly higher consumption than in the previous year. It is possible that this is indicative of a small water leak. However, the school could not confirm this.

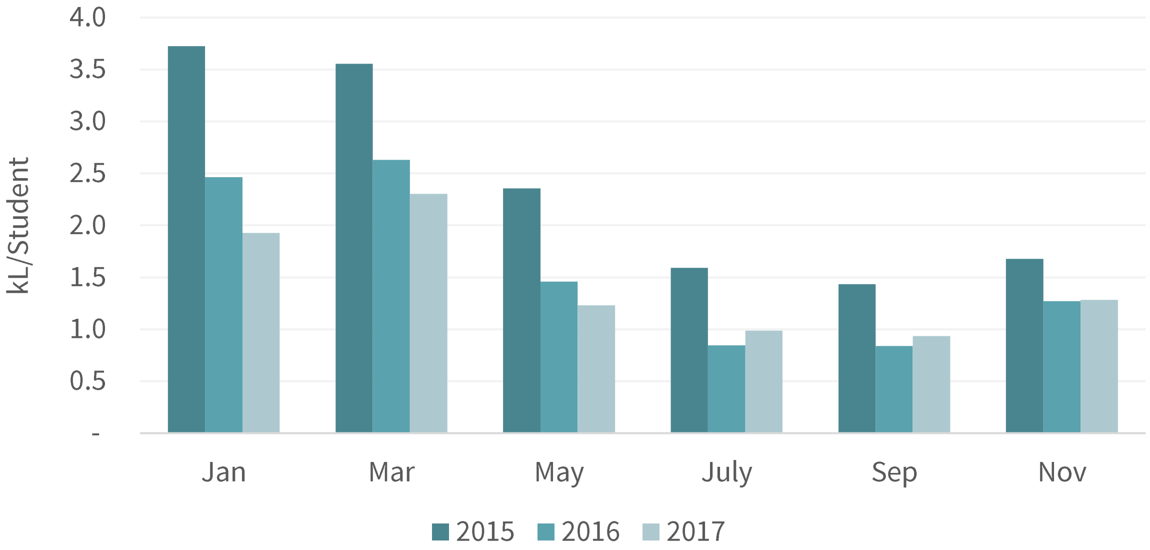


Figure 40: Hill PS water consumption per student (2015 - 2017).

In his interview, Principal Lee said he believed that their water consumption is still high compared to similarly sized schools. To test this, the school turned off their water metre at 6pm on a Thursday then turned it back on at 6am the following morning. Over this period of time, they used 3,000 litres of water. To their knowledge, there was nothing that could have contributed to water consumption other than an underground leak. Other sources have also indicated that the water meter could be reading incorrectly because it is located underneath a power line, which can allegedly interfere with the meter readings. The Water Corporation did not believe that there were any leaks or errors with the metre, however Principal Lee said the school will continue to investigate their water consumption (Lee, phone interview, 29 November 2018). Water cost also decreased, however it only decreased by 10% despite a decrease in consumption by 36% (see Table 21) due to the fixed costs the school is charged for each toilet and urinal at the school.

Table 21: Hill PS utility consumption and costs (electricity, gas and water) on a per student basis from 2015 to 2017.

Utility	Metric	2015	2016	2017	Number Difference (2015/2017)	Percentage Difference (2015/2017)
Electricity	Consumption *(kWh/student)*	385	326	290	-95	-25%
	Cost *($/student)*	$110.78	$77.30	$81.50	-$29.29	-26%
Gas	Consumption *(kWh/student)*	146	117	130	-16	-11%
	Cost *($/student)*	$19.02	$14.84	$17.01	-$2.02	-11%
Water	Consumption *(kL/student)*	13	9	9	-5	-36%
	Cost *($/student)*	$109.83	$96.64	$98.31	-$11.52	-10%
Total Utility Cost	*($/student)*	$239.64	$188.79	$196.81	-$42.83	-18%

6.2.9 Carbon Emissions

Hill PS saw the third largest decrease in carbon emissions per student (29%) out of all the LCSPP schools. This significant reduction was due largely to their significant reductions in electricity and water consumption during the program. Even across all other metrics (total and per square metre in addition to per student), carbon emissions decreased by at least 20% (see Table 22). Electricity was overwhelmingly the largest contributor to carbon emissions (95%) and therefore even a small reduction in electricity consumption had a larger impact on emissions than water or gas.

Table 22: Hill PS total carbon emissions (tCO_2-e) on a total, per student and per square metre basis for 2015, 2016 and 2017. The percentage difference between 2015 and 2017 is also shown.

Measurement	2015	2016	2017	Percentage Difference (2015/2017)
tCO_2-e (total)	88.9	76.64	70.75	-20%
tCO_2-e/student	.364	.291	.256	-29.6%
tCO_2-e/m^2	.020	.017	.016	-20%

6.2.10 Student Action & Influence

The student focus group was held with six students participating in the student Green Team in grades 3 and 4. When students were asked about how young people could act on climate change, they had several ideas, with most of them focussing on how they could influence other people to act more sustainably. Several students talked about educating others through speaking, the use of technology or other creative methods.

Max talked about reminding other students not to litter and to conserve water at school events. Another student, Ash, also had ideas about what they could do to raise more awareness of how litter affects animals. Other students talked about how to encourage students to use the existing bins correctly, such as presenting a PowerPoint to classrooms.

> *"…if someone drops litter or chucks it on the floor, maybe pick it up or give them a reminder, if it's someone that you know…Maybe we could give the whole entire school a gentle reminder at every assembly and show them what to recycle and what not to. – HPS Student (Max, focus group, 25 March 2018)*

> *"You could do photo impact. And you could also do fact impact on the school, so then you could show photos of turtles with the milk [rings] around their shells." – HPS Student (Ash, focus group, 25 March 2018)*

> *"We make a PowerPoint and go around to all the classes and demonstrate, present it to all of them." – HPS Student (Avi, focus group, 25 March 2018)*

Max also talked about the changes happening in the canteen, showing he was aware of the sustainability initiatives the canteen was pursuing.

> *And the canteen's also changing, cause they're not gonna buy any more plastic forks, they're gonna use the normal metal spoons. And also they're banning straws." – HPS Student (Max, focus group, 25 March 2018)*

When the students were further prompted about how they could act on climate change as young people, the students discussed ways the school could be more sustainable. The topics students mentioned were all areas that Hill PS's low carbon action plan targeted, showing a level of continuity between the initiatives the teachers were pushing and the participation of the students.

> *"What we should do with the taps, we should have those push on, so [students] don't forget and they easily just shut off by themselves."- HPS Student (Avi, focus group, 25 March 2018)*
>
> *"More bins. Different types of bins. Or maybe like the leaders or the different committees go at the end of the week and sort it into paper that's dry, hard plastic, soft plastic, glass, etc." – HPS Student (Max, focus group, 25 March 2018)*
>
> *"Also, possibly use less energy, cause this school has solar PV." – HPS Student (Frankie, focus group, 25 March 2018)*

On a broader level, one student, Ash, talked about the importance of educating the next generations about climate change, demonstrating awareness of the importance of education and empowering others to act.

> *"…well the new generation help the future by educating them and telling them what possibly could happen in the future, but you could change it to make it a positive outcome." – HPS Student (Ash, focus group, 25 March 2018)*

6.2.10.1 *Peer & Community Influence*

Half the students said they talked to their friends about low carbon topics or things they learned from the Green Team.

> *"My friends in the Green Team, we sort of talk about it sometimes. What we do and stuff." – HPS Student (Ray, focus group, 25 March 2018)*

Two students explained that they did not often talk to their friends about low carbon topics because they were preoccupied, or their friends already knew about it.

> *"Not a lot cause my two friends are in the Green Team." – HPS Student (Frankie, focus group, 25 March 2018)*

> *"I'm too busy playing." – HPS Student (Avi, focus group, 25 March 2018)*

Another student thought his friends would listen, but he did not see a reason to bring it up unless they acted in an unsustainable way.

> *"They'll definitely listen, it's just, there's no real reason for bringing it up. Unless they leave the tap running." – HPS Student (Avi, focus group, 25 March 2018)*

Students also talked about encouraging others to use the bins correctly, and Max said he monitored the bins at lunch to ensure waste was put in the correct bin.

> *"What I do is basically nearly every lunch, I go to the bins before the bell goes and I tell them which bin to put it in, cause they usually put the recycling in the normal bin and normal bin stuff in the recycling." – HPS Student (Max, focus group, 25 March 2018)*

When the students were asked if they talked to their wider community about low carbon topics, two students said they talked to their community.

> *"Like my neighbour? Kinda." – HPS Student (Frankie, focus group, 25 March 2018)*

> *"I talk to my community, cause I talk to the school and that is my community. And I talked to them and told them which one goes into the recycling bin and which one doesn't, and that Asha is gonna change the canteen routines and all that." – HPS Student (Ray, focus group, 25 March 2018)*

6.2.10.2 *Intergenerational Influence*

All except one student in the focus group said they had talked to their family members about low carbon topics in some way. The student who said she did not talk to her family about low carbon living said she did not because they already knew a lot about sustainability. Two students mentioned examples of how they talk to their siblings at home about not being wasteful.

> *"Sometimes. Not all the time. But I mostly tell my sister. Cause she doesn't really know that much…she plays with dolls and wets lots of things and wastes the water."– HPS Student (Frankie, focus group, 25 March 2018)*

> *"...sometimes my little brother can't reach the tap. So he needs me to help... I make absolute sure that the tap isn't dripping. I check both of them. – HPS Student (Max, focus group, 25 March 2018)*

Most of the students described how they talk to their family members about low carbon topics via conversation. One student said she communicates with her family in other ways, such as creating a PowerPoint about a low carbon topic and presenting it to her family.

> *"Yeah, I have conversations with them. I sometimes will build a PowerPoint and just present it to my family. And pretend that they're a younger age and [my stepfather] always tells these random younger age jokes and all that." – HPS Student (Ray, focus group, 25 March 2018)*

6.2.10.3 *Parent Survey Results*

To gain additional insight into if and how students were taking low carbon living knowledge back home to their parents, the parents at Hill PS were surveyed. A total of 39 parents responded to the survey, the second highest number of responses out of all the schools. Just under half said they were aware of the low carbon initiatives that Hill PS was pursuing, however none of the schools specifically mentioned the LCSPP or school carbon emissions. Most of the parents (71%) knew about an initiative relating to waste (e.g. composting, worm farms, plastic reduction, waste-free lunchboxes) and three parents specifically mentioned waste reduction efforts in the canteen, demonstrating the canteen messages were successfully reaching parents. Most parents found out about the school's initiatives through the school newsletter, another parent or their child.

Across the main four questions measuring intergenerational influence, the largest responses from parents were those saying they noticed changes in their child's attitudes or behaviour around low carbon living. Almost half of parents reported that they noticed changes in their child's LCL attitudes and/or behaviour, which is twice as many parents than the average across the rest of the schools. The vast majority said their child's change in behaviour was because of school, with most saying their child changed their behaviour because of what they learned in class. The reported changes in behaviour and parents attributing this change to the school was notably higher (10%) than the rest of the LCSPP schools. The types of behaviours that parents described in their children ranged from encouraging other family members to be more sustainable, to sorting rubbish and turning off lights (see Table E6 for all responses).

Nearly half of parents said their child discussed low carbon living topics with them and, unlike most of the other schools that participated in the LCSPP, several students at Hill PS specifically talked about climate change or carbon reduction. They also talked about topics that were identified across all school parent surveys, such as leaving the tap running, turning off lights, reducing their carbon footprint and using less plastic, as can be seen in Table E5.

When it came to the household, about a quarter of parents said their child caused their household to adopt new LCL practices, which was similar to what was observed across all schools. Most of the examples parents gave were similar to the changes they described in their child's behaviour, such as encouraging others to turn off the taps whilst brushing teeth and increasing recycling. In addition, five parents also reported their own personal LCL attitude or behaviour changed because of their child's influence.

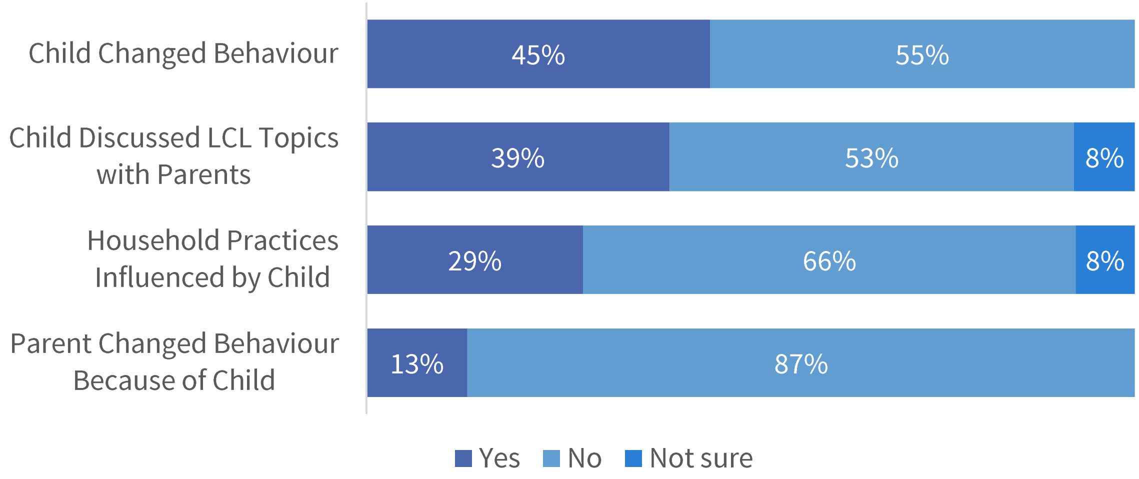


Figure 41: Hill PS parent survey responses to each of the intergenerational influence survey questions.

The results from Hill PS's parent survey measuring readiness to transition to low carbon living showed that they had the same average LCRI score compared to parents at all 10 participating schools (3.7). Across the intergenerational influence questions, Hill PS was below average when it came to the percentage of parents that said their child spoke with them about LCL topics and whether their child influenced household practices. However, they were slightly above average with the amount of children that changed their LCL attitudes/behaviour. This could be an indicator of Hill PS's whole school approach to sustainability, showing that sustainability messages are successfully influencing students.

When correlations were calculated between each intergenerational influence question, it showed there were not any significant differences in the correlation coefficients between each of the variables compared to the results from all school survey responses. However, there was a slightly stronger relationship for Hill PS between students discussing LCL topics with the parents and parents reporting a change in their own attitude or behaviour because of their child's influence. This could suggest that parents at Hill PS may be more willing to change their own attitudes or behaviour based on discussions they have with their child, further indicating the sustainability mindset within Hill PS's community.

6.2.11 Challenges

To understand the broader picture of Hill PS's carbon reduction journey, the Low Carbon Committee was also asked to share some of the major barriers and challenges they have encountered. Some of the major inhibitors for low carbon initiatives they discussed primarily involved the inability to access funding, a lack of time and overloaded staff members.

Even with a passionate and dedicated Low Carbon Committee, the lack of time to implement initiatives is a major recurring issue for the school. Principal Lee said he does his best to provide teachers with as much time as possible to work on initiatives within the constraints of the budget.

> *"Time. Because time is money, really. So, every teacher I release is $551 out of my budget. I release them a fair bit, because we think it's important. And they work very hard, those girls. So, therefore, the payback is - I try and buy them some time out." – HPS Principal (Lee, interview, 25 March 2018)*

However, while the Principal endeavoured to provide staff with additional paid time to work on low carbon initiatives, he said he also had to consider how much time each teacher was already committing to the school so that they did not get overloaded with too many responsibilities. He highlighted that the staff were already stretched thin in terms of time and responsibilities because the school continued to grow in student numbers.

Freya also mentioned that while the staff and teachers at Hill PS were generally highly supportive of initiatives, it could be hard for them to carve out time in their day to help with these. To address this, the school was working on integrating sustainability even more into the curriculum. She said they were always on the lookout for lesson plans, lesson ideas, excursions and incursions that they could slot easily into their classrooms.

> *"They need to be motivated to be a part of it too, which a lot of them are, but yeah, again, it's another thing on top of what they're already doing. So this year, we're really looking at integrating sustainability into the curriculum and how we can help people to do that, teachers to do that. So hopefully that will help in that area." – HPS Teacher (Freya, interview, 25 March 2018)*

Some initiatives that had not gained as much traction in the past included some previous Wastewise initiatives. Freya did not think these initiatives were unsuccessful. Rather, she saw the situation with waste as one that was a learning experience, where the school now knew how to approach it differently and were having success with their new approach.

> *"Yeah well, it didn't really work. It allowed us to make it better in a different way and, hopefully, it seems to be working well right now, I think. So, hopefully it keeps doing that." – HPS Teacher (Freya, interview, 25 March 2018)*

From the perspective of the canteen, Asha, the Canteen Manager, noted issues related to waste when it came to recycling at the school due to the different councils that students live in, and what rules students are used to, as well as getting students to return reusable cutlery and not throw it away. With each of these challenges, however, the school was working on alternative solutions, such as campaigns to educate students about the bins and compostable cutlery until students got into the habit of returning reusables.

The school also wanted to pursue larger retrofitting initiatives, such as LEDs and push taps. However, they had encountered several policy-related barriers in this area. Principal Lee said the Department of Education did not see a significant cost benefit in upgrading all of the lighting to LED as the school's current lights were not the most inefficient ones.

> *"They don't see sufficient bang for your buck. Because they're going, 'You got fluoro's.' And that's a fair comment. I understand that. They only see a medium cost benefit, not a high." – HPS Principal (Lee, interview, 25 March 2018)*

Another challenge for the school in trying to pursue infrastructure upgrades was a lack of upfront capital and no access to alternative funding opportunities due to the Education Department's strict procurement and financing policies. This meant that even though the school wanted to, they were unable to fund initiatives like solar PV, LEDs and low-flow taps.

Key Finding 6-4: Government funding models and Department of Education budget constraints prevented the school from pursuing large infrastructure upgrades, such as LED lights, low-flow taps and solar PV.

Lastly, while Hill PS had a tremendous amount of interest and support from the parent community, Freya said they were still struggling to determine how to best utilise that support. They were brainstorming ideas on the best way to get the parents to help, but figuring out how to best include them was challenging.

> *"So as far as how to utilise them, we haven't quite got to that stage…Yeah, and that's sort of on me at the moment, but...I don't know. I find that a little bit intimidating." – HPS Teacher (Freya, interview, 25 March 2018)*

Money, staff time, utilising parent support and navigating the complexities of how to achieve consistent messaging to students were all areas that Hill PS had challenges in. However, the school were committed to addressing these difficulties. Despite these challenges, the school made significant progress and had many successes with their whole-school strategies, which are discussed in the next section.

Key Finding 6-5: While the school has tremendous support from parents, they had difficulty utilising this parent support to help advance their low carbon initiatives.

6.2.12 The Success of HP's Initiatives

It is evident that one of Hill PS's biggest keys to success was their integrated whole-school approach to sustainability and carbon reduction. The school integrated their low carbon initiatives across all areas and were able to get support from parents, staff and students. When the Principal, Teacher and Canteen Manager were asked about what they thought were the biggest contributing factors to the success of the school's initiatives, they cited aspects of the whole-school approach.

> *"We're pretty good at the whole school stuff. Our parent community, on average, are on board with us and want us to do this. Not saying that we're more special*

> *than other schools. And our kids are onboard and want to do it with us." – HPS Principal (Lee, interview, 25 March 2018)*

> *"Yeah, I think it's just our whole school approach. It's at every level…It's just everywhere, the message is everywhere, and I think that that can only be a good thing. I do think actually that it is unique." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Freya thought the participation of the canteen in the school's overarching low carbon initiatives was an important and unique element of the school. Asha, the Canteen Manager, also thought the willingness of the parents to participate and help with initiatives at the school had played a significant role in their success.

> *"Asha has done a really good job. I think there's definitely still ways forward that we can do, but yeah, I think that's something that's been pretty special about our school." – HPS Teacher (Freya, interview, 25 March 2018)*

> *"There's the way that the P&C, in particular, works with the school, whether that be through financial support of projects, grant writing help, just general support of that same message, and support of the different initiatives. That doesn't happen everywhere." – HPS Canteen Manager (Asha, interview, 25 March 2018)*

Along with high interest from parents, the school had great success in getting students involved in their low carbon initiatives, which could be partly explained by the sustainability culture of parents in the intake area.

> *"Lots of motivated kids in the sustainability area, which is really cool. And willing to give up their lunchtimes to be a part of that and also after school for some of them to be a part of that as well". - HPS Teacher (Freya, interview, 25 March 2018)*

The support of other key stakeholders at the school, such as the Business Manager, also helped with their initiatives. Because the Business Manager played an important role at the school, being responsible for collating and paying the school's utility bills, as well as making decisions about cost savings measures for the school, having their support meant initiatives were implemented more smoothly.

Overall, the staff at Hill PS were highly supportive of low carbon initiatives and did not provide any resistance. The school also succeeded in distributing the responsibilities for school-wide carbon reduction and did not rely on a single champion staff member. Instead, the school had a team of staff that worked together, each taking charge of different sustainability areas. Principal Lee described a culture of cohesion in the school and thought part of the reason for this cohesion was the sustainable community that the school sits in, as well as a culture at the school of working together towards common goals and values.

> *"I don't think there's any blockers in the school at all…And they're proactive...everyone helps here. And that's how this school works. But I think that when you've got something that is valuable, and they hold the values, it makes it easier." – HPS Principal (Lee, interview, 25 March 2018)*

Freya agreed that the school had tremendous success with a group of motivated staff the school had working on initiatives, and their ability to utilise everyone's strengths in different areas. She also saw the support of Principal Lee as a critical component, as well as the involvement of students.

> *"I think we're lucky 'cause we have a motivated group of staff for doing that. So then utilising everyone for their strengths and all that, I think was really important. I think having the principal, obviously on the committee is super important. I think getting student involvement has been pretty crucial to the process." – HPS Teacher (Freya, interview, 25 March 2018)*

Principal Lee believed the main drivers for their initiatives boiled down to time, a little bit of money occasionally, coordination by the Low Carbon Committee, and passion from staff driving the initiatives. He stressed how important the leadership from the teachers on the Low Carbon Committee was, and how their passion showed in all areas of the school.

> *"They're just as likely to walk past my office and flick the light off if I've left [it on]. You know, I come back and my office is in darkness." – HPS Principal (Lee, interview, 25 March 2018)*

No one on the Low Carbon Committee believed that any sole initiative was more successful than the rest. Rather, they spoke about the initiatives in a holistic sense, with an emphasis on integration and continuity of the sustainability concepts across the school. This whole-school approach was one of Hill PS's strengths and was also demonstrated by the high level of awareness and interaction the students had about the initiatives being pursued at the school.

Key Finding 6-6: A whole-school approach, where all areas of the school (administration, canteen, curriculum) work towards the same low carbon goals creates cohesion, no resistance from staff and consistency in sustainability messaging for students.

6.2.13 Text Analysis & Emergent Themes

6.2.13.1 *Text Analysis*

Several areas of Hill PS's school plans, newsletters and documents were analysed to understand how the school communicated their low carbon initiatives within the wider community and their low carbon goals. In Hill PS's 2018-2020 school business plan, they stated their commitment to sustainability in their "Partnerships" section where they had the following target and strategy:

- Target: *"Maintain, and continue to develop, partnerships with the broader community"*
- Strategies: *"Implement our Sustainability Action Plan which embraces our community partnerships with ClimateClever, Waste Wise, WaterWise and other member schools, and build on the opportunities these relationships provide" (Hill PS Business Plan 2018-2020)*

In their 2017 annual report, they also made a note under their "Highlights" section about their participation in the Low Carbon School's Pilot Program (LCSPP), as well as updates about their worm farm.

However, while there was mention of their initiatives in their business plan and one of their annual reports, there were no updates on the website. The school newsletters were unable to be accessed, so it is unknown how often the school communicated low carbon initiatives with parents. The school did, however, communicate with parents and community via other online platforms and the school Facebook page.

6.2.13.2 *Emergent Themes Across Participants*

By far the most consistent theme across both the students in the focus group and the Low Carbon Committee members in the interviews was around intergenerational influence.

Students described how they talk to their family members about low carbon topics and the Committee highlighted the potential for students to influence their family in greater ways.

The importance of passionate people and a cohesive team also emerged as themes for Hill PS. When it came to student engagement, there was a significant emphasis on embedding sustainability concepts into the curriculum, in-line with their whole school approach. Table 23 shows a summary of the number of codes for each theme from all school responses (interviews, committee member survey and focus group). Two other themes that emerged were related to interviewees and students saying their own attitudes/behaviour had changed as a result of the school's low carbon initiatives and there was an emphasis on addressing issues with lack of sustainable behaviour change at the school, and addressing this challenge by increasing school awareness and education about sustainability. The interviewees at Hill PS talked most frequently about students at the school with staff/teachers being the second most frequently discussed topic. This is unsurprising as the school focussed heavily on sustainability messaging for students. The participation of the school's staff was also widely discussed amongst Committee members.

During discussions about barriers, "time" and "money" were the third and fourth most commonly mentioned words, with the Principal discussing both issues at length. Money was largely discussed as a barrier and something that was needed, however saving money also surfaced frequently.

The topic of parents also surfaced as the sixth most frequently used word and was spoken about equally across all three interviewees. Discussions about parents was an indicator of strong parent support and the school's focus on community. Waste and recycling also came up in discussion often, with many references made by Asha the Canteen Manager about the ways the school was encouraging students to use the correct bins. Figure 42 shows the most frequently used words, with the larger words depicting greater frequency of use.

Figure 42: Hill PS 25 most frequent words used in interviews.

When the text of the focus group was analysed, it showed that students mentioned the leaders of their various sustainability committees most often, and generally in relation to their ideas about how young people can act on climate change at the school. In-line with the most frequently mentioned words in the interviews, recycling was the second most frequent word used by students, while “bins” was the fifth most used. The fourth most mentioned term, “normal”, was used in relation to discussions about bins and what the students were used to seeing at school. The students also talked at length about water consumption and referenced low-flow taps, washing hands for too long and the Water Wise program. Figure 6 shows the frequency of words used where the size of the word indicates the amount it was used.

Figure 43: Hill PS 25 most frequent words used by students in the focus group.

Table 23: Hill PS summary of coding themes and the number of school stakeholders that had responses that fell into each category. The interviews and student focus groups were analysed for themes as well as the committee member survey responses (n=9).

Category	Theme	Number of Responses
Barriers & Challenges	Crowded Curriculum	4
	Linking Initiatives to Curriculum	4
	Getting School Stakeholders on Board	3
	Lack of Knowledge	2
	Lack of Money	3
	Lack of Time	5
	Policies	4
Behaviour Change Challenges	Convenience	3
	Habits	6
	Old Social Norms	4
Behaviour Change Solutions	Education and Awareness	7
	Leading by Example	4
	New Social Norms	4
School Carbon Emissions	Importance of Measuring CO2	3
	Involving Students	3
	Saving Money	1
School Role in Community Decarbonisation	Educating Community	3
	Educating Kids	6
	Home Behaviour Change	3
	Influencing Parents via Students	4
Social Impact	Community Outreach	1
	Own Attitude and Behaviour Changes	9
Intergenerational Influence	LCL Actions Already Taken as a Family	5

	Student Encourages Family Behaviour Change	4
	Power of Intergenerational Influence	7
	Student Talks to Family about LCL Topics	10
Peer Influence	Bring up LCL Topics with Peers	5
	Taking Responsibility for Other People's Actions	3
Student Involvement	Student Empowerment	4
	Sustainability Integration into Curriculum	6
Student Ideas for LCL Action	Community-level	1
	Individual-level	7
	School-level	4
Success Factors	Involving Students	1
	Importance of Policy	3
	Passionate people	4
	Support of Administration	3
	Support of Other School Staff	2
	Sustainability Champion	1
	Teamwork	4
	Whole-School Approach	2

6.2.14 Summary

With an integrated whole-school approach, Hill PS set the foundation for collaboration within the school, which included a continuity of sustainability messaging for students and alignment of values with their community. The principal was highly supportive and engaged, and there is a dedicated and passionate group of teachers leading initiatives, as well as support from the wider school staff who are willing to take new initiatives on board. Students were keen to be involved with sustainability, and the parent body and local community were also highly supportive. Responses from parents indicated that they were aware of the school’s latest low carbon initiatives, which was further demonstrative of the active participation and communication the school has with the community.

Hill PS embraced a whole-school approach to their carbon reduction initiatives and sustainability concepts were integrated across all areas of the school, from extra-curricular involvement to curriculum-based activities, and with neighbourhood/parent support. The participation of the canteen allowed this message of sustainability to be integrated even while students eat their lunch.

Their whole-school approach meant that there was a distributed responsibility for ensuring the success of initiatives, and a sense of working together towards common goals. Most of the staff at Hill PS appeared to come to the school with a team mentality in relation to the school's goals and initiatives. This was demonstrated by the amount of support by staff and high levels of communication between the P&C Committee, the Low Carbon Committee, the Principal and the Canteen staff. Considering that most parents that said their child changed their attitude/behaviour and attributed it to their child learning about low carbon living in the classroom, this could indicate that there was a level of continuity in sustainability messaging. The school also integrated sustainability into their 2018-2020 business plan, which reflects their commitment to continue to pursue sustainability across all areas of the school.

While Hill PS was financially constrained and unable to pursue larger retrofits, they saw the opportunity to reduce their costs from other initiatives. They are ambitious with their goals to reduce their consumption and committed to engaging students as much as possible in the process. Low Committee Members believed addressing carbon emissions was important to do from a moral perspective, but they also saw the benefits of saving money for the school.

The structure of the school meant staff could pursue their individual interests but still come together and work towards a common goal – reducing their school's carbon emissions. The teachers leading the initiatives approach the implementation with the perspective of growth and learning, always adapting and finding new ways around barriers. With the moral lens that the Principal approaches school sustainability, staff are brought on-board with a vision and set of values that reaffirm the values of their community and unite the school towards a common good.

6.3 Acacia Primary School

6.3.1 School Overview/Background

Acacia Primary School is located in the greater-Perth area in a fast-growing suburb within an economically and culturally diverse neighbourhood. The school was built in 2012 and is rapidly growing, with the student population growing from around 420 students in 2015 to around 600 by 2017, representing a 58% increase. In 2015, the school had an ICSEA value of 1020, with 12% of students from a language background other than English. 4 per cent of students were Indigenous. The school’s ISCEA value was only slightly above the average of 1000, meaning students had an average educational advantage compared to other schools in WA. The school had 59 full-time equivalent staff in 2015: 36 teaching, 19 support and 4 administration. They had an average attendance rate of approximately 94%, which is higher than average, and their average NAPLAN scores for Years 3 and 5 were generally 80% above national minimum standards (NMI) (Department of Education, 2019).

From an outreach perspective, Acacia PS engaged with their parents and wider community through several mediums, including three separate Facebook pages to communicate their initiatives: the general school page, an Acacia PS sustainability page and a page for their vegetable garden. They also used their website, newsletter and an online system to inform parents about things happening at the school.

Acacia PS has a student sustainability group called Carbon Kids, which started in 2014. The group works on various aspects of sustainability, including implementing low carbon initiatives. There was a big emphasis in the school on empowering the students to take ownership of sustainability. The school also had a Sustainability Committee comprised of the Principal, a teacher, and the gardener.

Two focus groups were conducted with the Carbon Kids group, with a total of 10 students in grades 4, 5 and 6. Interviews were also conducted during school hours with all three of the main Sustainability Committee members to get their unique perspectives on Acacia PS’s carbon reduction journey. Below is a brief overview of the members interviewed.

6.3.2 Sustainability Committee

6.3.2.1 *Greta - Principal*

Principal Greta started at the school in 2015 and has a strong background in education. When she was teaching, she reports she always incorporated sustainability into her lessons. She regularly attended the Low Carbon Schools Pilot Program (LCSPP) workshops and meet-ups and played an active role in making sustainability a priority at Acacia PS.

6.3.2.2 *Leah – Teacher*

Leah has taught at Acacia PS since the school opened in 2012 and was the key person behind the school's Waterwise initiative. She teaches Year 3 and works to integrate sustainability in all areas of the curriculum by collaborating with other teachers at the school.

6.3.2.3 *Kent – School Gardener/Educator*

Kent has worked part time as the gardener since the school opened in 2012. Just after Principal Greta came to the school in 2015, he was given additional time to do hands-on work with students, as well as manage some of the IT systems at the school.

6.3.3 Waste-Free Wednesday

Waste is a big area of focus for Acacia PS. Every year, the students conduct a waste audit as a requirement of the Waste Wise program – an educational program run by the Waste Authority where schools can attain accreditation for waste reduction. The program requires schools undertake a range of initiatives to achieve this accreditation. A pre-primary teacher at the school leads the school's waste initiatives. Since the school has participated in the Waste Wise program for several years, the school has a few years' worth of waste audit records which they use to monitor their progress.

An initiative the school has seen great success in is Waste-Free Wednesday, which was implemented in 2016. On Wednesdays, the teachers ask the students to bring their lunch without any packaging and all the bins around school are removed. The intention is to discourage students from bringing waste because they then must take it home with them. As expected, there were initially some difficulties with students forgetting about Waste-Free Wednesday and they tried to hide the rubbish they brought in their lunchbox by flushing wrappers down the toilet or putting it in bathroom bins. The Sustainability Committee sees the day as a process that the students will take time to adjust to.

> *"You come across those sorts of problems, but I think it is a long-term goal. It's not something that you just click your fingers and overnight it's waste-free. It just doesn't happen that way. It wouldn't happen even with adults, let alone kids." – APS Gardener (Kent, interview, 19 March 2018)*

However, despite some challenges, Waste-Free Wednesdays has proved successful by many accounts. The school has seen a decrease of rubbish in all the bins across the school throughout the week, and cleaners now need to empty the bins less frequently. Kent also thinks Waste-Free Wednesdays is starting a norm in the school of no waste lunches, which he hopes parents are applying on the other days of the week.

> *"Not only is a Wednesday completely waste-free, but people are, 'Oh, well we might as well do it on Monday and Tuesday and Thursday and Friday as well'." – APS Gardener (Kent, interview, 19 March 2018)*

On the rest of the days of the week, Kent said that on their lunch breaks and during recess, the Carbon Kids team also helps ensure proper waste disposal and recycling by standing by the bins and making sure things are put in the right place. To keep the momentum going started by Waste-Free Wednesdays, the teachers intend to start waste-free competitions between classes, where the classes with the most waste-free lunches get recognised and awarded. Students at the school also have the opportunity to attend excursions to the local waste and recycling centre to help expand their understanding of waste.

Principal Greta mentioned how she had spoken to principals at other primary schools and some have virtually zero waste. She believed this was something Acacia PS could work towards because it not only has environmental and social benefits, but leads to lower waste disposal costs and cleaners emptying the bins less frequently.

> *"I've spoken to principals in schools and they have no waste all week...at much smaller schools, but that's something that we will aim for. What's the difference? For example, the cleaners don't need to empty the bins. There's a whole lot of side [benefits] as you go down that track as well." - APS Principal (Greta, interview, 19 March 2018)*

Key Finding 6-7: Encouraging students to bring zero-waste lunches one day a week resulted in a reduction in the school's total rubbish.

6.3.4 Acacia PS's Low Carbon Initiatives

During the LCSPP, the school had a total of 46 actions and their action plan was updated at least monthly by Principal Greta. Over 90% involved no cost, and in line with their focus on waste and energy, these two areas were the largest categories of initiatives on their action plan, with water close behind. While the percentage of initiatives falling within the energy category was lower than that observed across all schools, their waste category was larger than the rest of the schools. Figure 44 shows how many actions were categorised in each of the carbon emissions areas.

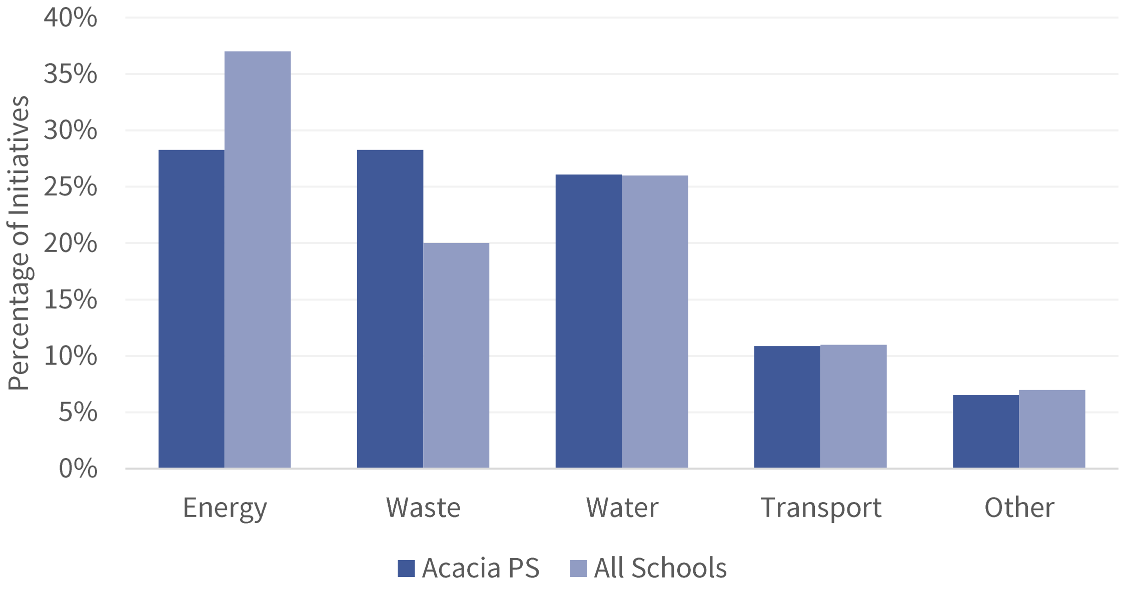


Figure 44: Acacia PS low carbon actions identified by percentage in each carbon emissions category compared to the percentage in each category for all schools.

Of all the initiatives on their action plan, nearly half focussed on educational activities, which is twice as many as the rest of the schools. This demonstrates the commitment Acacia PS has in putting students at the forefront of their initiatives. Examples of educational activities include putting students in charge of checking recycling, and getting students to research ways to get students to ride their bicycles to school more often. Figure 45 shows the breakdown of actions in each category in comparison to all schools. The school also focussed on the behaviour change of staff and students, with 19% of their initiatives targeting some sort of behaviour change, such as end of day and school holiday switch off, and encouraging students to turn off taps in the bathroom, with signs created by students. Infrastructure formed the third largest category, and these types of actions included turning off cool rooms that were not being used and unplugging water fountains so they no longer cool water. The number of infrastructure-related actions were considerably less than across all schools, which could be due in part to the financial barriers associated with infrastructure upgrades. Table E9 shows a summary of the types of completed or ongoing actions the school listed on their action plan.

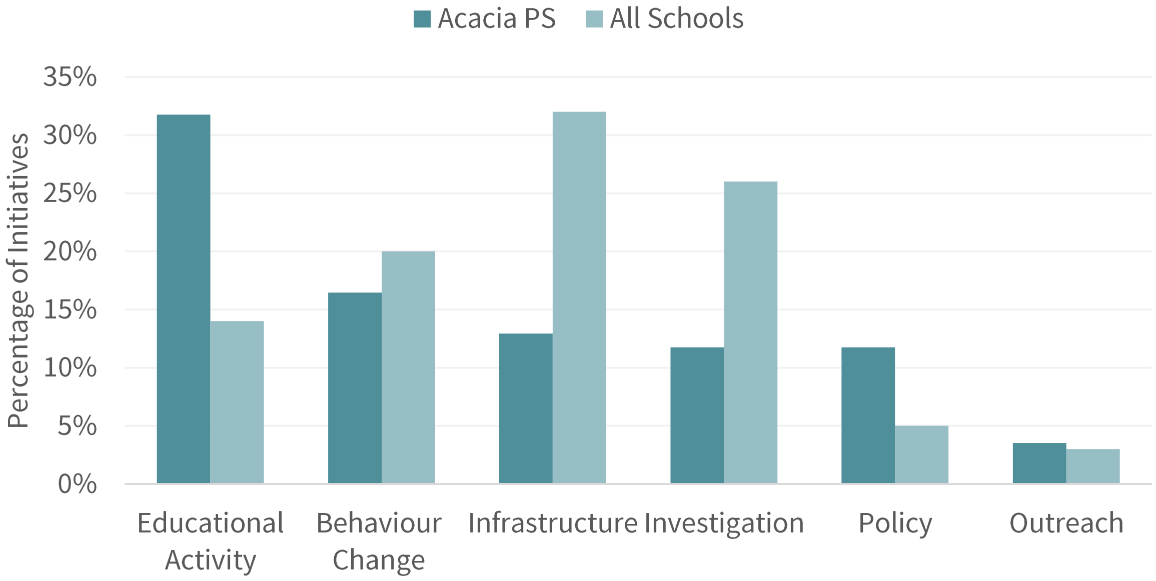


Figure 45: Acacia PS percentage of low carbon actions by type compared with the percentage of action type across all LCSPP schools.

From a cost perspective, the school did not have a fund dedicated to sustainability initiatives, however Principal Greta was able to allocate small amounts of funding to initiatives where needed, as she oversaw the overall school budget. However, many low carbon initiatives were still out of reach for Acacia PS, due to the high upfront cost required (e.g. solar PV or LED lighting retrofits).

6.3.4.1 *Energy*

The school completed a Type 1 energy audit in 2016 that a partner of the LCSPP offered free of charge. The school subsequently went on to tackle the highest consumption items that the audit revealed. One example was a cool room that was installed in their cafeteria. Until the audit was performed, the cool room was almost always kept on, even though it was empty and not being used. After the audit indicated this was an easy way to save a significant amount of energy, Principal Greta turned off the walk-in cool room in the canteen in February 2017 and it was only turned on as needed from that point forward. All the drinking water fountains were also disconnected from power as it was decided that it was not essential to keep the water cold. Since there was no feedback by anyone at the school regarding the change in temperature of the water after it was turned off, the Committee decided the fountains would remain disconnected from power.

The school also implemented a switch off protocol around September 2017. The gardener, who also worked on the school's IT, created an automatic switch off system for their computers and printers, meaning the school no longer keeps electronic devices on that use power over the school holidays, and at the end of each school day. One of the teachers also purchased a power energy monitoring device in the hope of being able to use it with the students as a teaching aid. However, Principal Greta said the device they purchased was far too complicated to use, and the teachers had difficulty interpreting the numbers the device was giving. As a result, the device was never used.

Students also work to help reduce electricity consumption by making posters that were placed next to each light switch to remind teachers, staff and students to turn the lights off as they leave the room. Principal Greta thought educating people at the school was a strategy they could use to help save more energy.

> *"…if you can show people the amount of energy that's being used, there's huge scope for the reduction of energy in this school." APS Principal (Greta, interview, 19 March 2018)*

Key Finding 6-8: A basic electricity audit of the school highlighted easy efficiency gains, such as turning off walk-in cool rooms and disconnecting school water cooler fountains from power.

6.3.4.2 *Waste & Water*

In addition to Waste-Free Wednesdays and some recycling on campus, the school has a thriving garden compost, worm farm and a Garden Kids Club where Kent takes students who are at-risk of not progressing out to do gardening. Kent said the change he sees in the students participating in the Garden Kids Club is profound and rewarding. In addition to the teaching Kent does with students in the garden, one class each year takes responsibility for collecting organic food scraps each day around the school and adding them to the compost and worm farm.

Both Principal Greta and Kent expressed concern about how disconnected some young people are with the natural world, simply because they are not exposed to it. Kent is passionate about getting students out in the garden so they understand the effort and time it takes for things to grow, and he hopes this instils an appreciation for the food on their table. At the end of 2016, the school planted one fruit tree for each classroom, which the students are responsible for taking care of. Principal Greta described how enthusiastic some students are about their class fruit tree and how some had not ever tasted a mango or peeled a mandarin, but were able to experience this with their class fruit tree.

> *"…you have to remember that lack of knowledge. I had a year two student, very bright year two student, who wrote me this fabulous story and drew me this beautiful carrot bush. The most green, luscious bush, with these carrots hanging off it. She did not know they grew under the ground." – APS Principal (Greta, interview, 19 March 2018)*

The teachers also managed to integrate the garden into the curriculum at the school, which allows classes to easily carve out time to spend time in the garden as agriculture is tied into the curriculum as a "technology". Since the garden is now part of the curriculum, there were plans to expand the garden, as well as increase their composting abilities.

Key Finding 6-9: Embedding garden activities into the curriculum allowed more teachers to utilise the garden as a teaching resource.

Acacia PS also pursued several water initiatives. The school participated in the Waterwise program and held several Waterwise educational activities with students. Examples of the educational activities included awareness activities and involving students in ensuring fountain taps were turned off at the appropriate times. They also promoted tips for saving water and other sustainability initiatives to the community through the Acacia PS sustainability Facebook page and the newsletter. Water conservation signage made by students was also placed around the school to remind the school community to conserve water.

6.3.5 Utility Consumption & Cost

Between 2015 and 2017, Acacia PS experienced a substantial 58% increase in student numbers. To accommodate these additional students, the school installed 14 transportable classrooms, which increased the total building square metres by 14%. By 2017, the school occupied a land area of 21,538, 27% of which were buildings and the rest, green areas like the school oval and garden beds. When compared to the other primary schools, the amount of building space is relatively small. When the total square metres was calculated on a per student basis, Acacia PS's building spaces appeared to be efficiently utilised, with the second lowest square metres per student (9.7 m^2/student) compared to the rest of the 13 schools in the cohort. In terms of utility cost, the school saved a total of $38.25 per student and decreased across all three utilities (electricity, water and gas), which is further discussed in the following sections.

6.3.5.1 *Energy*

Acacia PS's **total** electricity consumption during the LCSPP increased by 28% (see Figure 46). However, considering that student numbers increased significantly during this time and the school also increased in total square metres, an increase in total consumption is expected (see Table E4 for total utility consumption and cost figures).

While the school implemented automatic shutdowns of computers as part of their switch off protocol, their total average consumption increased between 2015 and 2017 for most school holiday periods, as shown in Figure 47. This could be a result of the 14 additional classrooms with additional security lighting left on at night-time, and could also indicate there are appliances that could still be switched off. It should also be noted, however, that while the total electricity consumption increased between 2017 and their baseline year (2015) by 28%, the change between the years the school participated in the program (2016 & 2017) was 8%, which is half of what it was the year prior (Table 24). This trend in decreased consumption between 2016 and 2017 was also evident during school holiday periods. This demonstrates there was a decrease in the rate of electricity consumption for the school.

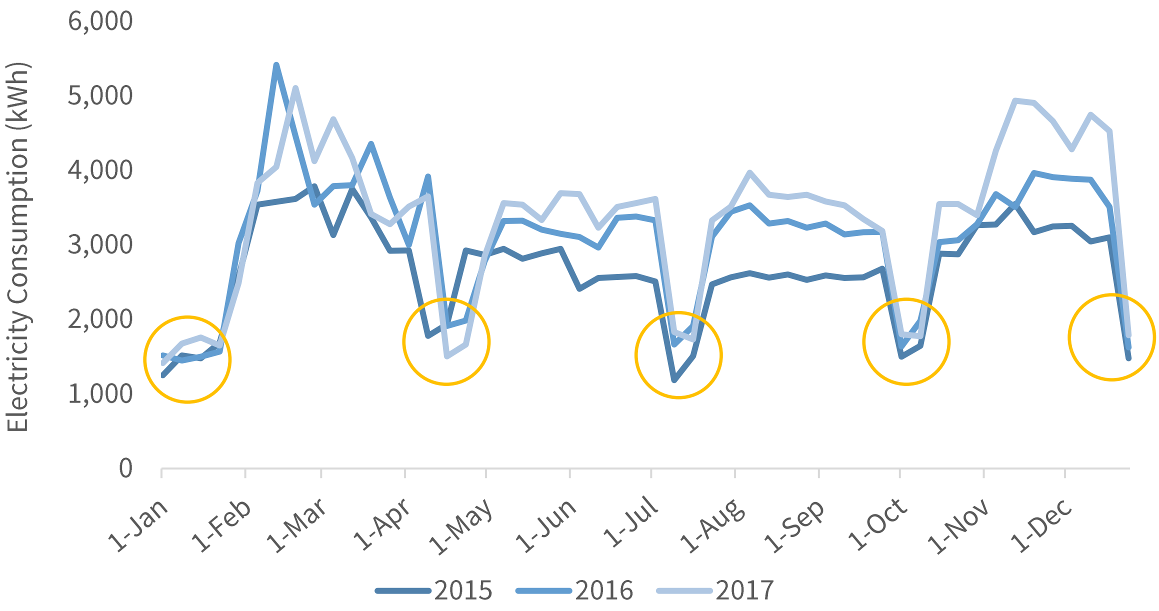


Figure 46: Acacia PS total weekly electricity consumption (kWh) (2015-2017). The areas circled in yellow are school holiday periods.

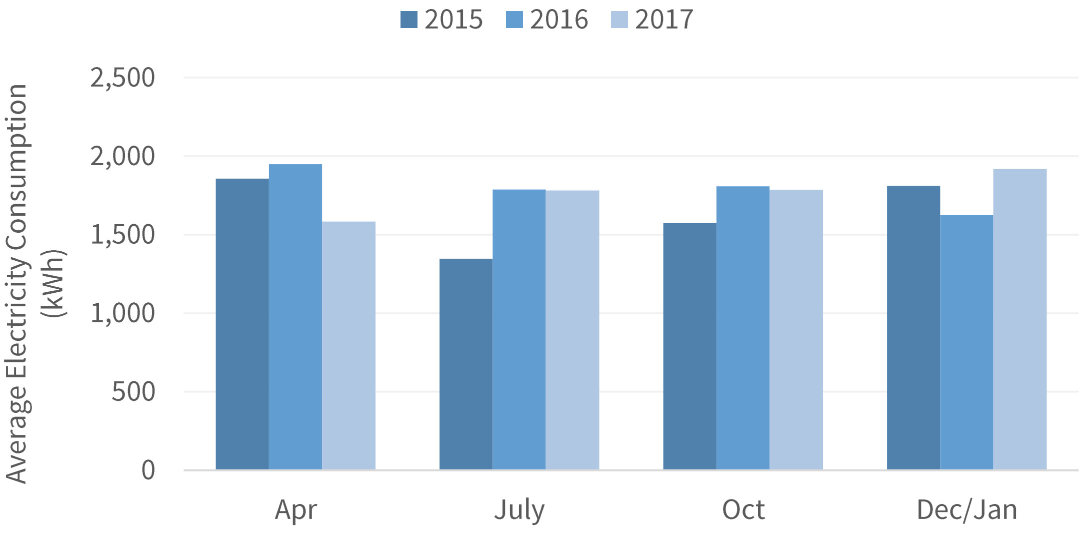


Figure 47: Acacia PS average total electricity consumption for each school holiday period between 2015 and 2017.

Energy consumption on a per student basis, however, decreased by 19%. It is more evident looking at the data on a per student basis that the school was using less energy per student overall despite an increase in student numbers. Electricity cost per student also decreased by 13%, saving the school $11.37 per student.

Table 24: Acacia PS utility consumption and cost (electricity, water and gas) per student = per year (2015 – 2017).

Utility	Measurement	2015	2016	2017	Percentage Difference (2015/2016)	Percentage Difference (2016/2017)	Percentage Difference (2015/2017)
Electricity	*(kWh/student)*	357.82	330.93	289.76	-8%	-12%	-19%
	($/student)	$90.57	$83.35	$79.20	-8%	-5%	-13%
Water	*(kL/student)*	5.17	4.16	3.97	-20%	-5%	-23%
	($/student)	$91.67	$76.05	$68.20	-17%	-10%	-26%
Gas	*(kWh/student)*	74	74.6	48.37	1%	-35%	-35%
	($/student)	$7.88	$6.75	$4.48	-14%	-34%	-43%

While gas had the largest decrease in consumption per student (35%), in this case, using the student metric was not the most suitable measure considering none of the 14 additional transportable classrooms used gas and, instead, used electricity for heating. Therefore, these classrooms did not affect total gas consumption.

When the total gas consumption is observed, the school increased by 4%, shown in Figure 48. From a cost perspective, total gas cost decreased by 10%. This reduction in gas price can be attributed to a 43% reduction in cost per gas unit, which was the result of a renegotiated contract with their electricity and gas supplier at the beginning of 2017. Overall, the school saved $296 on gas between 2015 and 2017. This is a saving of $3.40 per student.

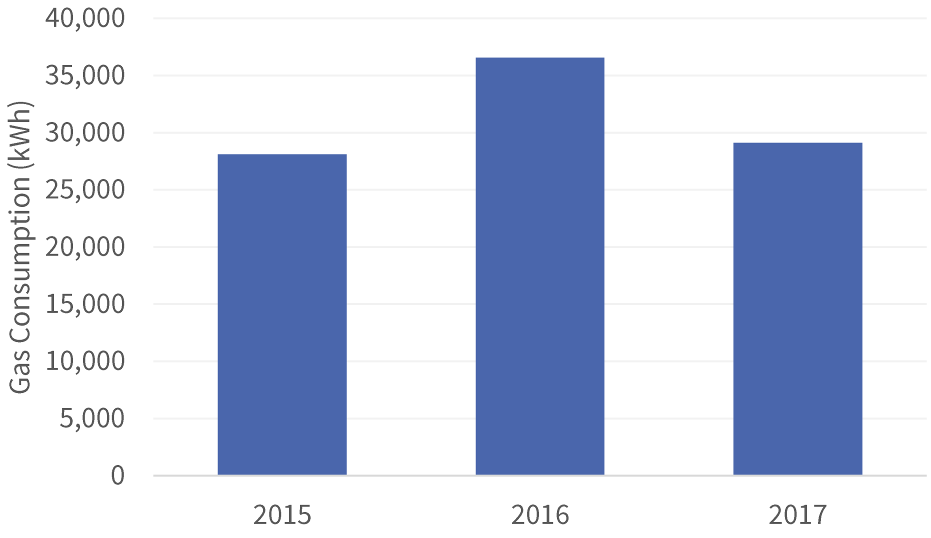


Figure 48: Acacia PS total gas consumption (kWh) (2015 - 2017).

6.3.5.2 *Water*

Water consumption per student decreased by 23%, with costs decreasing by 10%, saving $23.47 per student. Figure 49 shows the school's water consumption per student throughout the year and their largest decrease can be seen for the February period, where they used 40% less water in 2017 than they did two years prior. However, as seen in June to October, the consumption increases in 2017 from the previous year. This could be attributed to the increasing use of toilets and sinks by students, but might also be due, in part, to the increased water requirements of the 15 young fruit trees that were planted at the end of 2016.

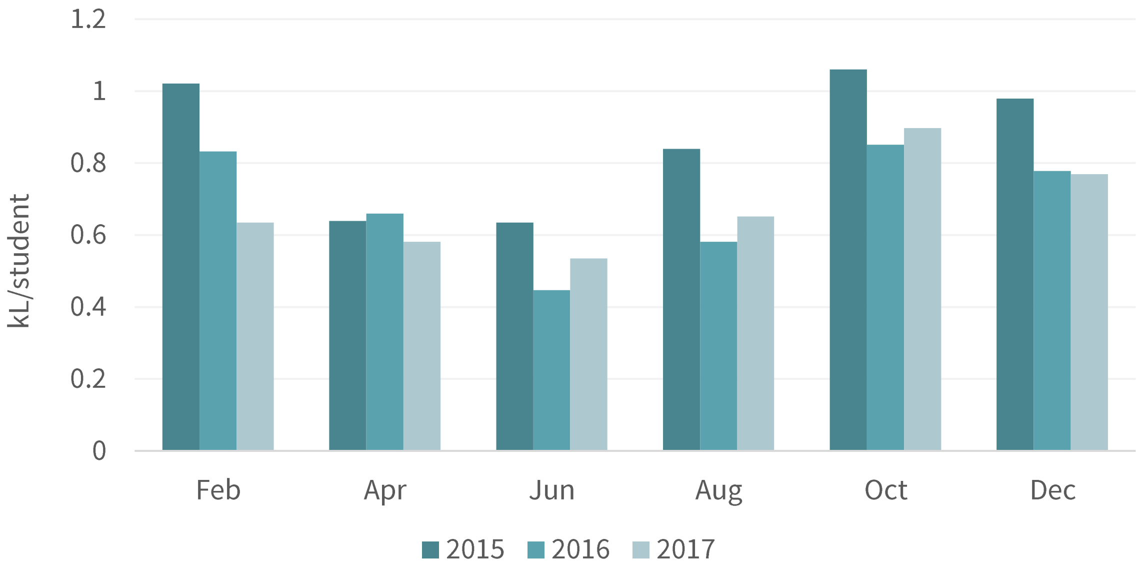


Figure 49: Acacia PS water consumption per student (2015 - 2017).

6.3.6 Carbon Emissions

Total carbon emissions increased for Acacia PS by 17%, as shown in Table 25, with electricity accounting for 92% of their emissions. However, as discussed in earlier sections, the school had a significant increase in student numbers and total square metres. Therefore, it is expected that the school would increase their consumption due to the additional buildings using electricity, and the increased number of students using the facilities. On a per student basis, Acacia PS saw a 26% decline in carbon emissions. As seen in their total electricity consumption, the rate of increase for total carbon emissions decreased drastically during the LCSPP compared to the increase observed for the year prior. Arguably, their emissions per student might have been even higher by a considerable amount if the school were not actively implementing low carbon initiatives.

Table 25: Acacia PS carbon emissions (tCO_2-e) from electricity, gas and water on a total, per student and per square metre basis for 2015 – 2017.

Measurement	2015	2016	2017	Percentage Difference (2015/2016)	Percentage Difference (2016/2017)	Percentage Difference (2015/2017)
tCO_2-e (total)	120.76	137.79	141.19	14%	2%	17%
tCO_2-e/student	0.318	0.281	0.235	**-12%**	**-17%**	**-26.2%**
tCO_2-e/m^2	0.023	0.025	0.024	8%	**-5%**	3%

6.3.7 A School’s Role in Community Decarbonisation

When the Sustainable Committee was asked for their perspective on how schools can play a role in community decarbonisation, they generally thought the school could be more involved. Leah thought they could act as a hub for things like recycling cans, which could also serve as a fundraiser for the school. She also thought students could have a bigger role in influencing the community, with students promoting the school’s low carbon initiatives at community events.

Kent also believed that schools could play a vital role in helping the community be more sustainable through students changing the attitudes and behaviour of their families. By creating new sustainable social norms at the school, the students could then take those new norms to their families.

> *"… if we can be sending a message to the kids on a daily basis, then they go home and go, 'Oh, Mum, why'd you do that? Do it this way because then you save that or you reuse that.' Or whatever it is. If it's a case where the kids then go home and have that where they think it's normal, and where they can pull out their friends and families and whoever it is, even if it's not in [the school], even if they go to visit relatives in England, they go, 'I can't believe you're doing that.'"*
> *– APS Gardener (Kent, interview, 19 March 2018)*

Principal Greta thought it important for schools to play a role in decarbonising the community. However, she said from a time perspective, it can be difficult for schools to do because they have so many other responsibilities. She did believe, however, there were plenty of learning opportunities if students were involved more in the carbon reduction process.

> *"I think the opportunities for students to see what you can do, in [real] time, is fantastic…" – APS Principal (Greta, interview, 19 March 2018)*

She thought students could be involved in multiple stages of the carbon calculation, specifically around electricity consumption.

> *"[We were] hoping to set up just a very simple activity about letting students see what power was being drawn and then flicking off all the power in the school; just the lights, and then just watching it. So seriously, a 15 to 20 minute activity that would indicate the type of power. There's so many simple things you can do. It's just the logistics around curriculum and adding it all and that type of thing."*
> *– APS Principal (Greta, interview, 19 March 2018)*

Leah also saw potential in involving students more in the maths side of calculating resource consumption and costs. She mentioned a high performing student in one of her classes who was able to do some calculations on water consumption. She thought more students could be involved in this way.

> *"I had one particular boy that was way above where he needed to be in maths… It was kind of, 'Here's some information. Here's some data that we got. What can you work out from it?' He did work out how much water we were using on a daily basis. He did a few different calculations with that and went and shared it with Principal Greta." – APS Teacher (Leah, interview, 19 March 2018)*

Key Finding 6-10: Staff at the school see significant potential in involving students in the carbon emissions reduction process using maths activities and using real-time data like electricity.

6.3.8 Student Empowerment & Action

While the school has an adult-organised Sustainability Committee, Carbon Kids is student-driven, with support provided by the Sustainability Committee. The group is made up of students from grades three to six and has about six students who regularly attend the meetings. The Sustainability Committee focusses on empowering students by giving them opportunities to develop solutions for the school, taking ownership of projects.

> *"That's something that we've been really conscious of with the Carbon Kids group, is to not take over their meetings. It's how to facilitate them so that they're putting their ideas in play, because those are the things that will be more likely to be taken home." – APS Teacher (Leah, interview, 19 March 2018)*

Kent mentioned that while it can take a lot longer to achieve initiatives when they are student-led, if staff led them, learning opportunities were lost.

> *"…it's one of those things where it would be really easy for us, as the staff, to step in and take over and get it working faster, but it defeats the purpose of it." – APS Gardener (Kent, interview, 19 March 2018)*

Principal Greta is particularly passionate about empowering the students and believes students are incredibly capable, if they are provided with opportunities.

> *"Kids love living things, they love biology, they love animals, they love growing plants; it means so much to them, it's just real to them, they can see it. So, yeah, that's my passion. That's it. That's why I will support it 'til the cows come home." – APS Principal (Greta, interview, 19 March 2018)*

Leah, Kent, and Principal Greta all commented on how unique the sustainability ideas are that students come up with at their meetings. They also mentioned how they had to help guide the Carbon Kids group in the beginning because the students were a bit shy and still learning how to do things, like hold meetings. Over time, however, they had seen the students develop confidence within the group, and most students were now more comfortable driving initiatives. Kent said he had seen the students in the Carbon Kids team improve their abilities, including the way they approached sustainability at the school.

> *"They get in the right frame of mind, and their abilities definitely improve, which I get almost as much out of that as everything else. The fact of seeing them change." – APS Gardener (Kent, interview, 19 March 2018)*

Kent also mentioned how the Carbon Kids students were willing to give up their lunch time, as well as other free time to participate, which showed a lot of commitment, particularly considering their age.

While the Sustainability Committee had witnessed tremendous growth in the students, Leah mentioned that it was still difficult to get the students to think bigger and believe that they could make a real difference.

> *"That's a bit of a challenge, getting the kids to focus on bigger picture things and to actually believe that they can make a difference." –APS Teacher (Leah, interview, 19 March 2018)*

Principal Greta also noticed the students involved with Carbon Kids sometimes struggled to understand why people did not use the bins correctly, or why everyone did not always participate in Waste-Free Wednesdays. She said this was something they were trying to teach the students.

> *"Students are tough. They want a penalty – 'and you don't do this, and this will happen – punishment'." – APS Principal (Greta, interview, 19 March 2018)*

In addition to empowering the students and providing them with opportunities to take ownership, the school aimed to provide them with a global understanding. Principal Greta hoped to build more empathy in the students though activities and fundraisers, such as the lap-a-thon, where students gained an understanding of what some people in African villages must do to get their daily supply of water.

Key Finding 6-11: Empowering students to lead initiatives provides learning opportunities for students and gives them ownership of the initiatives.

6.3.9 Youth Action & Influence

The student focus groups took place in two rounds. The first focus group consisted of five students in years 4 and 5 and occurred during lunch time. The students ate their lunches while participating in the focus group. The second group had five students in years 5 and 6 and they participated in class time.

When students in both focus groups were asked how young people can act on climate change, some initial responses students discussed included reducing plastic wrap and engaging people at school to act more sustainably. Interestingly, most of the students' answers involved action at a school or community level, rather than individual level, demonstrating an understanding of how collective action can make a difference.

> *"We could ask everyone who goes to school to walk or at least ride." – APS Student (Cam, focus group, 19 March 2018)*

> *"If everyone picked up at least one piece of plastic or rubbish a day, the Earth would be clean in no time." – APS Student (Sammy, focus group, 19 March 2018)*

> *"Everyone could go on trains and buses so it would reduce traffic and it will help the environment, as well."- APS Student (Casey, focus group, 19 March 2018)*

Some of the ideas students had for the school involved awards and prizes for the most sustainable classrooms, with one student sharing an idea of how to improve uptake of Waste-Free Wednesday.

> *"We could get this teddy for the school and the winners...the class that has the tidiest classroom when we come over to check, the teachers could write on how tidy they are and then the class with the most amount of points wins this teddy. We've done that with the Golden Broom" - APS Student (Erin, focus group, 19 March 2018)*

> *"Maybe at schools we could make out of recycled paper this big thing and there's a tree in there and then there's lots of leaves and each time the school improves in Waste-Free Wednesday we put a leaf up. And by the end of the term, if it's all filled up, we win a school tree to look after." - APS Student (Cam, focus group, 19 March 2018)*

There was also mention of interacting with other schools, with one student in the older group bringing up ideas about engaging with other schools to learn and share ideas.

> *"...something that I'm intrigued with is the fact of some things like excursions, maybe? Or incursions, like this. Because I would get to talk and then just as a school by ourselves we can't take much of an action because we're not overly famous. Whereas, if you go to an incursion, talk about all the schools, then they all meet up, and then, like [share] ideas" - APS Student (Taylor, focus group, 19 March 2018)*

Other students agreed with Taylor's idea and discussed other ways schools could engage with each other.

> *"Yeah because some people come to our assemblies. You could do a clean up day. Kids could just go around the schools or to famous events." - APS Student (Erin, focus group, 19 March 2018)*

> *"Just go to other schools assemblies and [say] like 'do this' to the other schools" - APS Student (Ali, focus group, 19 March 2018)*

Waste was a topic both groups mentioned frequently, which is unsurprising given Acacia PS's focus on waste. Many students talked about picking up litter and reducing plastic-use and waste. The older group brought up litter most frequently, with some students expressing concern over littering happening at school and in the community.

> *"...some things that they've done around the school isn't the best because the skate park…teenager kids are just littering there. So, then that blows into our school." – APS Student (Erin, focus group, 19 March 2018)*

> *"Then all I see after I get out of McDonald's or something, I see litter, thrown over the ground!" – APS Student (Casey, focus group, 19 March 2018)*

While students were generally positive about the ideas they had to act on climate change, some older students (grades 4 and 5) showed some scepticism and worry when asked what they, as young people/individuals, could do to combat climate change.

> *"Not much to be honest." – APS Student (Taylor, focus group, 19 March 2018)*

> *"[Climate change]'s not going to stop because all we know people are going to keep doing it for the rest of their lives and sooner or later we're going to have big smoke coming all over the world. Smoke's taking over it instead of water…" – APS Student (Casey, focus group, 19 March 2018)*

One student also said that when she first learned about climate change at school, she felt bad about it, which is why she joined the Carbon Kids group. Another student also showed some guilt about his use of electronics due to energy consumption.

> *"I literally do feel bad when I go on my tablet because then I'm wasting a bunch of electricity and battery." – APS Student (Casey, focus group, 19 March 2018)*

Key Finding 6-12: Students in grades 4 and 5 expressed more scepticism, worry and concern about climate change and what people can do to help stop it than younger students.

However, one student highlighted the way young people think can be an advantage when it comes to acting on climate change.

> *"I think kids are sometimes better because with adults, they think about what could happen. How much money it's going to cost, how you're going to maintain it. Whereas kids, it's like, "let's just do this"." – APS Student (Taylor, focus group, 19 March 2018)*

Key Finding 6-13: Students generally talked more about community and collective action to address climate change than individual-level action.

6.3.9.1 *Peer and Community Influence*

When students were asked whether they discuss low carbon living topics with their friends, some students said they would mention topics to their friends.

> *"Sometimes. Mostly in the Carbon Kids group, but I do talk to [my friend] at recess and lunch sometimes." - APS Student (Erin, focus group, 19 March 2018)*

However, most students in the older group said they did not talk to their friends about sustainability topics because they did not think their friends were interested in hearing about it.

> *"My friends think it's boring to talk about it…Is it boring when you're gonna be drowning? Or is it boring when you're gonna eat, like, plastic?" – APS Student (Taylor, focus group, 19 March 2018)*

> *"No, I just don't try…They just think it's all weird." – APS Student (Jamie, focus group, 19 March 2018)*

Another student said she does not talk to her friends about the environment, but she told a story about how she will often pick up rubbish after her friends.

> *"When I was sitting out at lunch, I was sitting with my friends and then they started to take off and they just put their rubbish in the garden bed. I'm like, "that's not on, pick it up, kids", and they're like, "no, thank you!", and then they ran off. I'm like, "oh great, now I have to pick up rubbish that's not even mine". Then I go put it in the bin…"- APS Student (Casey, focus group, 19 March 2018)*

Students also talked about influencing people at the school and their peers more directly. The idea of fundraising and making posters to educate people was discussed on multiple occasions. However, a few students wondered whether posters are effective in changing behaviour.

> *"Well not many people listen to environment posters, but we could [do that]..." - APS Student (Jamie, focus group, 19 March 2018)*

A few students said they wanted to make educational videos and digital presentations about carbon reduction topics to help educate other students.

> *"Instead of using paper, I've been using Google Slide and I've been making a slide to show the kindies and youngers, younger than us, what they can do because they just like to drop things and not pick it up." – APS Student (Casey, focus group, 19 March 2018)*

> *"I started making an iMovie about not to litter because a lot of people usually have the app iMovie." – APS Student (Taylor, focus group, 19 March 2018)*

From a wider community perspective, the students had many ideas about how the school might influence the community to reduce their carbon emissions. Examples included doing community events and facilitating collective action.

> *"It could happen with us telling the kids and the kids telling their parents. When something goes viral on the internet everyone tells each other. Then it just spreads…." – APS Student (Taylor, focus group, 19 March 2018)*

> *"Maybe since most people at our school know a lot of the people in our neighbourhood and are friendly to them, maybe we could just say, 'Before you go to bed or something, could you please pick up maybe a piece of rubbish or two?'" – APS Student (Mo, focus group, 19 March 2018)*

6.3.9.2 *Intergenerational Influence*

When the students were asked if they talked to their family (i.e. parents, aunts, cousins or siblings) about low carbon living topics, most of the students said yes, specifically topics around waste and energy conservation.

> *"…our school does a thing called Waste-Free Wednesdays and we're not allowed to have any wrappers. And if I see my mum put in a wrapper, I say, 'It's Waste-Free Wednesday.'" – APS Student (Mo, focus group, 19 March 2018)*

> *"I know we've changed with how much electricity we use because at night we used to have four lights on, now we have one or two." – APS Student (Ali, focus group, 19 March 2018))*

> *"Well, I say to them, turn off something once you've used it. Then I found out I'm actually the only one who still turns off the light, turns off the fan, turns off any devices." – APS Student (Jamie, focus group, 19 March 2018)*

All the students in the first group said they thought their own attitudes or behaviour changed as a result of participating in the Carbon Kids group. They also talked a lot about the things they already did at home, such as using reusable shopping bags or using a worm farm for food scraps. Some students mentioned how people within a family can copy each other's behaviour.

> *"...sometimes when they're having family time, you just want to go over and go, 'What are you doing? I want to do it'. And then from biggest to the second biggest, and then they all keep wanting to copy." - APS Student (Erin, focus group, 19 March 2018)*

Students thought that because siblings copy each other, they could lead by example around sustainability. When asked if they thought parents could also copy their behaviour, all the students thought this was possible.

> *"I know because my brother... when I'm tidying my room and stuff, he just copies me and does his room. So I'm guessing if I start picking up rubbish, he'll start picking up rubbish, too." – APS Student (Corey, focus group, 19 March 2018)*

6.3.9.3 *Parent Survey Results*

A total of 22 responses were received from parents of students at Acacia PS to gain parent perspectives on intergenerational influence. Around 60% of parents said they were aware of the school's low carbon initiatives, and most said they were aware of Waste-Free Wednesday, showing a high level of communication with parents about this initiative. Nearly all the parents said they found out about the initiative through the school newsletter, indicating this was a successful method of communicating about initiatives taking place at the school.

Half of the parents said their child mentioned or spoke with them about a LCL topic, which was the same percentage as the rest of the LCSPP schools. The things their child spoke with them about coincided with what the students discussed in the focus groups: reducing waste, saving energy & water, recycling and Waste-Free Wednesday (see Table E3 for all parent responses about LCL topics). These topics were similar to those identified across all LCSPP schools. Figure 50 shows the breakdown of parent survey responses for all intergenerational influence questions.

Over a quarter of parents noticed their child's LCL attitude or behaviour, which is slightly higher than the rest of the schools. Nearly all the parents (75%) said they thought these changes in attitude/behaviour were a result of their child learning it in class or participating in a school activity. The behaviours they described included pointing out when taps ran longer than necessary, wanting a waste-free lunch or saying no to straws. Table E2 shows all parent responses to changes in their child's attitude/behaviour. In addition, over half the parents said their own LCL attitudes or behaviour had changed, with 41% attributing the change to their child.

At the household level, five parents said their children influenced LCL practices in their households, and as a percentage, this is slightly lower than the rest of the schools. Of the parents who said yes, all but one mentioned their child encouraging the household to turn off electricity. Four also mentioned water conservation. All responses from parents about changes in household behaviour were also mentioned by students in the focus groups, showing consistency in student and parent reported influence.

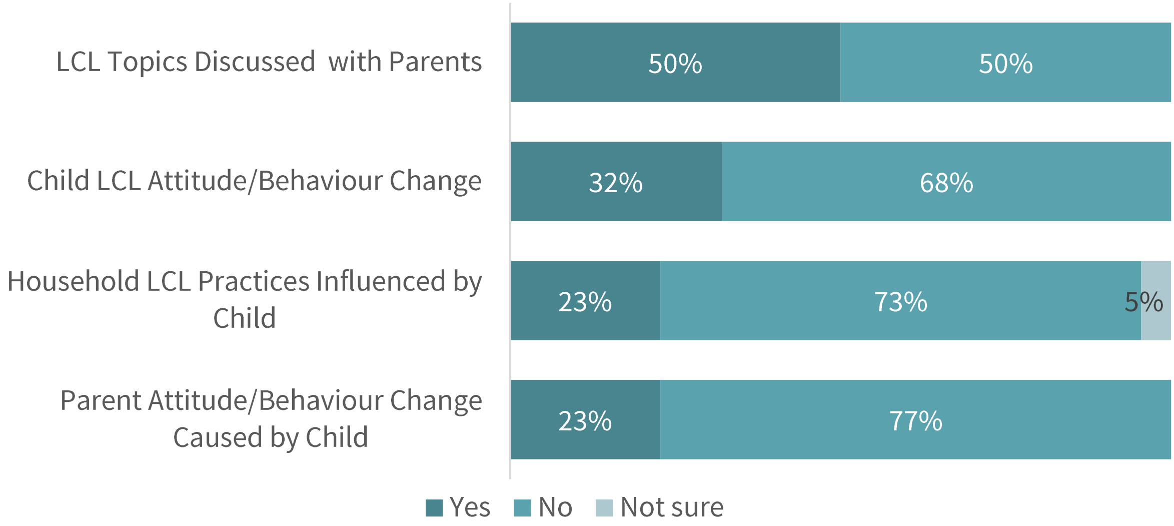


Figure 50: Acacia PS parent survey responses for each intergenerational influence question.

The parents at Acacia PS had the lowest Low Carbon Readiness Index (LCRI) score (3.3) out of all schools in the LCSPP, which could indicate parents at Acacia PS are generally less aware or concerned about climate change. However, Acacia PS also had the highest percentage of parents attributing their changes in attitude/behaviour to their child, at 11% above the total school average. While the sample size of parents was relatively small, this higher rate of reported change by parents as a result of their children could be attributed, in part, to parents being less likely to already be practicing low carbon living, and therefore having a higher potential for being influenced by their child. Acacia PS also had the highest principal support score (10) than all the schools, and the high amount of support from the principal was affirmed in the interviews with the Sustainability Committee at the school. Correlations between intergenerational influence and proenvironmental attitude and behaviour variables were not performed for Acacia PS because there were too few parent survey responses.

6.3.10 Challenges

A lack of time and getting buy-in from staff at the school were considered some of the main barriers for Acacia PS. All Sustainability Committee members noted the difficulty in getting staff on board with initiatives, and Principal Greta said she realised including sustainability in the curriculum was not as straightforward for some teachers. However, while there are challenges with getting more people at the school involved, there was an understanding by the committee of how it can just “take a bit of time” to get people on board with the initiatives.

> *“It's trying to get [sustainability] across the school, which is difficult because it doesn't float everybody's boat. There's quite a few teachers here who are quite passionate about it; and others, I just give huge encouragement to.” – APS Principal (Greta, interview, 19 March 2018)*

While Acacia PS has successfully integrated some aspects of sustainability into the curriculum such as getting the garden into the curriculum, there are still difficulties linking school low carbon initiatives into the required curriculum:

> *“As teachers, we all feel that the curriculum is already too jam-packed. You have to balance your concern over how the children are progressing with what else you can put on them to do” – APS Teacher (Leah, interview, 19 March 2018)*

> *“There's a lot of real-life and real stuff that we could be doing with the kids. It's just during the connections between what we have to be doing and what we'd like to be doing.” – APS Teacher (Leah, interview, 19 March 2018)*

Key Finding 6-14: Despite some successes linking initiatives into the curriculum, teachers still feel the curriculum is too crowded to add topics like sustainability.

Principal Greta noted, however, that there are varying and creative ways that principals can approach curriculum requirements. She said this is an area they are still working on.

> *“It is challenging, because you have a mandate. You have to do so many hours of so many learning areas each week. So, that's a mandate from the department. One of those things, from my perspective, is how much we can stretch that as well. Some principals stretch things really well and some don't, and some in between.” – APS Principal (Greta, interview, 19 March 2018)*

Along with the successes Acacia PS has experienced in relation to their waste initiatives, they had also experienced some policy-related barriers in terms of increasing school recycling. Due to their local government's policies, the school did not qualify for public waste pickup, and therefore had to pay a private contractor to collect additional waste streams (e.g. recycling or green waste).

> *We don't have the ability, at this point, to recycle plastics as a school… I'm trying to negotiate with the council, because as a school, we don't pay rates. No government schools do. They then, the councils say, well, you don't pay rates, you're not entitled to the recycle bins, which I find a little odd. - APS Gardener (Kent, interview, 19 March 2018)*

This poses a significant cost barrier to the school and frustration in the school because the garbage disposal truck drives around the entire perimeter of the school, yet is not allowed to pick up the school's waste. While the school tries to find solutions to recycling, staff have taken it upon themselves to take the milk bottles in the staff room with them to recycle at home.

> *"In the staff room here, the milk bottles, [staff] have been taking them home and putting them in the recycle bin because otherwise that goes into our general waste bin, which ends up in landfill."- APS Gardener (Kent, interview, 19 March 2018)*

Key Finding 6-15: Government and council policies, in addition to financial barriers, prevent the school from increasing recycling options on campus.

At the time the interviews took place, Leah was drafting a sustainability policy for the school. She mentioned how important it was to include other staff in the process to give them a sense of ownership over the policy. Leah and Principal Greta both said the policy could help get whole-school buy-in, as well as ensure the longevity of the school's low carbon initiatives. Principal Greta touched on the importance of a sustainability policy when there is a changeover in principals, and where a new principal might not prioritise sustainability.

> *"…I've heard other people at the meetings, and they go, "new principal, sustainability's out the window". And you've got to have it in there, so at least*

> *there's some possibility; even if it's being driven by the school board, then they can have their ten cents." – APS Principal (Greta, interview, 19 March 2018)*

From an infrastructure perspective, Principal Greta has high ambitions for putting solar on the roofs of the school, as well as LED lights. However, the high upfront costs for solar and LED means they are financially out of reach of the school. This financial aspect, along with bureaucratic barriers, means solar has become a low priority for Acacia PS.

Key Finding 6-16: High upfront costs for infrastructure upgrades, such as LED lighting and solar PV, prevents schools from pursuing them.

6.3.11 Successes – Resilience & "Giving things a go"

In all three interviews with Committee Members, there was a deep acknowledgement of how important it is to embed sustainability principles across all aspects of the school, and how this process can take time. When asked what she thought the most successful low carbon strategies they have implemented were, Principal Greta did not talk about low carbon initiatives on a project-by-project basis. She talked, instead, about the importance of approaching it holistically, and how the school are, little-by-little, working to embed these values into all aspects of the school.

> *"Nothing really stands out, it's more about things are being done on the surface I guess and it's about bedding them down and getting deeper into those things as well… and we have some amazing staff." - APS Principal (Greta, interview, 19 March 2018)*

Within the curriculum, Leah talked about how the school is working to integrate sustainability across all areas, taking a more thematic approach to the curriculum.

> *"We're trying next term to go away from doing subjects and go to theme work so that we can come up with real situations and incorporate all the learning through those." – APS Teacher (Leah, interview, 19 March 2018)*

The diverse skill-set of the teachers at the school, and a committed Sustainability Committee, allows the school to focus on multiple areas of sustainability at once. For example, one teacher is handling their Waste Wise initiatives, Leah is leading their Waterwise initiatives, Kent is managing the garden and IT, while Principal Greta focusses on the bigger picture of school carbon reduction. Several other staff are also working on other aspects of sustainability at the school.

All three of the key members of the Sustainability Committee also highlighted how the passion of the committee, as well as the passion of the students, had really driven them forward with their low carbon initiatives. The staff at Acacia PS had all been willing to put in the extra steps to make things happen.

> *"I think it's the passionate people, whether it's staff or kids. There's definitely some of the students are really passionate about it, which I think is fantastic at that age. And, yeah, passionate staff…" - APS Gardener (Kent, interview, 19 March 2018)*

Kent also said Principal Greta had always been willing to "give things a go", which he believed was important in trialling different types of strategies and initiatives.

> *"It's good - the fact that we're always trying to bring new things to the school, as well, trying to incorporate new strategies, or whatever it is, [and] we're not just, 'Well, we're doing this, and that's it. That's all we're going to ever do.' …we're willing to try different things and change and adapt for it."– APS Gardener (Kent, interview, 19 March 2018)*

At one of the monthly LCSPP meet-ups in 2017, Greta said how the meet-ups with other schools, who were also passionate about sustainability, was a great support network, and made her feel like she was less alone in pushing forward with sustainability at her school. She reiterated in the interview how people passionate about sustainability need to be resilient because there were so many situations where sustainability was knocked back and not given priority.

> *"I think you have to be really resilient to be the type of person that we are." - APS Principal (Greta, interview, 19 March 2018)*

Kent also believed this resilient attitude in the staff at Acacia PS was a key factor in keeping things moving forward at the school.

> *"…you've got to just keep persisting through it, not let that get to you. And just realise that one day, people will just get it, and realise it's not that hard. It doesn't take too long to do it, or it actually works out cheaper." – APS Gardener (Kent, interview, 19 March 2018)*

It was also acknowledged by the two committee members, as well as Principal Greta herself, that her own passion and drive for sustainability resulted in her allocating a significant amount of her own time to the program, which had ultimately been a significant driver of the school's low carbon initiatives.

Key Finding 6-17: A culture of resilience and innovation were key factors in the school's success on their sustainability journey.

6.3.12 Text Analysis and Emergent Themes

The school's website, reports, business plans and newsletters were analysed to understand how information related to the school's low carbon initiatives was communicated. On the Acacia PS's website, there is mention of the school's sustainability goals in their "mission" and "teacher values", in addition to the school's overarching values. The item under "mission" that relates to their low carbon goals is:

> *"To create and maintain a culture that preserves and sustains the environment, has high expectations and celebrates excellence in teaching and learning (Acacia Primary School Website, accessed 08 Dec 2018)".*

Within the Business Plan for 2018-2020, Acacia PS also notes their goals to embed sustainability across the school. Under "Key Focus Areas" it states:

- *"embed whole school ICT and Sustainability plans into whole school Learning Area plans" (Acacia Primary School Business Plan 2018-2020, accessed 08 December 2018)"*

The plan also states targets, where one is aimed at reducing utility consumption and makes reference to another document that outlines the targets in more detail.

- *"An ongoing reduction in electricity usage.*
    - *Refer to Whole School Operational Plans for explicit targets (Acacia Primary School Business Plan 2018-2020, accessed 08 December 2018)".*

In their Annual Reports for 2016 and 2017, under "Highlights", the student Carbon Kids team is discussed and the school's goal of reducing their carbon footprint is explicitly mentioned in both reports. In the 2017 report, the school also makes a note under the section

"The School and its Context" specifically about their involvement in the Low Carbon School's Pilot Program (LCSPP).

> *"Our school also continued down the path of reducing our carbon footprint through a number of sustainability initiatives, including being a member of the Low Carbon Pilot School group (Acacia Primary School Annual Report 2017, accessed 08 December 2018)".*

In addition to having sustainability goals listed on their website and in their business plan, the school also regularly updates the community and parents about their sustainability journey on a Facebook page dedicated to promoting sustainability at the school. On this page, they regularly post about their initiatives and call for volunteers for various events related to their low carbon initiatives. The school also communicates with parents and the broader community through an online platform and online newsletters. In 50% of their newsletters in 2017, a low carbon initiative, such as Waste-Free Wednesday, or activities by the student Carbon Kids team, were mentioned.

The breadth of communication about school low carbon initiatives shows a commitment from the school to communicate to the broader community, while creating accountability for the school through the inclusion of targets in their business plans. Acacia PS also specifically discusses their carbon emissions reduction, indicating the school is committed to reducing their emissions. Out of all the schools, Acacia PS appears to have the highest level of communication about their low carbon initiatives and was the only school to specifically discuss carbon reduction at the school with the wider community.

6.3.13 Emergent Themes across Participants

In the interviews with the Sustainability Committee, "students" emerged as the most frequently mentioned word, with "time" coming in as the second most frequent word. "Time" was referenced in relation to there being a lack thereof. Considering that Waste-Free Wednesday is such a large activity for the school, "waste" came up frequently in the interviews, as well as the concept of recycling and the frequent mention of "bins". "Recycling" and "bins" were mostly talked about regarding the difficulties the school faced when it came to increasing their recycling streams. For success factors, principal support and the importance of a team were themes that were discussed. Policy-related barriers, as well a crowded curriculum, were commonly discussed themes in the interviews.

There was also a strong theme of ideas about how students can act on climate change, student empowerment, and the potential for engaging students in the curriculum. The Principal and teachers also spoke a lot about the potential for students to be involved in the carbon reduction process. Figure 51 below shows an illustration of the top 20 words mentioned in the interviews.

Figure 51: Acacia PS 25 most frequently mentioned words in interviews.

Similar to the frequently mentioned words in the interviews, students talked a lot about Waste-Free Wednesday. They also talked a lot about rubbish in relation to Waste-Free Wednesday as something that is a challenge to address with students. When they talked about “home”, the term “light” was commonly used to describe how they would communicate with their family to turn off the lights. Other themes showed that most students talked mostly about the ways young people can act on climate change at a community-level, rather than just an individual level. Figure 7 shows a graphic of the top 25 most frequently mentioned words by the focus groups.

Figure 52: Acacia PS 25 most frequently mentioned words in the focus groups.

The strongest theme that emerged across both interviews and focus groups related to the potential and power of student influences on parent sustainability attitudes/behaviour, as shown in Table 26. There was also a strong theme related to behaviour change, and the importance of educating others and raising awareness to influence people to be more sustainable and adopt low carbon living practices.

Table 26: Acacia PS summary of coding themes and the percentages of school stakeholders that had responses that fell into each category. The interviews and student focus groups were analysed for themes as well as the committee member survey responses (n=12).

Category	Theme	Number of Codes
Barriers & Challenges	Crowded Curriculum	2
	Linking Initiatives to Curriculum	1
	Getting School Stakeholders on Board	1
	Lack of Knowledge	2
	Lack of Money	1
	Lack of Time	3
	Policies	2
Behaviour Change Challenges	Convenience	1
	Habits	6

	Old Social Norms	1
Behaviour Change Solutions	Education and Awareness	6
	Leading by Example	1
	New Social Norms	1
School Carbon Emissions	Importance of Measuring CO2	1
	Involving Students	2
	Saving Money	1
School Role in Community Decarbonisation	Educating Community	2
	Educating Kids	1
	Influencing Parents via Students	7
Social Impact	Community Outreach	2
	Own Attitude and Behaviour Changes	3
Intergenerational Influence	LCL Actions Already Taken as a Family	2
	Student Encourages Family Behaviour Change	1
	Student Talks to Family about LCL Topics	4
Peer Influence	Bring up LCL Topics with Peers	3
	Don't Try to Bring up LCL Topics with Peers	3
	Taking Responsibility for Other People's Actions	2
Student Involvement	Hands-On Learning	3
	Student Empowerment	3
	Sustainability Integration into Curriculum	3
Student Ideas for LCL Action	Community-level	5
	Individual-level	1
	School-level	2
Success Factors	Getting Others On Board	1

	Importance of Policy	2
	Partnerships	1
	Passionate people	2
	Support of Administration	3
	Teamwork	3
	Whole-School Approach	2

6.3.14 Summary

Acacia PS is led by a passionate Principal with support from a committed and diverse team of staff members that work together to address sustainability at the school. There is a heavy emphasis on empowering students to lead low carbon initiatives at the school, which has enabled students in the Carbon Kids group to take more ownership of initiatives.

A crowded curriculum and challenges integrating initiatives are barriers the school encountered. However, the staff at Acacia PS are making big strides in working to integrate sustainability and initiatives across the curriculum. There are more opportunities for situations like the garden, where its incorporation into the curriculum allows teachers to allocate classroom time for their students to work in the garden. The staff also see significant potential in engaging students in the carbon emissions reduction process.

There was an emphasis within the school on how students can help influence families' behaviour and students said they generally spoke about low carbon topics with their family members. All the committee members and many of the students thought the school could play a bigger role in helping their communities decarbonise. Students also appeared to have a good understanding of how people can make a difference when they do things together.

The parents at Acacia PS may be less likely to transition to low carbon living than other schools in the cohort, according to the parent survey results. However, parents/guardians appear to be more likely to be personally influenced by their children around low carbon living. This could suggest there is significant opportunity in the school to influence community around sustainability by engaging students in the school carbon reduction process. Given the high amount of communication the school has with the community around low carbon initiatives, the school is demonstrating they are already playing an active role in influencing their community.

The school aspires to install solar PV and increase their waste streams. They have encountered several policy-related barriers, such as local government rules and regulations around waste pickup. However, the passion of the Principal and the committee is unwavering, and with sustainability being incorporated into business plans, the school aims to embed low carbon initiatives even more, moving forward.

6.4 Wattle Secondary College

6.4.1 School Overview/Background

Wattle Secondary College is a merit-based school for Years 7 to 12 that offers Gifted and Talented programs in dance, drama, media arts, music theatre, and visual arts. The school takes students from over 50 primary schools from all parts of the Perth Metropolitan area and there are three local intake schools for the school. The school is located within the City of Fremantle, which is a local government known for its strong stance on sustainability. The council prioritises sustainability, as demonstrated by their commitment to their One Planet Strategy, which aims to help them achieve a high international standard of sustainability (City of Fremantle, 2019). In 2017, the student population reached just over 1,600, which was a 9% increase since 2015.

The school opened in 1956 as one of the first secondary schools in Western Australia. The school site itself is just over 27,000 square metres and is a mixture of old and new buildings, along with two theatre buildings which members of the community can hire. The school holds over 100 shows throughout the year in their theatres, all of which take place in the evening. They also regularly hold student music performances during lunchtime, and many other arts and music events throughout the year.

In 2017, the school had just over 140 full-time equivalent staff: 90 teaching, 40 support and 16 administration. Their ICSEA ranking was 1129, indicating students have an educational advantage compared to the rest of schools in WA. The school’s average NAPLAN scores for Years 7 and 9 were generally 97% and 99% above the national minimum standard, respectively. The school’s attendance rate was also higher than average at 92%. During the LCSPP, Wattle SC won several awards, such as the Western Australian Secondary School of the Year award and the Governor’s School STEM Award for their advances in STEM education (Department of Education, 2019).

Wattle SC has a staff-led Sustainability Committee that meets monthly to advance the school's low carbon initiatives. The committee is comprised of Keera (teacher), Mei (parent) and three other staff members at the school. The school engages students in their low carbon initiatives, primarily through the student Roots & Shoots program. They also have a small but committed parent and community (P&C) group that helps facilitate various events. In 2017, Jane Goodall visited the school to film a promotional video using Wattle SC as a showcase example of their Roots & Shoots program *(Wattle SC Annual Report 2017).*

Interviews were conducted with members of the Sustainability Committee, the principal and students participating in the student Roots & Shoots team. A teacher and a parent were interviewed to get the perspective of the Sustainability Committee, and five students in grades 9 and 10 were interviewed in a focus group setting. The goal of the interviews and focus groups was to better understand Wattle SC's carbon reduction journey, as well as understanding if, and how, students brought their low carbon knowledge home.

6.4.2 Sustainability Committee

6.4.2.1 *Wesley – Principal*

Principal Wesley has held the position of Principal at Wattle SC since 2003. He has a long history as an educator and was the Principal at two other high schools before coming to Wattle SC. He also previously worked for the Department of Education for several years (Department of Education, 2019).

6.4.2.2 *Keera – Teacher*

Keera is a Science Teacher and Science STEM Outreach Officer at Wattle SC and is the primary contact for most of the school's low carbon initiatives. She's taught at the school since 2012 and plays a large role in managing the student Roots & Shoots team and leads many of Wattle SC's low carbon initiatives.

6.4.2.3 *Mei – Parent*

Mei works as Sustainability Consultant outside of the school and is the only parent on the Sustainability Committee. Mei previously attended Wattle SC and remains involved with the school even though her children have graduated.

6.4.3 Building a Culture of Sustainability

There is a significant focus at the school level on being a good person. There are regular discussions with staff around self-improvement and being part of a bigger picture. Principal Wesley stresses how important it is for people within an organisation to work towards something together, to share common goals and values, and to give staff a sense of purpose.

> *"…we talk about being a good person, we talk about building capacity in yourself and what you contribute and how it makes you feel better in your job…how it enhances your own family by being part of things that are bigger than just yourself. And people want that in their life. They really do." – WSC Principal (Wesley, interview, 22 March 2018)*

He explained that creating a sustainable movement at the school begins with starting small, making it a social norm and appealing to people's values.

> *"Win people's hearts and minds over, in terms of 'it's the right thing to do' to do something in this. It doesn't have to have a massive impact. It's just the right thing to talk about…"– WSC Principal (Wesley, interview, 22 March 2018)*

Principal Wesley said taking it to a personal level also helps to get people on board with the idea of being more sustainable, because then it almost becomes a personal challenge to do better. He reiterated that it is not necessarily financial incentive that stops people from using things like bottled water, but rather a belief about it being the right thing to do.

> *"It's almost like a religious belief in a way. You've got to shift into a new way of thinking and you've got to have a driver who's got to sell a thing that's not the money that you're really doing [it] for. You're doing it for the future and the environment and this world that's going to be full of so many people." – WSC Principal (Wesley, interview, 22 March 2018)*

Keera on the other hand, did understand that financial incentives can be a useful driver to get staff interested in initiatives, particularly because Wattle SC is an independent school that can reallocate savings to other areas.

> *"So, even if people aren't green-minded, then at least they can see the economic sense. In doing that, and being able to save money that can go elsewhere." – WSC Teacher (Keera, interview, 22 March 2018)*

Principal Wesley described the changes that happened at Wattle SC as slow but steady. He used the example of the use of water bottles; initially people did not think twice about grabbing a disposable bottle of water, but over time, jugs of water begin to appear and that became the new normal. Keera also said she noticed that people generally seemed more aware about sustainability issues than before.

> *"…the real impact is the change of attitude by experiencing it here or being part of a process here. It's a learned behaviour that goes on through the community and what they do." – WSC Principal (Wesley, interview, 22 March 2018)*

The Principal also explained the school had to be tended to regularly for things to run smoothly, and it took a lot of hard work to get everyone on the same page.

> *"It's always described as cogs in a machine. And [if] one of the cogs is broken then the others all don't turn around either. So you've got to keep looking and find out which one still needs fixing, "this one, okay, we got them all in place now", which we have."- WSC Principal (Wesley, interview, 22 March 2018)*

Principal Wesley believed that good schools should be having conversations about values and what it means to be a good person. If the right conversations were taking place, he thought staff at schools would not see sustainability as something extra to do, but instead there would be a level of excitement about it. However, he recognised that establishing a culture of good values at a school took time, and he had seen how much time and effort it had taken to build and support the values of Wattle SC.

Key Finding 6-18: The Principal believes that linking sustainability to the values of being a good person with school staff creates more lasting change around sustainability.

6.4.4 A Performance Theatre That's Almost Always Running

As an arts school, the school has two theatres, as well as three dance and rehearsal studios. There is one smaller theatre and the much larger Aspen Theatre, a 456-seated theatre that boasts a function room, servery kiosk, large dressing rooms and large, naturally lit foyers. The Aspen Theatre, as well as rehearsal spaces, can be hired by the public for events and functions throughout the year. With over 150 school performances taking place in 2017, 64 space hires, 3 exhibitions, and numerous rehearsals for students, the Aspen Theatre is in operation until at least 6:30pm nearly every day of the year, with only two weeks around the New Year Holiday period when it is not in use.

For the most part, the theatre is run separately from the rest of the school. The theatre operates on a separate budget from the school, which the Theatre Manager is responsible for. They receive a predetermined amount of funding per year. However, they earn additional income through hiring spaces out to the community. Any savings made in the theatre are reinvested into the theatre to buy additional equipment and upgrades.

As expected, the continuous use of two major buildings at the school means there is an increased difficulty with managing the theatre's operations and costs. For example, unlike other buildings at the school, staff cannot simply turn off all the lights when they leave because buildings are still in use.

> *"So we're not like a school that shuts down at night and thinks, 'Oh, don't forget to turn all the lights off', and then the power runs down and we make a lot of savings. We're still fully in action at night time. But we still can do that efficiently as well." – WSC Principal (Wesley, interview, 22 March 2018)*

The theatre has begun to focus on increasing the efficiency of their equipment and, in 2015, the theatre started to replace their lighting with LEDs, as their original globes blew out. While Ashley, the Theatre Manager, would like to see all their lights switched to LEDs, some of the specific lighting they regularly use does not have a suitable LED replacement available to purchase (Ashley, phone interview, 21 November 2018). The theatre would also like to install solar PV and low flow taps for bathrooms. However, at the time of this research, cost was a barrier.

The theatre has also implemented several small behaviour change initiatives. Some of these included encouraging sustainable behaviours by adding stickers in bathrooms to encourage people to use less paper towels, as well reminders to encourage people to use the half-flush toilet function. Ashley said these two initiatives were easy and effective.

> *"They have been quite easy to install and we have noticed a slight reduction in all of the usage, so that shows that's working." - WSC Theatre Manager (Ashley, phone interview, 21 November 2018)*

While Ashley said the theatre does have a broad sustainability goal of reducing consumption and increasing efficiency, there are no sustainability or carbon reduction targets specific to the theatre. This is largely because the theatre is unable to see their electricity consumption at a building level, making it impossible to see the effects of their theatre initiatives since costs and consumption are aggregated into the school's overall consumption for all buildings.

6.4.5 Successes and Challenges with Waste

Keera said waste is one of the biggest challenges for the school and something they have struggled with on many levels over the years. When the school started to investigate their waste usage and costs, the bills themselves had very little information on them. Keera and the Business Manager went through all bills to gain more clarity and, in the process, they discovered they were charged for multiple mattresses that were left by teachers or other members of the community without the school's approval. This further highlighted the issue of waste at the school.

> *"And I think that was an eye-opener to our registrar as well…to try and work [it] out. Whereas, power, you know how much you've used, and there's a charge for that. But, this is just, 'Oh, we take the bins away twice a week, and this is the charge'." – WSC Teacher (Keera, interview, 22 March 2018)*

The Sustainability Committee also wanted to add recycling bins at the school. However, there were concerns about the additional cost the waste company charges if the bins are contaminated. Keera knew of some schools doing co-mingled recycling, but to be successful, they must heavily monitor it. Given the high risk of contamination for such a large campus, the committee concluded that ensuring bins are not contaminated was too challenging and potentially expensive.

> *"…we wanted to do a lot but the regulations, the rules, of how they treat a school... We don't even have yellow [recycling] bins. We can't."– WSC Parent (Mei, interview, 22 March 2018)*

Mei said that while the school had experienced some challenges around waste, it also helped pave the way for them to become more innovative in the way they approach waste.

> *"I think it became sort of, 'Okay, we can't handle this problem. We can't just give it to someone else to recycle.' So they came up with the idea when looking at recycling plastics and turning them into 3D printing or something. So keeping it*

> *all in-house, not giving it to the outside where it would cost more, the problems with contamination." – WSC Parent (Mei, interview, 22 March 2018)*

Despite their challenges with general waste and recycling, in 2017 the school won a grant to install a state-of-the-art composting machine. It was put at the school as part of a trial connected to the State Government's Waste Wise school program. The composting machine can compost up to 20kg of organic waste per day. An outdoor shed was built to house the composting machine and students can visit if they have supervision as part of a class or activity. The students named it Audrey, based on the Little Shop of Horrors film.

The students collect organic waste at lunch time and each day the gardener picks it up, checks for pieces of plastic, then puts the waste into the composter. Ensuring there is no plastic put in the machine is an important step in the process. Keera thought the composter highly beneficial and was in conversation with Waste Wise to extend the trial at the time of this research.

6.4.6 Wattle SC's Low Carbon Initiatives

During the LCSPP, the school listed over 50 initiatives on their low carbon action plan. Nearly half of the school's actions were focussed on energy, which is slightly more than most schools, with water forming the second largest category. Figure 53 shows the percentage of the school's actions based on carbon emissions category compared to all schools.

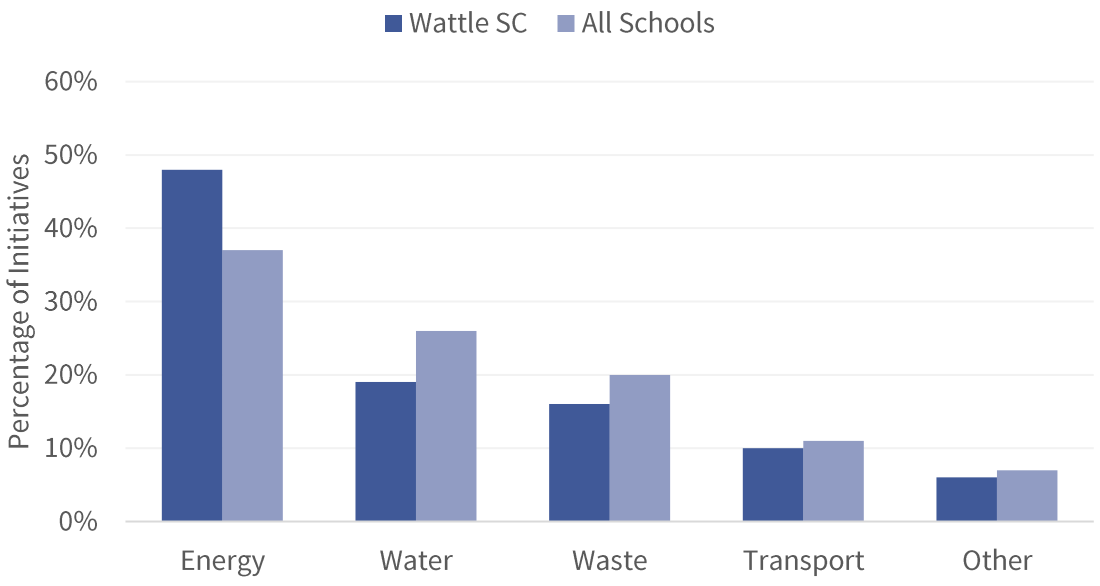


Figure 53: Wattle SC low carbon actions identified by percentage in each carbon emissions category compared to the percentage in each category for all schools.

Over a third of their initiatives focussed on infrastructure, which is shown in Figure 54, and another 25% focussed on investigating options for decarbonisation (e.g. conducting audits or exploring options for better insulation for buildings). Actions in the infrastructure category included initiatives such as installing timers on appliances or purchasing eco-switches. However, most of these actions were still in the planning phase at the time of this research due to upfront cost barriers. They also focussed more heavily on policy-related initiatives compared to the rest of the schools. They established a low carbon/sustainability policy, which included guidelines for sustainable purchasing and they had plans to complete a renewable energy policy, a procurement policy for recycled paper, and a school student drop-off/pick-up policy to reduce congestion.

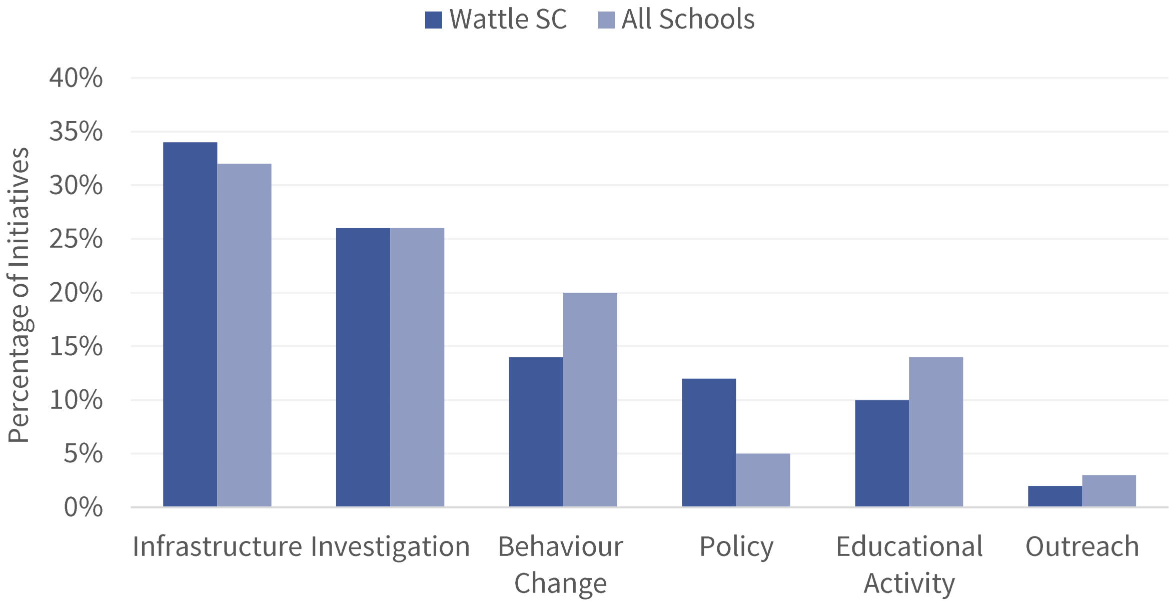


Figure 54: Wattle SC percentage of low carbon actions by type compared with the percentage for all schools.

The school had a relatively small number of initiatives specifically focussed on educational activities for students due to the time of year when the school joined the LCSPP. The curriculum for all subjects and classes were already planned for the following year when the school joined the program, which made it difficult to incorporate new lesson plans or activities. However, the student Roots & Shoots group were involved in other aspects of sustainability, such as recurring recycling drives for uncommonly recycled items (e.g. toothbrushes and plastic bags), as well as recycled fashion shows. Lastly, while the school did not have a dedicated budget for low carbon initiatives, if the Sustainability Committee requested money, it was always considered and often approved if due diligence was done in advance.

6.4.6.1 *Energy*

One action that helped inform many other initiatives at the school was a Type 1 energy audit, which was conducted towards the end of 2016. The audit involved a brief assessment of the areas with the largest electricity consumption and recommended no or low-cost actions that would have the largest impact.

An example of the actions that came from the audit results was to set the hot water heater storage from 60 to 50 degrees Celsius and establishing a switch off protocol. Keera explained that a lot of electronics were left on before the audit, but after utilising the audit findings and initiating an end of day switch off protocol, this was improved. She mentioned that before the protocol was in place, she would go to the office at the end of the day and everything was still left on. Since the switch off protocol was put in place, however, everything was turned off in the office by staff, including the printer.

The Sustainability Committee started the process for their switch off protocol by sending an email to all staff explaining the protocol. To ensure the protocol was followed, the business manager had the gardener, who is on campus during the school holidays, double check that everything was switched off. The first switch off protocol for a school holiday period at the end of 2016 proved very successful, and Keera said she used this success to further inspire staff.

> *"…we got really awesome results from that, so I presented at one of our staff meetings and said, 'Look, this is how much we've saved. We've saved enough to power a house for a whole year.' And, because we are an independent school, I've tried to link it to, 'this is money that we're saving that we can use for other things'. So, even if people aren't green-minded, then at least they can see the economic sense." – WSC Teacher (Keera, interview, 22 March 2018)*

Keera said that while not everyone always follows the protocol, she thinks people at the school are a lot more aware of their consumption than they used to be.

In addition to a switch off protocol, the school switched all the lighting in both gymnasiums to LEDs as part of scheduled infrastructure upgrades. They are also gradually replacing lights that go out with LEDs throughout the school. The school intended to pursue other initiatives, such as installing timers/sensors on lights, air conditioners and heaters and colour-coding the power points that can be turned off at the end of the day. However the handyman did not have time to attend to these initiatives.

When it came to renewable energy, Wattle SC aspires to install 100kW on the school. They have a quote for the cost and a plan of where it will go, but the current barrier is the upfront cost of installation. There are discussions at the school about putting solar PV on in phases so that the financial cost is spread out. However, there are no solid plans in place.

6.4.6.2 *Water*

The school also conducted a water audit where a consultant came and checked all taps for flow rates and leaks. The audit revealed that all school bathrooms had high water-flow taps (9 litres/minute). The Sustainability Committee decided to trial both 2 and 3 litre flow taps in the women’s change rooms to determine which was preferred before they switched all the taps over to low flow. The 2-litre tap was the preferred tap because it had a higher water pressure, so all the water taps in the school bathrooms were changed to 2-litre taps.

Like most schools in the LCSPP, Wattle SC participated in the Waterwise program and held several educational activities for students, as well as putting signs around the school to conserve water. To address water used in gardens, they also developed a plan to plant trees that use less water, where possible.

The school also actively investigates their water consumption from bills on a regular basis, and this investigation enabled them to identify that they had a major water leak that was caused because of neighbourhood construction, which is discussed in a later section. They were also in the process of investigating their groundwater usage and installing rain-water-tanks to use for the edible garden and other garden beds.

6.4.6.3 *Waste*

As mentioned in an earlier section, the school has a state-of-the-art composting machine which handles a large portion of their organic waste and they have an on-campus garden and several worm farms.

They began more closely monitoring their waste consumption during the LCSPP and renegotiated their waste contract in 2016 to get lower waste disposal rates. The amount of paper recycling in classrooms and office spaces was increased and the student Roots & Shoots team held several recycling drives for products like toothbrushes.

They also participated in the Waste Wise program and did activities such as the Message in a Plastic Bottle activity which taught students about plastic consumption and waste. Students were also encouraged to participate in Plastic Free July, where all single-use plastic was avoided for the month of July and students were encouraged to reduce the packaging of their lunch and drinks.

6.4.7 Utility Consumption & Cost

Between 2015 and 2017, Wattle SC's student population increased by 9% to just over 1,500 students. During this time, the school classroom spaces expanded by 200 square metres due to the installation of three new transportable classrooms in 2016. The school's consumption and cost for all three utilities decreased on a per student basis, with the most significant reduction taking place in water consumption. Overall, they saved $2.17 per student on their utilities. The following sections discuss Wattle SC's utility consumption and cost in more detail.

6.4.7.1 *Energy*

Wattle SC used the most total electricity per year than any other school in the program. Despite their student growth, they still saw a 1% reduction in overall electricity consumption between 2015 and 2017 (see Table E11 for total amounts). Their high consumption can largely be attributed to their use of theatres, which mean events are held at the school most days of the year. (Table E12 shows the total utility costs on a total, per student and square metre basis).

The school's total weekly electricity data is shown in

Figure 55, with the school holiday periods circled in yellow. While total electricity consumption did not decrease significantly, there is a decreasing trend overall for most periods of the year, particularly school holiday periods. As shown in Figure 56, the average total electricity consumption for each school holiday period reduced from the previous year from July 2016 onwards. The largest reduction occurred over the summer holiday period, which is the last week of December to around the middle of January. This period saw a reduction of 29% between 2016 and 2017, which is the second largest decrease of all schools in the LCSPP. This demonstrates the success of Wattle SC's switch-off protocols.

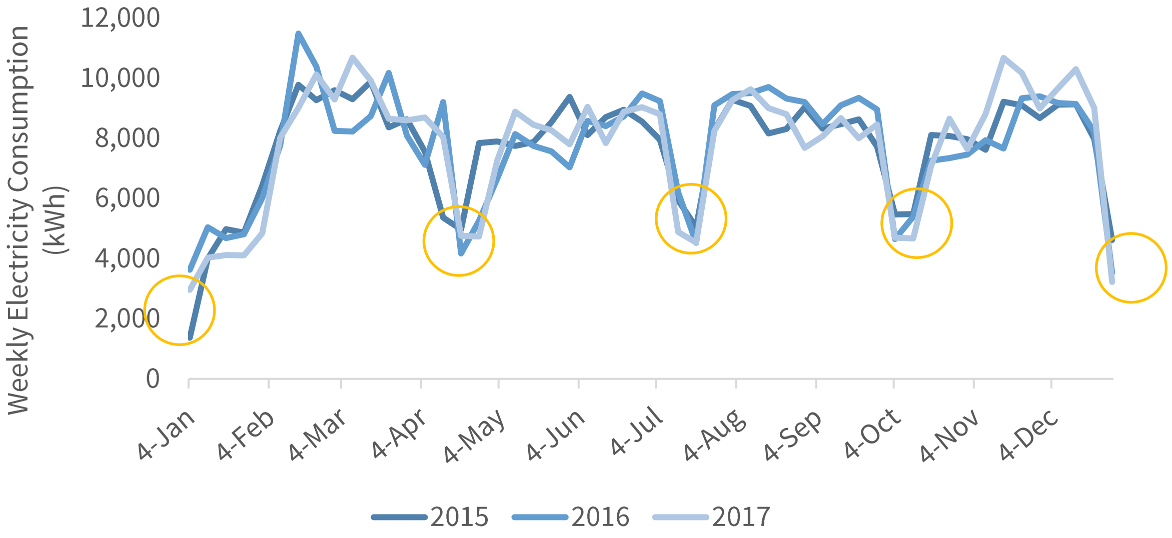


Figure 55: Wattle SC weekly total electricity consumption (2015 - 2017). School holiday periods are circled in yellow.

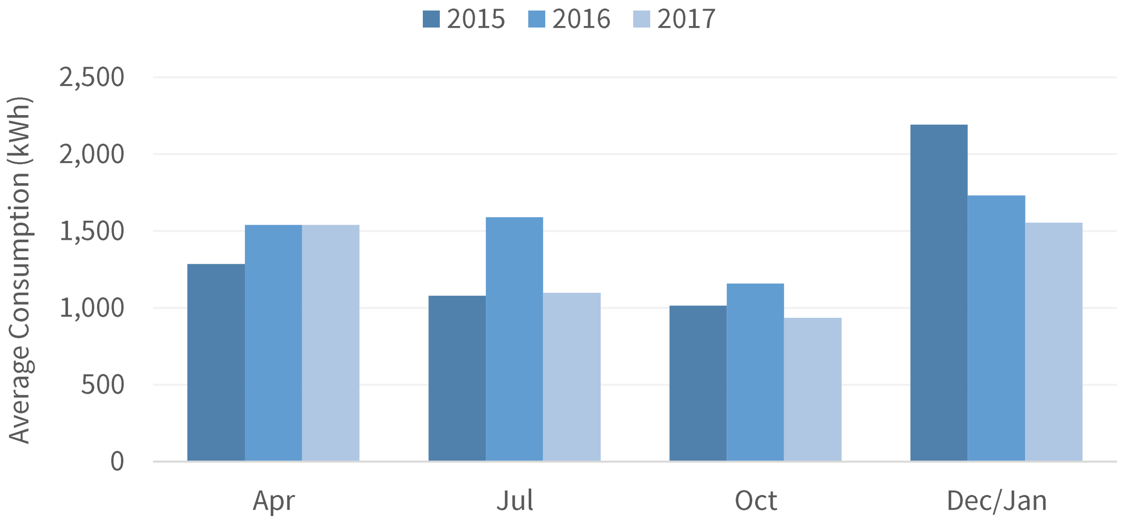


Figure 56: Wattle SC average total electricity consumption during school holiday periods (2015 to 2017).

On a per student basis, electricity consumption decreased by 9%, while their electricity cost increased by 16% (see Table 27). This inconsistency between consumption and cost occurred because the school used 20% more electricity during on-peak times when charges are at a higher cost per kWh, and their energy provider increased the cost per kWh by 16% in July 2016.

Table 27: Wattle SC utility consumption and costs per student (electricity, gas and water) and the differences between 2015 and 2017.

Utility	Measure	2015	2016	2017	Amount Difference (2015/2017)	Percentage Difference (2015/2017)
Electricity	*(kWh/student)*	559	539	510	**-42**	**-9%**
	($/student)	$123.75	$128.03	$132.18	$8.44	7%
Water	*(kL/student)*	4.8	2.8	1.2	**-3.6**	**-75%**
	($/student)	$53.98	$50.47	$46.04	**-$7.94**	**-15%**
Gas	(kWh/student)	37	18	15	**-22**	**-61%**
	($/student)	$4.66	$2.43	$2.00	**-$2.66**	**-57%**
Total Utility Cost	*($/student)*	$182.39	$180.92	$180.22	**-$2.17**	**-1%**

Gas decreased significantly for the school, with a 61% decrease in consumption per student (see Figure 57) and 57% reduction in cost per student. This decrease, however, can be largely attributed to issues with gas leaks at the school. In 2016, they discovered they had several gas leaks across the school and to fix the leaks, gas had to be turned off for several months.

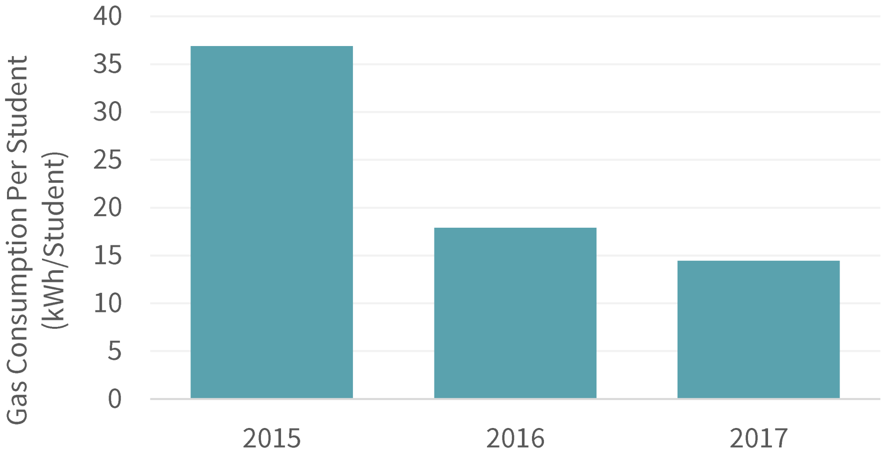


Figure 57: Wattle SC gas consumption per student (kWh) (2015 - 2017).

6.4.7.2 *Water*

Wattle SC's water consumption also significantly decreased by 75% with an obvious decline in usage after the school switched all their faucet taps in bathrooms from 9 litre to 2 litre, as shown in Figure 58. From October 2016 onwards, their water consumption was 15% less than in previous periods. The spike in consumption seen in March 2017 was caused by leaks in the shared neighbourhood pipes from construction works. While the school achieved a high reduction in consumption, their costs only decreased by 15%, which still saved them $5,560 during their participation in the program. This disproportionate decrease in cost was due to the 110 water fixtures (e.g. toilets and urinals) the school had on campus. They were charged $94 per fixture from the Water Corporation and these charges made up 80% of each water bill.

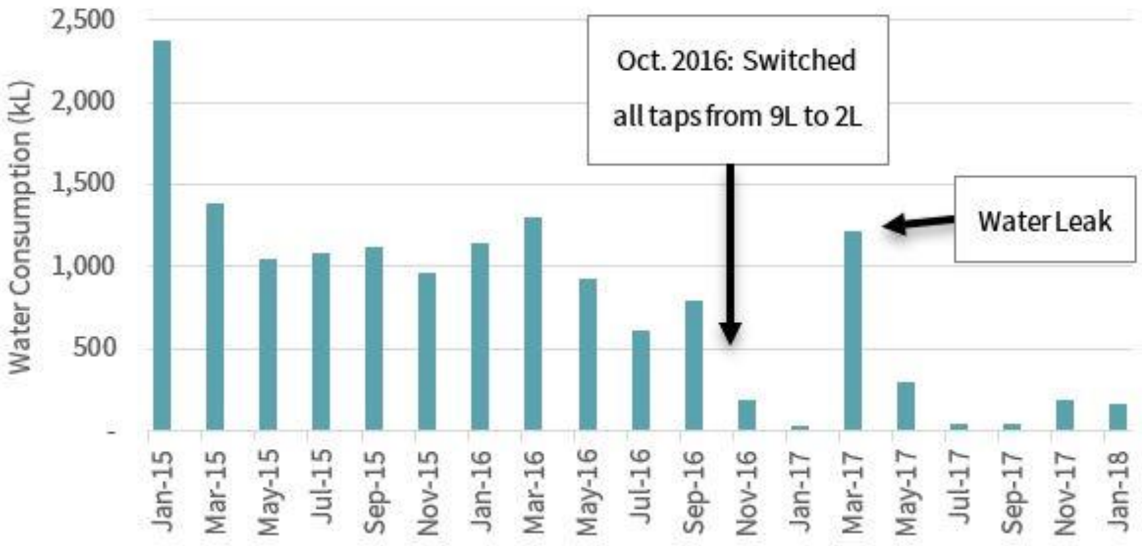


Figure 58: Wattle SC total water consumption (2015 - 2017).

Key Finding 6-19: A water audit helped the school identify the presence of inefficient water taps and changes subsequently allowed them to save over 500 litres of water per bill.

6.4.8 Carbon Emissions

Wattle SC saw a 17% decrease in their carbon emissions per student, which was slightly lower than the average across all schools. Electricity accounted for 99% of their total carbon emissions, and while they only decreased their total electricity consumption by 1%, they still saw a 10% decrease in total carbon emissions. This was due to the changing electricity grid in Western Australia which used more renewable energy in 2017 than 2015. Table 28 shows the school's carbon emissions on a total, per student and square metre basis.

Table 28: Wattle SC total carbon emissions (tCO2-e) on a total, per student and per square metre basis from 2015 to 2017. The percentage difference between 2015 and 2017 is also shown.

Measurement	2015	2016	2017	Percentage Difference (2015/2017)
tCO_2-e (total)	698.26	647.61	625.30	**-10%**
tCO_2-e/student	0.477	0.433	0.392	**-18%**
tCO_2-e/m^2	0.025	0.023	0.022	**-11%**

6.4.9 Student Engagement

Roots & Shoots was the student-led group at Wattle SC that worked on various low carbon initiatives at the school. Roots & Shoots is an initiative of the Jane Goodall Foundation and the structure of the organisation is set up to encourage students to pick three projects per term: one for animals, one for people and one for the environment (Wattle SC Website, accessed 03 November 2018).

At the time of this research, the group was comprised of students from grades six to twelve with around 10 to 30 students regularly attending meetings. Keera said the group had always focused on what the students wanted to do, and they received the support they needed to make ideas happen.

> *"At the beginning of the year they come up with these just crazy things that they wanna do. Really crazy. And then we narrow it down, and we work it into other ones, and myself and another teacher, we try and help them get to that." - WSC Teacher (Keera, interview, 22 March 2018)*

In 2017, following student concerns about animal cruelty and environmental impacts, the students increased the amount of vegan options at the canteen. One of the recurring campaigns the Roots & Shoots team ran was a recycling drive held multiple times throughout the year where they encouraged parents to bring less commonly recycled items to the school campus to be recycled.

The group also participated in several tree plantings and clean-ups events throughout the year and they helped facilitate events, such as recycled fashion shows where students created fashion pieces with only used items of clothing.

When asked about their ideas for acting on climate change, the students had several ideas. Sam thought simple things could be done by young people on an individual level, such as recycling, having shorter showers and eating vegetarian food.

> *"I usually have four-minute showers just because...things like that, eating not too much meat because obviously, meat is methane so I'm half vegetarian, because at my mum's house I'm part vegetarian, but at my Dad's I am." – WSC Student (Sam, focus group, 22 March 2018).*

> *"Just really simple things in everyday life, like recycling, and not wasting water and having half an hour showers... not eating not too much meat because obviously, meat is methane…" – WSC Student (Nat, focus group, 22 March 2018)*

Another student, Andy, thought that putting solar PV on your house and thinking globally and acting locally was important. Sam also talked about her observations of how plastic deteriorates in the environment, and how that encourages her to avoid plastic.

> *"When I came on the bus home, once I saw this plastic bag fly into a tree and it got caught there and every single day, on the way back from school I look at the tree and progressively watched it deteriorating and bits flying off. It's still there, it's just tangled in the tree." – WSC Student (Sam, focus group, 22 March 2018)*

The students also talked about getting solar PV installed at the school. Since the school did not have funding to install solar, the students were brainstorming ideas about how to raise money for the solar PV. The students said they were limited with their options, however, because they could not have fundraisers, such as bake sales because it interfered with school canteen’s sales.

> *“We had this whole brainstorming session where we just got all the possible ways we could get [the money]… there were are a lot of draw backs because we would like to do bake sales and stuff to help raise money, but the canteen hates when we do bake sales because it’s a separate company, not run by the P&C.” – WSC Student (Sam, focus group, 22 March 2018)*

Despite these challenges, the students were thinking of ways around these types of issues and had come up with creative ideas, such as trying to get someone famous like the actor Sam Worthington to fund their solar PV.

All students also reported that they had all changed their attitude or behaviour in some way since getting involved with Roots & Shoots. Another student said he had changed the length of his showers and was more aware of things wrapped in plastic at the supermarket.

> *“I'm just a lot more mindful about what I do, and like litter and stuff, especially litter.” – WSC Student (Nat, focus group, 22 March 2018)*

> *“I always think a lot more about what I put in the bin, whether it can be recycled and all that.” – WSC Student (Chris, focus group, 22 March 2018)*

The Principal said he had noticed changes over the years in students participating in the Roots & Shoots team. He had seen some students leave so inspired that they had graduated and begun pursuing careers in sustainability.

> *“They've been inspired by it and you're really laying down the seeds of things 10 years in advance. Not looking for short term gains in a school environment.” – WSC Principal (Wesley, interview, 22 March 2018)*

Mei said she saw the potential for students to lead low carbon initiatives in the future. She thought the students could also do all the data analysis and reports and saw this as a huge opportunity for the students to be involved in something bigger at the school. Keera also thought an ideal scenario to incorporate carbon emissions reduction into schools would be to mandate, within the national curriculum, that all classes include a small focus on sustainability.

> *"... put the kids in charge of the whole thing; the strategies, and they collaborate with the business managers, and they come up with the initiatives." – WSC Parent (Mei, interview, 22 March 2018)*

Keera said they were starting to build a committee of STEM teachers to work on integrating low carbon initiatives and other aspects of sustainability into the curriculum. The Sustainability Committee saw this as an important step, and Principal Wesley saw a lot of benefit in integrating sustainability into the curriculum.

> *"…when it's part of their normal curricular learning, then the children will do it with a more solid focus on it rather than add-on. Because they know it's counting for marks and, of course, the teachers won't be complaining, they'll get on board. So you can get a much bigger barter." – WSC Principal (Wesley, interview, 22 March 2018)*

The school tried to focus on educating students in a way that allowed them to see the root issues of the problem, and Principal Wesley said this was something that had improved over time. Keera said her approach to educating students about environmental issues was never to tell the students not to do something, but rather focus on providing them with the information and the facts, and hope they make their own decision.

> *"I certainly don't stand there and go, 'Don't use plastic ever again.' But at least, they have all the facts, and then they can… make a decision from that." – WSC Teacher (Keera, interview, 22 March 2018)*

She hoped that by modelling best low carbon practice at the school, students would take that knowledge and change their behaviours at home.

> *"…modelling best practice, which we should be doing anyhow in all things. Then that will translate to home. Or at least, have an awareness on people's radar that these things are happening." – WSC Teacher (Keera, interview, 22 March 2018)*

Principal Wesley reiterated how he thought the biggest benefits of low carbon initiatives was their potential to influence students and, subsequently, society.

> *"…that's where you get the real impact - is what happens in the household. You get children learning about the recycling process and things here… And in the homes all of a sudden they start talking better about their recycling, and about*

> *separating their glasses and plastics." – WSC Principal (Wesley, interview, 22 March 2018)*

6.4.10 Parent, Peer & Community Influence

Few students discussed influencing their peers, with most of the students saying they did not discuss very many low carbon topics with their friends. Some students feared coming across as "nagging" and Sam said she did not feel like her friends actually listened.

> *"Yeah, it feels a bit nagging." – WSC Student (Andy, focus group, 22 March 2018)*

> *"I think if they actually took in what we said, actually acknowledged it, then I would do it more… now, they're all just like," yeah, yeah…" But, mind you, the littering thing all my friends will go and pick up litter if I ask them to, but apart from that…." – WSC Student (Sam, focus group, 22 March 2018)*

Most of the students said they discussed low carbon living with their parents. However, there were mixed responses about influencing their behaviour. One student acknowledged that he had not really done much to influence his parents because his family were already quite environmentally-minded. Another student said her family was also already moving away from plastic bottles because her mother was worried about their health impact. Cam said that he tried to use less plastic and encouraged his family to use renewable energy, where possible.

> *"Using less plastic. I've also been making sure that my parents are gonna use solar PV in the next house that we're building." – WSC Student (Cam, focus group, 22 March 2018)*

Other students mentioned that they would encourage their family members to be more sustainable, whether that was telling them to take a shorter shower or encouraging the family to buy biodegradable bin bags.

> *"The main thing that I do is, when my sister is in the shower for half an hour singing "Hey Ya", as much I love my sister singing (I don't really)…I do tell her get out of the shower." – WSC Student (Nat, focus group, 22 March 2018)*

> *"…one time I brought home a little pamphlet that we stuck on the fridge because it a magnet for Roots & Shoots and it's interesting 'cause in there it said that*

> *Gladwrap was recyclable. So, we just recycle Gladwrap from now on." – WSC Student (Nat, focus group, 22 March 2018)*

However, students also brought up the challenges asking family members to change their behaviour.

> *"So, it is hard to tell them what to do 'cause unless the president of the world just goes, 'Yep, no one is allowed to have more than four minute showers', even then people wouldn't do it because it is their choice, and you just have to say, 'It's for your own good and if you want to do it, do it, I highly recommend it'." – WSC Student (Sam, focus group, 22 March 2018)*

6.4.10.1 *Parent Survey Results*

To get the family perspective on intergenerational influence, surveys to parents/guardians of the students were sent through school newsletters and a total of 62 parents completed the survey. Wattle SC had the highest number of total responses out of all the schools. However, the number of parent responses only represented 3.8% of the student population.

Over half of the parents knew about the school's low carbon initiatives and they primarily knew this from reading the school's newsletter or from their child. Most parents were aware of recycling initiatives (67%), and over half also knew about actions to lower the school's energy usage. This indicates that the school was successful at communicating their recycling and energy reduction initiatives within the parent community.

While there were mixed responses in the focus group from students about whether they discussed LCL topics with their family members, almost exactly half of parents said their child discussed LCL topics with them, which was slightly above the average across all schools. The things the students discussed most with their parents were the effects of climate change, recycling, and renewable energy (See Table E13 for all responses about LCL topics discussed). Compared to the rest of the schools, parents at Wattle SC reported more discussions with their children about climate change and renewable energy. This could indicate that students had more exposure to climate change education than some other schools.

Nearly a third of parents reported that they noticed changes in their child's LCL attitudes or behaviour, with 60% of them attributing this change to the school (i.e. school activity/excursion or classroom education) and the rest attributing these changes to their family. The changes parents described were almost identical to those described by the rest of the schools. They included encouraging others to act more sustainably, recycling more, using less plastic and generally being more aware of the surrounding environment (see Table E14 for all student attitude and behaviour changes).

Just under a quarter of parents said their child encouraged them to adopt new LCL household practices, which is 10% lower than the average across all schools. Unsurprisingly, many of the household practices that children influenced were related to recycling, which could be because the Roots & Shoots team holds recycling drives multiple times throughout the year. Reducing plastic use was a common influence, along with encouraging families to turn off lights and travelling more sustainably (see Table E15 for all responses). Exactly 60% of parents said they experienced changes in their own LCL attitudes or behaviour. However, only 7 % said these changes were because of their child, which is much lower than other schools. Most of the parents said their changes in attitude or behaviour were caused by either their own personal beliefs or a news source.

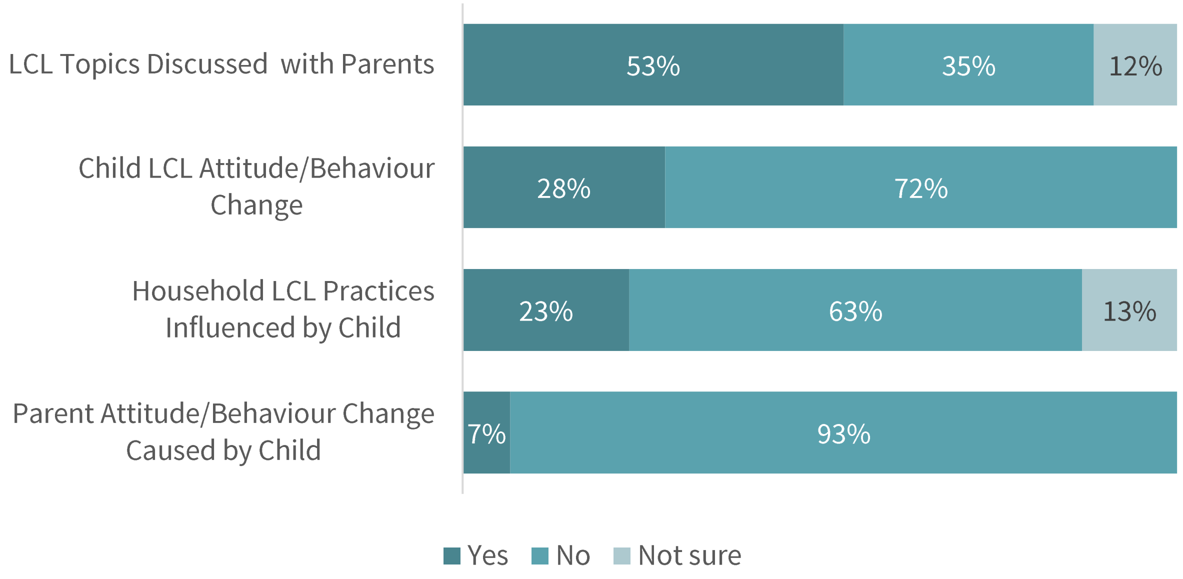


Figure 59: Wattle SC parent survey responses to each of the intergenerational influence survey questions.

When the Low Carbon Readiness Index (LCRI) scores were averaged across all parents for Wattle SC, their average (3.7) was exactly the same as the average shown across all of the schools, indicating parents at the school were not any more or less likely to be ready to transition to low carbon living than other schools in the cohort. However, fewer parents reported that their child influenced their home LCL practices, and even fewer said they had personally changed their LCL attitudes or behaviour because of their child, indicating there could be other factors at play affecting Wattle SC students' influence on their parents and family.

Correlations were calculated between intergenerational influence questions and the LCRI scores to understand the relationships between the variables. Like the rest of the schools, there were no significant relationships between the intergenerational influence questions and the LCRI. However, there was a very strong correlation (r_{φ}=.90) between children changing their LCL attitudes or behaviour and parents reporting that their child influenced changes in their household (see Table E16 for correlation table). This correlation was much stronger than the rest of the schools which might indicate that Wattle SC students who were acting more sustainably themselves were more effective at influencing their families.

6.4.11 Challenges

Throughout their carbon emissions reduction journey, Wattle SC also encountered several challenges. Getting enough staff time to work on initiatives was an ongoing challenge for the school. To try and address lack of staff time, the school tried to involve parents and their local community in their initiatives through their newsletter, online school platforms, their Facebook page and Twitter. However, Keera said it could be difficult to engage parents because they lived all across Perth, sometimes quite far from the school. Mei (a parent) also mentioned that the school struggled with volunteers because parents tended to be time-poor. Keera said there were strong communities at the school around arts and sports, but less of a cohesive school-wide community due to the geographical spread.

> *"I think there's quite a community maybe with our arts and with our soccer as well…So I think we do have that community. But it's not kind of like a whole school community…" WSC Teacher (Keera, interview, 22 March 2018)*

Mei thought issues with the staff having a lack of time could be helped by involving students more in the carbon emissions reduction process. She thought it was unrealistic to rely on teachers to do it all.

> *"Because it is so big, you need the kids to help. You can't really expect teachers to do it." – WSC Parent (Mei, interview, 22 March 2018)*

Key Finding 6-20: The school struggles with a lack of staff time to work on low carbon initiatives and parents are generally too time-poor to be involved.

One way the school was addressing this lack of teacher time was by integrating low carbon initiatives into the curriculum – an area Keera and other teachers at Wattle SC were working on. However, integrating initiatives into the curriculum can be problematic, not only because of how rigid curriculum requirements are, but because a high degree of pressure exists around student outcomes. Principal Wesley talked about the pressure on students to be high achieving from themselves, parents, and the Department of Education. The teachers must also meet specific learning outcomes, which means many teachers are resistant to anything that is perceived to be outside of these tightly defined academic goals. He said that if initiatives were not integrated into the curriculum, there would not be much uptake by teachers.

> *"…if you run a project where it just cuts time into people's learning programmes, and it means teachers have to do extra work, or give out other time, you'll probably find some will altruistically have a go at it and do it. And others will just go, 'look, someone else can do that'." – WSC Principal (Wesley, interview, 22 March 2018)*

Keera said it was also difficult to pursue most initiatives at a classroom level at a high school because each teacher only had a group of students for an hour. She used the example of how she only had her science students for four hours a week, which made it hard to dedicate a classroom to an initiative or activity like teachers could in primary schools. She also explained that the school's curriculum was already over-crowded, and she said some of the greatest successes they had integrating an initiative into the classroom had been achieved when they had all the work sheets and materials ready to give to teachers.

> *"…the most successful things that we've done here, Message in a Plastic Bottle, [is] because I can hand people work sheets… And a PowerPoint, and say, 'This is what you're teaching for three periods next week'." – WSC Teacher (Keera, interview, 22 March 2018)*

Keera would like to see low carbon initiatives mandated into the curriculum, like in maths. Given that STEM (Science, Technology, Engineering, Math) is a significant focus at schools, she sees potential with the curriculum integration of low carbon activities that are focussed on STEM. Keera said that at the end of the day, high schools are jam-packed with activities and curriculum, so it becomes about finding a way and being creative about it.

> *"So, if there were programmes that fitted in to that [national] curriculum. If they could find holes in there and say, 'Right, this is this hole we're gonna plug with this, this is this hole we'll plug with that.' Then that would make it a lot more successful."* - WSC Teacher (Keera, interview, 22 March 2018)

Key Finding 6-21: Staff report secondary schools are under pressure to deliver strict learning outcomes under the national curriculum which constrains teachers' willingness and ability to incorporate additional topics into their classrooms.

Difficulties finding times where all staff could attend meetings was also identified as an issue when the school first signed up to participate in the LCSPP. While a lot of people were very interested in participating, there were difficulties with people being unable to attend meetings. Keera said these schedule conflicts often make it difficult to keep interested people involved. However, people such as the school dance teacher and school gardener, who both could not make low carbon meetings, were still able to participate in some capacity and were kept in the loop with meeting minutes.

The school has also struggled with finances as Wattle SC was one of nine schools that received significant cuts to their funding in 2017. This meant the school had to re-evaluate their budget and some initiatives were no longer able to go ahead. Keera said that before the Department of Education changed the funding structure for high schools, they talked about hiring a school sustainability officer for two days a week. However, once their funding changed, this was no longer an option.

The Sustainability Committee reiterated how the school aspired to do more upgrades to infrastructure like solar PV and LEDs, but upfront cost was a major barrier. In addition, the uncertainty around school funding from the Department of Education also made it challenging for the school to plan long-term finances, and policies made acquiring solar PV challenging. Keera spoke of another high school she knew of that had tried to jump through policy hoops to get solar PV for nearly two years, with little progress. While the school has discussed alternative funding options, such as installing the panels in phases or holding fundraisers for the panels one by one, the cost was still too prohibitive. Keera said she would like to see the government provide more funding options for schools.

> *"So, it'd be really nice if the government would have like, a million dollars. And it would be, 'Right, we're gonna give this to you, but this is when you're gonna pay us back. So that you could do all that infrastructure'."– WSC Teacher (Keera, interview, 22 March 2018)*

Key Finding 6-22: The school identified several policy-related barriers to change, including changes to funding structures and a lack of policy support for solar PV.

In addition, Principal Wesley said their steady increase in student population at the school was making it difficult for them to see the financial impact of initiatives, because each new student increased their overall resource consumption, in addition to the school's increasing use of electronic devices that used electricity. Given their large budget (over $20 million), Principal Wesley did not always see the direct cost benefits of low carbon initiatives. This was particularly true when considering the cost of hiring consultancies to scope and install new efficiency measures. However, he noted that financial benefit was not the only reason for taking action.

> *"When you talk about saving money, it actually costs me a lot more money to be part of the environmental processes than anything I'd ever save. Because it's staff costs…You send them off in the year, you might have sent two or three thousand dollars of their time just getting them off to things, and the savings they make financially in the school were only $2,000 or something like that... [however] It's never about the money side, and it shouldn't be about it." – WSC Principal (Wesley, interview, 22 March 2018)*

With the high number of theatre productions occurring in the evenings and on most days of the year, Wattle SC experiences a significant challenge when it comes to energy conservation. Mei touched on this, mentioning that despite the unique challenges with the school, these challenges also provide significant opportunities.

> *"…the potential there is great because if you find an initiative in the theatre to reduce your power, you're going to reduce a lot. So it's that diversity of built form, types of kids that are here, and the new and the old. Your opportunities are varied, your challenges are varied."* – WSC Parent (Mei, interview, 22 March 2018)

Keera said they also still struggle to manage some of their newer building's energy usage, particularly when it comes to lighting at night.

> *"…we're still having a battle with the new building. 'Cause all the lights are on, on the outside…it's this glowing beacon on the hill…But the lights are connected to the alarm system. So when the alarm's on, the lights are on."* – WSC Teacher (Keera, interview, 22 March 2018)

Lastly, the school struggled with diversifying their waste streams and understanding their waste consumption due to their waste bills having little information on them. The school would add more recycling bins around school, but the risk of contamination due to user error was too high when the school considered the financial repercussions by the waste company if recycling bins were contaminated. This risk prevented the school from adding additional recycling options. Keera also referenced the amount of red tape there was, even when it came to managing the organic waste bins due to rules and limitations with the job descriptions of the cleaning staff, preventing them from emptying them.

Key Finding 6-23: A high risk of contamination for recycle bins due to user error and the subsequent high cost associated with contaminated bins prevented the school from increasing recycling options.

6.4.12 Wattle SC's Success

When looking at the successes of Wattle SC, having a passionate leader like Keera, principal support of initiatives, strong desire to demonstrate values-based leadership and education experience to improve and build capacity within school staff, were all identified as important factors in their success.

Keera said the electricity and water audits were key success factors in their carbon reduction journey because it allowed them to understand their usage and take actions in areas that had the most impact. Mei thought audits, in addition to implementing a strategic approach and system of monitoring and reporting was very useful for the school.

> *"So yeah, just setting up the simple process of 'Well, let's record what we're doing. Let's put it all in one place.' Because, again, all of that info's there, but it's just scattered through the business. Yeah, I thought that was a great process." – WSC Parent (Mei, interview, 22 March 2018)*

The school holiday switch-off protocol was one example of how the Sustainability Committee was able to show savings from the initiative and get more people interested and willing to participate.

> *"...you do an audit, a few initiatives, and then a really good report on what we're doing, where we're going, and where we want to go. And then once we got that, I think that's when we got the support from people." – WSC Parent (Mei, interview, 22 March 2018)*

Mei and Keera also noted that a good relationship with the school business manager was highly important for the school. The business manager helped ensure the success of initiatives, such as the school holiday switch off protocol by asking year-round staff members, such as gardeners, to check that appliances and lights were turned off.

> *"I think between Keera and Pam, the business manager, together they worked as a team and really got things on the ground." – WSC Parent (Mei, interview, 22 March 2018)*

Key Finding 6-24: A good relationship with the school business manager played a key role in advancing the school's low carbon initiatives.

Relationships with other schools in the LCSPP was also something Keera thought was beneficial because they were able to learn from other schools about how they were approaching carbon reduction. Other partnerships, such as those with state government programs, such as Wastewise, enabled them to trial a state-of-the-art composting machine, which would not have otherwise been possible for the school.

> *"I think it was interesting to see how other schools did things. So that you can say, 'Alright, it's working there.' Not everything about it might work, but at least*

> *there's a basis to start from. So the meet-ups were really good with the programme." – WSC Teacher (Keera, interview, 22 March 2018)*

From the Principal's perspective, one of the most successful strategies for the school was investing in staff and focussing on increasing staff capabilities. Principal Wesley highlighted that having staff members like Keera was highly important to push initiatives forward. He explained that someone driving change within a school must be able to speak well in public to convince others to come on board with an idea. However, it could be difficult to find staff that had both passion and leadership skills.

> *"You've got to have all of them in place. So normally they're a good scientist, or normally they're really passionate about their thing, but they're really quirky and they can't stand up and sell it."– WSC Principal (Wesley, interview, 22 March 2018)*

The Principal is a firm believer that investing in staff results in many positive outcomes, including positive impacts on the children's lives. He saw the low carbon journey as one that involved spending time and money to upskill and grow school staff and he believed this investment in key staff members pays off.

> *"It's worth sending those people to those things but money, it's worth spending the money, because of the impact that Keera has on children's lives and on their futures is amazing. And what I invest in her comes back a hundredfold."- WSC Principal (Wesley, interview, 22 March 2018)*

When asked about the initiatives that were most successful, Principal Wesley did not believe that any single project had the most impact. Rather, he saw the biggest impact in how the culture around sustainability was cultivated within the school. He mentioned how the school focussed on getting the whole school to work towards common values and encouraging staff to act as good role models for students.

> *"We have a value set that says the adults have to act in this way and the children may or may not learn from us modelling those with them. We don't have charts on walls that say, 'You will do this as a kid, you have to do this.' We have it for the staff, we say, 'you will behave in these proper ways and with a social conscience and also morally and ethically well, and then you will model that for children'." – WSC Principal (Wesley, interview, 22 March 2018)*

Key Finding 6-25: The Principal reported that building leadership capacity in staff was their most successful strategy, enabling staff to become more effective changemakers at the school.

6.4.13 Text Analysis & Emergent Themes

All of Wattle SC's reports, business plans and newsletters were analysed to understand how the school communicated its low carbon initiatives with the community. In their 2017 Annual Report, the school had a dedicated page for their sustainability and environment initiatives, including sections discussing their participation in the LCSPP, the Roots & Shoots Club and their Wastewise Program progress *(Wattle SC Annual Report 2017).*

In the school's Business Plan for 2016-2018, they included a commitment to reducing their environmental impact through the better management of resources. Under the section "Building Healthy Relationships with Each Other and the World" was the below strategy and achievement target:

> *(strategy) "Maintain an Environmental Sustainability Strategy linked to the Australian Curriculum."*
>
> *(achievement target) "Demonstrate a trend towards reducing the college's impact on the environment including rehabilitating the natural environment, utilities management and recycling."*

Moving forward, the school will be removing the separate section and instead weave their low carbon goals throughout the entire business plan. The school also regularly mentioned the initiatives of the student Roots & Shoots team in their newsletters, with the group and other initiatives of the Sustainability Committee mentioned in about 70% of their school newsletters in 2016 and 2017. In some newsletters before the school holidays, the Sustainability Committee also included information about water conservation and electricity conservation, with one mention of their carbon reduction goals.

6.4.13.1 *Emergent Themes across Participants*

When the Sustainability Committee members talked about barriers in interviews, a crowded curriculum, lack of time to implement initiatives and policy issues were the main themes that emerged. Having a champion within the school to lead low carbon initiatives was also the primary theme discussed by all committee members when talking about the success factors of the school. Passionate people, having the support of the Principal and teamwork were also mentioned frequently. In all interviews, there was also an emphasis on the potential for students to influence the wider society through influencing their family. Table 29 shows a summary of categories and themes and the number of times each theme was coded in the interviews and focus groups.

When the word frequency of the interviews was analysed, it was evident people (staff and students) were at the centre of the discussions in the interviews. The words “people”, “students/children/kids”, and “teachers/staff” were the top three most frequently mentioned words discussed by interviewees. In most cases, “people” was used to described staff members at the school. The terms “money” and “savings” were also widely discussed, with most of the discussion taking place around the opportunities to save money, as well as a lack of money to pursue larger initiatives. Like other case study schools, “time” was also mentioned regularly as something that was lacking at the school. The twenty most frequently mentioned words are summarised in Figure 60.

Figure 60: Wattle SC 20 most frequently used words mentioned in the interviews.

In the student focus groups, “plastic” and “recycling” were the most commonly discussed words. The students all suggested a reduction in plastic consumption to act on climate change, and this was also a theme they highlighted in the conversations they had with their families. This focus on recycling and waste by students is reflective of the initiatives the Roots & Shoots team runs, such as recycling drives. There was also an emphasis on “solar”, with students mentioning solar in several discussions about installing solar PV at the school, and even in their own homes. Figure 61 shows a visual representation of the 25 most frequently used words used by students.

Figure 61: Wattle SC 25 most frequently used words by students in the focus group.

Table 29: Wattle SC summary of coding themes and the percentages of school stakeholders that had responses that fell into each category. The interviews and student focus groups were analysed for themes as well as the committee member survey responses (n=11).

Category	Theme	Number of Responses
Barriers & Challenges	Crowded Curriculum	3
	Linking Initiatives to Curriculum	2
	Getting School Stakeholders on Board	1
	Lack of Knowledge	1
	Lack of Money	2
	Lack of Time	3
	Policies	2
Behaviour Change Challenges	Convenience	2
	Habits	3
	Old Social Norms	3
Behaviour Change Solutions	Education and Awareness	2
	Leading by Example	3
	New Social Norms	3
School Carbon Emissions	Importance of Measuring CO2	1
	Involving Students	2
	Saving Money	1
School Role in Community Decarbonisation	Educating Community	1
	Educating Kids	3
	Home Behaviour Change	2
	Influencing Parents via Students	6
	Modelling Best Practice Sustainability	1
Social Impact	Community Outreach	1
	Own Attitude and Behaviour Changes	4
	LCL Actions Already Taken as a Family	3

Intergenerational Influence	Student Encourages Family Behaviour Change	2
	Student Talks to Family about LCL Topics	4
Peer Influence	Bring up LCL Topics with Peers	2
	Taking Responsibility for Other People's Actions	1
Student Involvement	Student Empowerment	2
	Sustainability Integration into Curriculum	3
Student Ideas for LCL Action	Individual-level	2
Success Factors	Importance of Policy	2
	Passionate people	2
	Support of Administration	1
	Support of Other School Staff	1
	Sustainability Champion	4
	Teamwork	2

6.4.14 Summary

Wattle SC is a school ripe with culture, arts and values. They have a passionate Sustainability Committee championed by Keera who work on low carbon initiatives, with support from the Principal and administration. It is clear the Principal and staff see the potential for their low carbon initiatives to have ripple effects beyond the school through the students and into society. Students themselves said they have changed their own attitudes/behaviour from participating in the Roots & Shoots team, showing this impact.

The school was proactive about communicating with their community, and parents were largely aware of the main initiatives the school was pursuing, such as the Roots & Shoots recycling drives. Recycling was also the most common topic discussed with parents, as well as the primary change observed in student and household behaviour, which indicates that the messaging from the school around recycling was strong and consistent.

Wattle SC's school campus itself is unlike most schools due to its large performance theatre, which presents a unique set of challenges. However, these challenges did not weaken the resolve of the committee and students, and they explored new pathways and creative ways around these issues. The school also demonstrated the benefits that can be seen when effort is made to investigate consumption through water and energy audits, shown by their significant water savings from switching to low-flow taps. The committee reiterated the value that can be gained from approaching this investigation through the lens of school carbon emissions reduction.

The Principal firmly believes that building capacity in staff and growing their capabilities is a key to ensuring success at the school. This focus on building capacity in staff, in conjunction with focussing on the values and goals of being a good person and doing the right thing for the environment, creates a strong environment of purpose and positive values in the school. Strong leadership clearly plays a crucial role at the school, and Principal Wesley is unequivocal about why Wattle SC is on their sustainability journey.

6.5 Banksia Secondary College

6.5.1 School Overview/Background

Banksia Secondary College is a secondary college with students from years 7 to 12 located approximately 20 minutes outside of Perth CBD. Banksia SC is the only secondary school in a suburb that is rapidly growing, including many new suburban housing developments built since 2000. The suburb has a long history of environmental education, with a large portion of the area reserved as bushland, with extensive nature walks and parks (Seth, personal communication, 12 November 2018).

The school opened in 2014 and has seen a dramatic increase in student numbers, with a 270% increase between 2014-2018. A big portion of this increase was due to the introduction of Year 7s and 10s to the school starting in 2015. There has been a steady increase in student numbers each year. The school is expected to continue to rise in student numbers until another high school is completed in the area in 2020.

In 2015, the school had an ICSEA value of 1005, which indicates the students have an average educational advantage compared to other Perth schools. They also have 8% students whose language background is not English and 2% of the school are Indigenous. In 2017, the school had 163 full-time equivalent staff: 99 teaching, 48 support and 16 administration. They have an average attendance rate of approximately 88%, and their average NAPLAN scores for Year 7s and Year 9s in 2017 were 80% and 73% above national minimum standards respectively (Banksia Secondary College, Education Department Website, accessed 04 December 2018).

Banksia SC has several committees that work on various sustainability initiatives, such as transport, water and waste. There is also a Low Carbon Committee, which is comprised of staff, teachers, and the student-led Eco Team that aim to reduce school carbon emissions. Banksia SC also employs a school Sustainability Coordinator whose role is to advance the school's sustainability efforts in all areas.

Interviews were conducted with the most involved Low Carbon Committee Members: the Principal, the Sustainability Coordinator and the Building Facilities Manager. Two focus groups were also held with students who participate in the Eco Team. Below is a brief overview of the committee members interviewed.

6.5.2 Low Carbon Committee

6.5.2.1 *Liam – Principal*

Liam is Foundation Principal of Banksia SC. He undertook leadership roles at three other high schools in the Perth Metropolitan area before starting as Principal of Banksia SC. He also previously worked with local and state governments to initiate failsafe mechanisms that ensure students with special needs get identified as needing high care and support as they move through the school system.

6.5.2.2 *Yuan – Facilities and Maintenance Coordinator*

Yuan comes from a trade background as a licensed plumber and is familiar with many aspects of building management. Yuan's role is to maintain and monitor the school's operations, including electricity, water, waste, school transport and CCTV. His trade and construction background is essential to the role and he actively works to eliminate inefficiencies in the school's infrastructure to save money.

6.5.2.3 *Seth – Sustainability Coordinator/Educator*

Seth is an educator and the sustainability coordinator at Banksia SC. He has a vast background in sustainable development and has worked with various environmental education groups and the private sector.

6.5.3 School Sustainability Coordinator

A particularly unique aspect of Banksia SC is the existence of the paid position of sustainability coordinator, which is fulfilled by Seth. Seth's goal is to make Banksia SC the most sustainable high school in Australia and to identify pathways for how this can be achieved in the current education system.

Seth came onboard just after the school opened after the leadership at Banksia SC approached him to ask how he could help the school pursue sustainability. Seth's background is in non-traditional educational training. He has experience working in different sectors, which allows him to bring a broader perspective on sustainability to the school. From the beginning, Seth's main goal was to make sustainability at the school as self-sustaining as possible. He committed to only working on a fixed-term contract at the school with the firm intention to leave the school after embedding sustainability throughout its operations and curriculum. This was implemented to help ensure the position did not become long-term, which would dis-incentivise buy-in and ownership from school staff and students. Seth believes if a school does not have the intention to embed sustainability across all areas of the school and become self-sustaining, the school will always rely on a champion to lead the low carbon initiatives, rather than distribute responsibility across the school.

> *"I gave myself five years. This is year five…. Because I think you have to have a sunset clause...for sustainability especially. Otherwise, you're there for 10 or 20 years..." – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

At the time of this research, Seth was due to leave his role at the school at the end of 2018 because his fixed-term contract expired. The school intended to hire a successor for his role because Principal Liam believed the school was not quite self-sufficient enough when it came to low carbon initiatives at the school.

> *"In an ideal world, we would be positioned in such a way that the particular role becomes defunct because all of the various initiatives that we engage in are self-sustaining and everyone is taking the responsibility to own and deliver on various aspects of the initiative… Now, that's a long way off, as you can imagine. But that's the ultimate goal, is to get it so that it is completely self-sufficient in itself, and sustainable." – BSC Principal (Liam, interview, 24 March 2018)*

Banksia SC has gained a reputation in their community for sustainability and Seth said he is often asked by other schools to share tips and advice about their sustainability journey.

He stressed, however, that each school is so different that what works for them may not necessarily work for another school. He noted, on one visit to Waverly High School, who asked for his advice, how impressed he was by the sheer amount of initiatives they had implemented. Seth thought many schools have plenty of initiatives, but often lack structure for their sustainability efforts.

> *"I went down [to Waverly High School] and went, 'My God, I can learn from you! You've been doing this for a decade and a half', and I'm looking at it and going, 'Oh, all you need to do is create a government structure that ties all this together that you can measure and then report on what you're doing'. So they're already doing it in practice, they just need to measure and report on it." – BSC Sustainability Coordinator (Seth, interview, 24 March 2018*

A big focus for Seth at Banksia SC is ensuring they have a solid governance structure for their low carbon initiatives. He has been a critical player in starting to develop key policies at the school, such as energy and sustainable procurement policies. Seth's focus on integration of sustainability across all areas of the school sets them up for a more long-term approach to low carbon initiatives. He has also been a key player in developing partnerships between the school and industry, government and tertiary organisations, which is discussed in later sections.

6.5.4 Fostering Innovative Partnerships & Embracing Opportunities

Banksia SC has a heavy focus on partnerships with the community, and the administration aims to embrace opportunities wherever they arise. This approach means the school has made very advantageous partnerships and are able to provide students with unique and real-life experiences and learning opportunities.

Examples of these partnerships include a major national developer that is building large commercial developments in the area (e.g. shopping centres) and a local building company working on residential communities close to the school. The school has co-created programs with these partners both at the school and community level. One of the community initiatives the school worked on with the commercial developer was a series of signs and interactive QR codes that showcased the sustainable features of the local shopping centre they built. Another project resulted in the school and the builder creating a food garden at the local library together. Principal Liam believed these partnerships were, and continue to be, highly fruitful.

> *"...I think our partnership with [the commercial developer] and [local builder] both have been instrumental. They've been able to underwrite some of the programmes and initiatives that we've engaged with equally, so they've been able to provide levels of expertise and nationally and internationally renowned expertise to work with us. And that's been a great thing." – BSC Principal (Liam, interview, 24 March 2018)*

One of the most successful ongoing projects was created in collaboration with the commercial developer, local builder and a local government representative. It involved the development of a class for Year 10 HASS students that gave students the opportunity to design their own sustainable suburb in line with the Western Australian Government Suburb Guidelines. The class has run each year since 2016 and there is an event that showcases all the students' designs each year.

Other partnerships include two Perth universities providing a diversity of opportunities and experiences for their students, as well as partnerships with local and state governments to provide funding for initiatives and professional development opportunities for students. The school also regularly works with local primary schools for excursions on topics like waste, and they also have strong ties to a local Indigenous group, which Seth said took many years to foster [trust] to be able to establish.

Seth estimates the partnerships have brought in around $100,000 towards programs in the school in 2017, with several additional organisations wanting to partner with the school. Some of the ways these partnerships were realised was through providing funds or prizes for sustainability initiatives, funding local project costs, or providing expert advice or support on a topic. Seth believes these partnerships and access to industry experts are an important step in setting students up for the real world.

> *"...high schools need to be tapping into industry... it's really about exploring and sharing and communicating, discussing what are the leading examples globally really... because kids are coming into a global society, how are we connecting them to that?" – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

Key Finding 6-26: Building partnerships with private industry, such as developers, has been highly beneficial for the school financially and also provides enhanced experiences and learning opportunities for students.

One of the responsibilities of the Deputy Principal is to explore and expand community partnerships. The partnerships that the school formed are the result of the connections and collective efforts of Seth, the Principal and Deputy Principal. Principal Liam said they are always looking for ways to involve people in the community and then build partnerships from there. At the time of this research, they were looking to further develop partnerships with local government.

Principal Liam noted that while there are a lot of low carbon opportunities that the school has not yet considered, he believed it was important to remain flexible about how things could be integrated within their school’s context.

> *“…one of the important things that we have is that we do keep an open mind, and we hope to be innovative and creative wherever we can.” – BSC Principal (Liam, interview, 24 March 2018)*

He described the carbon reduction journey as one that is constantly changing, and he said it is important to remain resolute in working towards sustainability goals, but not get so bogged down in what is already happening at the school that new opportunities get missed.

> *“If you remain too long, you're thinking on what you're delivering on, and you can sometimes overlook opportunity that might be coming your way. But having said that, it's also exceedingly important to have that steadfastness, and that drive and determination from those involved to keep leading the charge. Invariably, there are always roadblocks that we encounter from time to time, that we need to be resilient and find ways around.” – BSC Principal (Liam, interview, 24 March 2018)*

An example of the importance of embracing opportunities when they arise was the case of geothermal energy at the school. A developer that the school partnered with wanted to develop geothermal energy production and the school would not pay any upfront costs because they would purchase the energy at a predetermined rate. The school created a business plan for the idea and sought permission from the Department of Education (DoE) to pursue the idea. However, the DoE's inquiry process took longer than expected and that, combined with the school's own lack of processes in this area meant the opportunity passed. Seth believed the school must be entrepreneurial in some ways and be ready to jump on opportunities when they arise, such as geothermal energy.

> *"…our decision-making processes around the school, the way they're structured are not able to capitalise on that, which means millions of dollars, I'd suggest, being lost, through lost opportunity." – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

6.5.5 Managing Consumption with a Building Management System (BMS)

When the school was built, it was equipped with a Building Management System (BMS), which serves as a central control system for the operational energy at the school, such as mechanical ventilation and air conditioning. The BMS allows the school to control their energy consumption and has many associated benefits.

While the BMS was installed at the school from the time it first opened, it was inactive and was not able to control any of the air conditioners or lights. The BMS was not discovered by the school staff until nearly two and a half years after the school opened. Yuan, the Facilities and Maintenance Manager, discovered it by accident and spent a lot of time getting up to speed with how to best utilise the systems.

> *"There's a lot of intelligence in this school that just never has been used because it was never commissioned. No one would know, the principals and that wouldn't know because no one's ever told them."- BSC Maintenance and Facilities Coordinator (Yuan, interview, 24 March 2018)*

The Principal noted that there were many issues with the BMS in the beginning, and the school had to ultimately spend around $18,000 to get it fixed to a point where it was useable. However, since that initial outlay of costs, Yuan estimates that the school has saved around $6,000 per utility bill in the months following the BMS getting fixed.

During the interview, Yuan pointed out a computer screen that displayed all the lighting and air-conditioning throughout the whole school. He said that he could set temperatures for all the air conditioners with timers for when they turn on and off. The air conditioners are always set at 24, and even if a teacher tries to put the air conditioner to a colder temperature, they cannot override the system temperature setting. If a room's air conditioners are turned on manually, he can see this in live time. He mentioned how this enables him to prevent common issues where air-conditioners are left on when no one is in a classroom. The school also had areas, such as reception, that operate so that air-conditioners are set to run for two hours and then, if someone wants to turn them on again, they press a button and it turns on for another two hours. This system is best suited for areas that do not have consistent hours of use.

The school was also built with a Lighting Control System (LCS) that controls the lighting in the school, which allows timers to be set for when lights turn on and off. Before the system was utilised, the school typically used about $3,000 during the school holiday periods, but once the LCS was up and running, the cost for the same time period dropped to around $800.

Yuan meets with one of the school's contractors once a month to review the school's transportable classrooms, amongst other aspects of the school, to ensure appropriate maintenance is undertaken. The school has 16 transportable classrooms due to the increasing student population, with 8 installed in 2017 alone. However, the student population is expected to decrease in the coming years as a new high school in the area will be enrolling some of the incoming Year 7 students.

Surprisingly, even though the school was only built in 2014, the school was not equipped with any LED lighting. The school sees an opportunity in switching to LEDs, however they cannot fund a full LED replacement for all their lights due to the significant upfront cost. Over time, Banksia SC plans to replace their lights with LEDs, with an initial focus on some of the most energy intense lighting, such as outdoor flood lights.

The utility bills for the school (i.e. energy, water and waste) go to the Business Manager who notifies Yuan when there is a spike in an area of the school, which he then investigates. Yuan noted the difficulty in sometimes monitoring their bills month to month because there can be significant variations from one month to another due to changes in consumption patterns due to external events. Based on what he had seen with the school's utility consumption, Yuan said air conditioning takes up the most resources and cost.

> *"Sometimes with power it's really hard because sometimes the fluctuation of the bills…sometimes we'll look at the power bill and I'm like 'oh, it will be six, seven, eight grand under", which is good... And then the other time we might be three or four grand up with our targets from last year, like before we started with the BMS*

> *system.” – BSC Maintenance and Facilities Coordinator (Yuan, interview, 24 March 2018)*

Yuan noted that having the support both from the Principal and Sal the Business Manager was highly important. When it came to infrastructure improvements at the school, Principal Liam and the Business Manager were always willing to support initiatives that would save the school money. Whether that was training for Yuan to learn about their monitoring systems or small efficiency purchases, most of what Yuan proposed was supported by the administration.

> *“Yeah. I'm pretty lucky here because with Sal managing corporate she's very supportive in all that sort of stuff, so if I said, ‘Okay, I need to go and get some training in BMS’, or whatever, we would, and Principal Liam [supports] as well… Because everyone knows that we have to spend something to get something back. But here it's a pretty good school to work at and they're all supportive.” - BSC Facilities and Maintenance Coordinator (Yuan, interview, 24 March 2018)*

Future plans for the school’s building operations include the optimisation of a sub-metering system that will enable Yuan to see the exact energy consumption of each building block. The system is already installed at the school but has not been set up, just like the Building Management System (BMS) and Lighting Control System.

Key Finding 6-27: While the school was built with intelligent management systems, the administration was not notified of their existence which meant they went unused for several years.

Yuan sees the potential for this, along with the information from their systems in educating students about the school’s consumption. Principal Liam and Seth also see the opportunity in using real school data to educate students.

> *“…that would actually graph [electricity use] and that will map it, so the kids could actually get onto those systems and watch it...” – BSC Facilities and Maintenance Coordinator (Yuan, interview, 24 March 2018)*

> *“I think we [could] get groups of students involved with using the data that they can generate from it, and they can use it in terms of sustainability and looking at*

> *examining practice and making change, but also it's a wonderful tool in terms of literacy and numbers…" – BSC Principal (Liam, interview, 24 March 2018)*

The school also uses the information they receive from the BMS to quantify and reduce their carbon emissions. With the use of such sophisticated systems, the school is able to precisely control their electricity consumption, which is a major advantage for the school in terms of carbon emissions and cost, as well as having great potential to provide learning opportunities for students.

Key Finding 6-28: The school's building management system not only allows them to closely monitor consumption, but also has the potential for educating and engaging students around energy consumption.

6.5.6 Banksia SC's Low Carbon Initiatives

During the LCSPP, the school identified several different types of initiatives across the emissions categories (energy, water, waste) on their action plan. Nearly half of the initiatives the school pursued were waste-related, with energy and water forming the second largest categories, respectively (see Figure 62). Banksia SC implemented fewer energy initiatives than the rest of the schools. However, this was because they largely focussed on getting their Building Management System (BMS) operational.

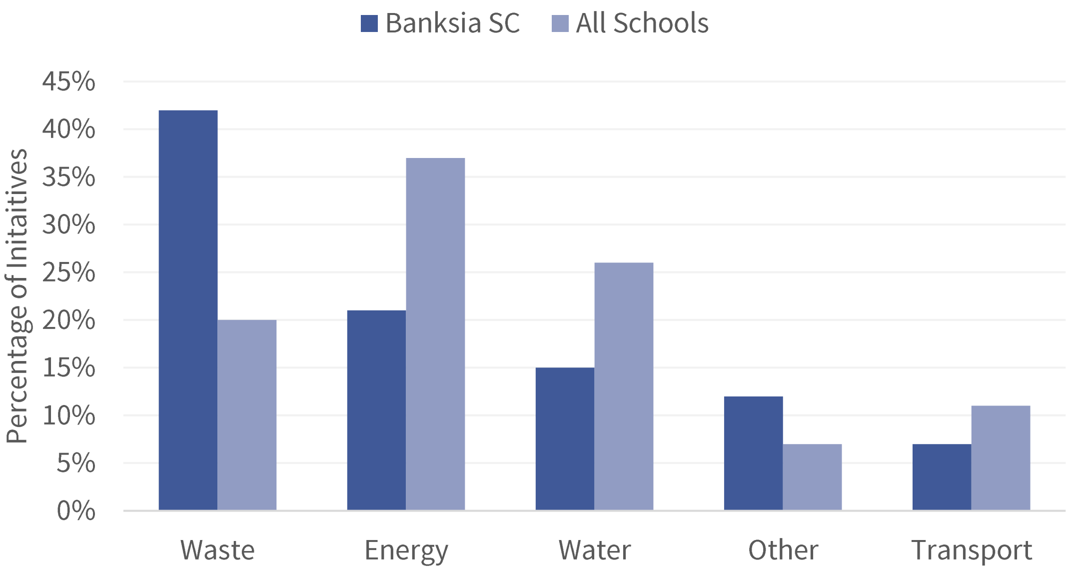


Figure 62: Banksia SC percentage of actions by emissions category in comparison to the percentage of actions for all LCSPP schools.

Of the initiatives listed on their action plan, investigation formed the largest category and policy actions (e.g. creating sustainable purchasing policies, strategy documents or forming committees to address low carbon initiatives at the school) was the second largest category. Banksia SC had significantly more policy initiatives than other schools. Pursuing infrastructure upgrades/changes at the school accounted for just under a quarter of their actions. These actions included maintenance to the building management system, implementing recycling systems and replacing fluorescent lights with LEDs. They had a similar amount of educational activities as the other schools. However, fewer behaviour change initiatives. This could be related to their BMS, which allowed them to schedule the after-school and holiday shut-down of lights and air-conditioners and, therefore, there was less need to encourage behaviour changes within staff. Figure 63 shows a summary of the action categories and Table E19 shows a summary of the ongoing and completed actions.

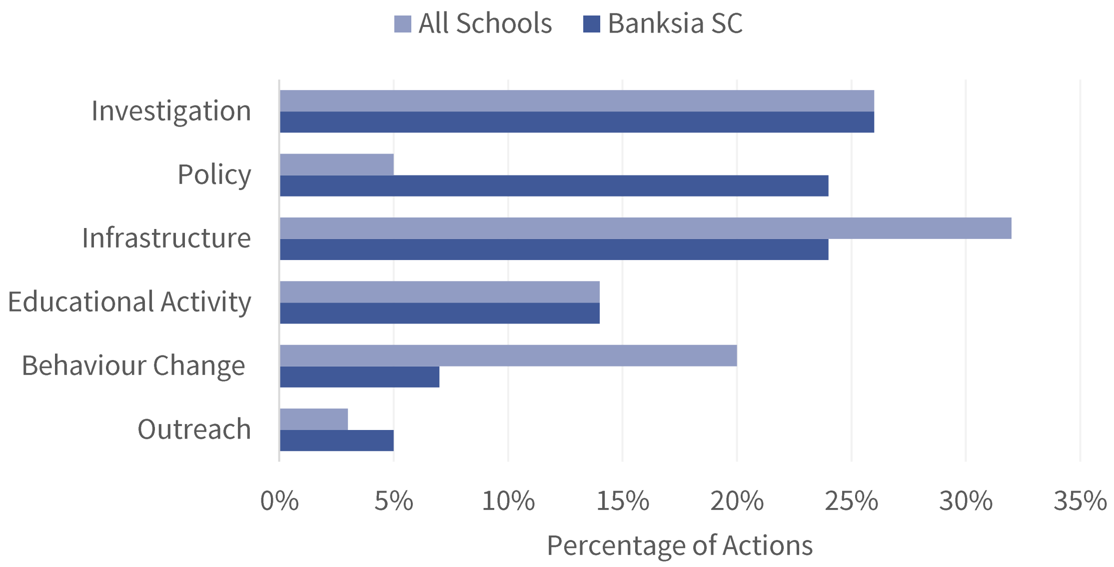


Figure 63: Banksia SC percentage of low carbon actions by type compared with the percentage of action type across all LCSPP schools.

6.5.6.1 *Energy*

A key energy action at Banksia SC was getting their BMS operational. While the school was equipped with the system when it was built, it required additional maintenance in order for it to work properly. Once the BMS was online, the school was able to monitor and control all the air-conditioning units throughout the school. In addition to the advances made with their BMS, they also had a plan to change their fluorescent lights to LEDs on an ongoing basis as the bulbs expired. Using this method, all of the security lighting was replaced by LEDs by 2018. Principal Liam said they had plans for solar PV and hoped to start installation in 2019. However, given their recent budget cuts and lack of upfront funds, solar PV was not proceeding. Seth also worked to develop an energy policy with renewable energy goals, as well as a sustainable procurement policy.

6.5.6.2 *Waste & Water*

Waste was an area that Banksia SC heavily involved students in. They participated in Wastewise and did several activities with students such as waste audits, litter audits and recycling programs. Students in the Eco Team also held waste education events for the neighbouring primary school and were also planning a community waste project.

From an infrastructure perspective, they increased their waste recycling options at the school through the addition of paper and organic waste composting on site. Considering the school was using approximately one million pages of paper per year, they started transitioning all their reports and communications sent to parents to digital. Since they switched completely to digital reports in 2016, the school saved 500,000 pages of A4 paper per year. Some of their other waste actions included improving their existing kitchen garden, worm farms and organic composting and they also had plans to start working on a waste policy that would outline the school's intentions towards zero waste.

When it came to water, the school was built with several water saving features. One example was the collection of their wastewater to water the ovals after it had gone through a filtering system. They also have a groundwater bore used for watering other vegetation around the school. While the school already had water conservation features, they were looking into participating in the Water Wise program to integrate more water education and conservation concepts into student learning. The school also participated in a water audit and started actively monitoring their water consumption through their bills.

6.5.7 Utility Consumption & Cost

Banksia SC is rapidly growing and increased their student population by 60% between 2015 and 2017, which was the highest increase out of all the schools. In response to this increase in students, 16 transportable classrooms were installed, which increased the total building square metres by 5%. By 2017, the school occupied a land area of 53,104 square metres, 45% of which are buildings and the rest is green space. Out of all the schools in the program, Banksia SC had the largest total square metres.

While the school's total utility consumption and costs increased (see Table E18), their consumption and cost per student decreased across all three utilities (electricity, gas and water). This is discussed further in the following sections.

6.5.7.1 *Energy*

Banksia SC's **total** electricity consumption increased by 12% between the baseline year (2015) and the end of the LCSPP (2017). However, as shown by Figure 64, between 2016 & 2017 consumption decreased by 3%, with most months in 2017 showing a lower consumption than the previous year. Some months such as July, September and December even showed 2017 total consumption was lower than the baseline year.

Banksia SC also decreased their consumption for most school holiday periods at an average of 9%, as seen in Figure 65. The largest decrease in consumption took place over the summer school holiday period (December/January) at 26%. These decreases across school holiday periods and general trend in decreasing consumption can largely be attributed to the school's BMS, which allowed them to schedule air-conditioning and lighting to be turned off when not in use.

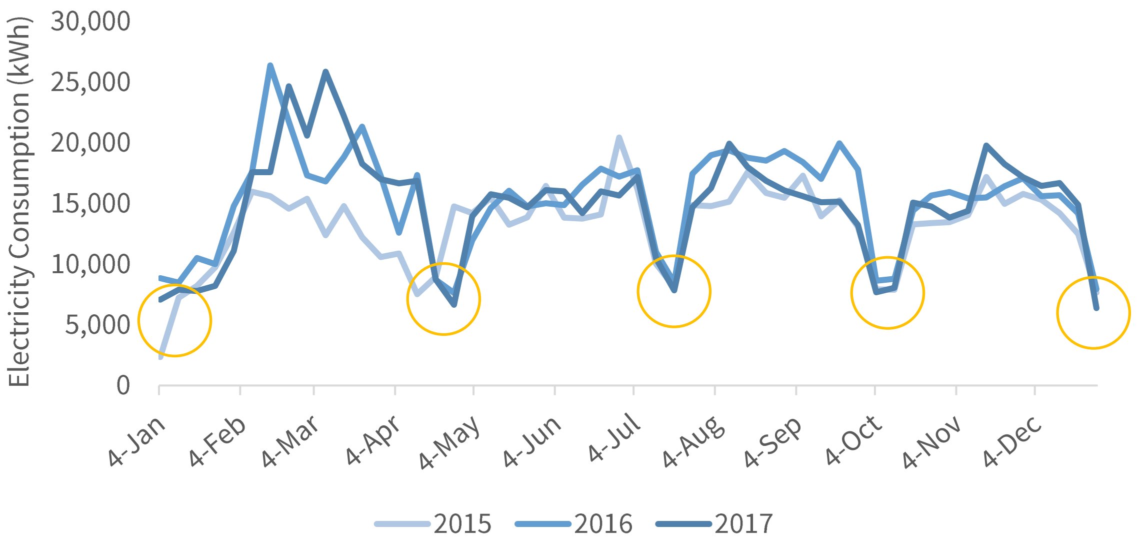


Figure 64: Banksia SC weekly electricity consumption (kWh) from 2015 to 2017.

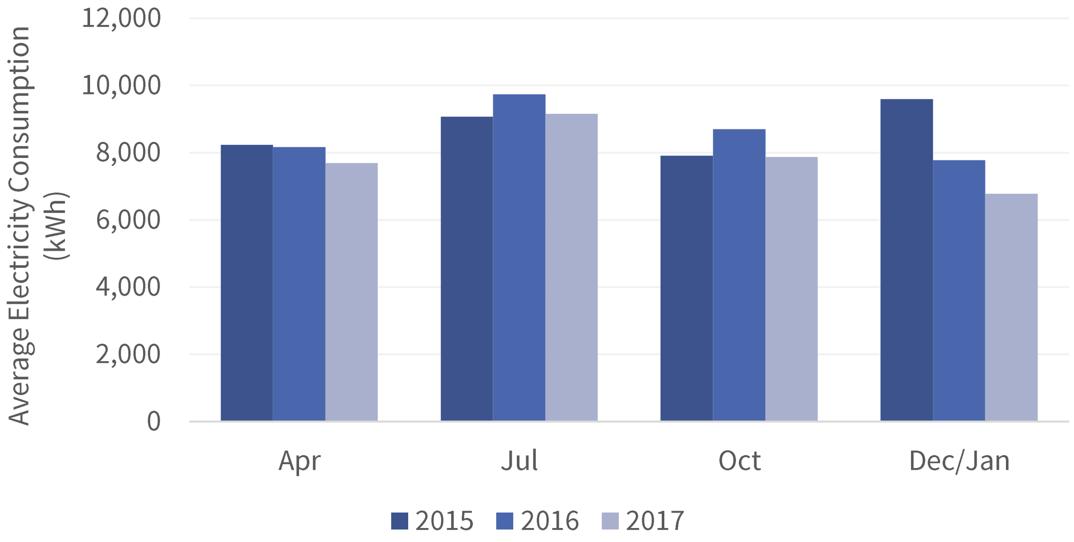


Figure 65: Banksia SC average total average electricity consumption (kWh) for school holiday periods between 2015 and 2017.

Looking at their electricity consumption per student showed a 30% decrease. Their cost per student also decreased saving them $33.09 per student (see Table 30). However, like the rest of the schools, they saw a disproportionate decrease in their cost compared to their decrease in consumption due to changes in electricity cost from their electricity provider.

Table 30: Banksia SC total consumption per student for each electricity, gas and water and the percentage difference between 2015 and 2017.

Utility	**Measurement**	**2015**	**2016**	**2017**	**Amount Difference (2015/2017)**	**Percentage Difference (2015/2017)**
Electricity	*(kWh/student)*	632	560	445	**-187**	**-30%**
	($/student)	$155.63	$140.99	$122.54	**-$33.09**	**-21%**
Gas	*(kWh/student)*	87	68	56	**-31**	**-35%**
	($/student)	$10.30	$7.84	$6.67	**-$3.63**	**-35%**
Water	*(kL/student)*	5.17	4.16	3.97	**-1.2**	**-65%**
	($/student)	$58.35	$37.30	$31.23	**-$27.12**	**-46%**

The school also increased total gas consumption by a modest 3% as shown in Figure 66. However per student, gas consumption and cost both decreased by 35%. Like Acacia PS, all transportable classrooms that were installed during the LCSPP did not use gas heating and therefore did not contribute to the school's consumption of gas.

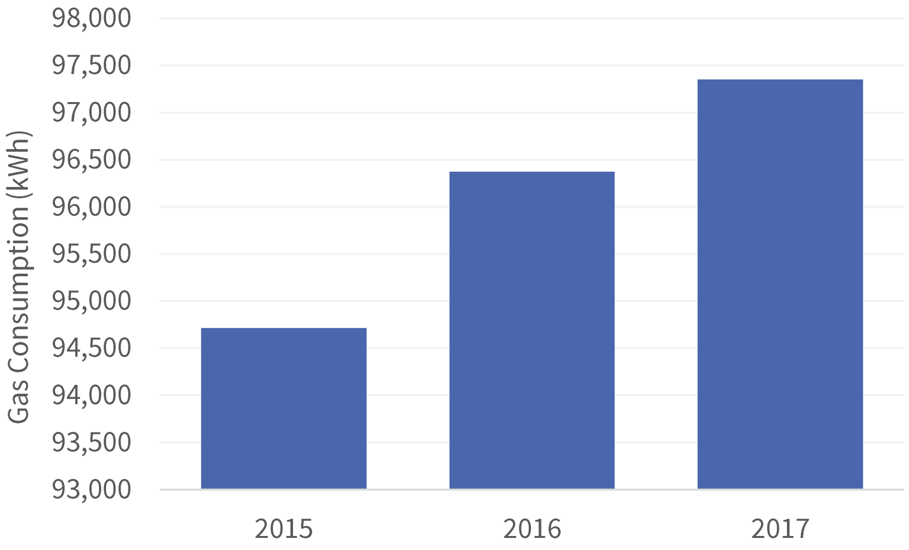


Figure 66: Banksia SC total gas consumption (kWh) (2015 – 2017).

6.5.7.2 *Water*

Total water consumption for the school decreased by 45% and as shown in Figure 67, there was a significant spike in consumption in September 2015. This spike was due to construction taking place at the school that caused several water leaks. For most months in 2017, there was less total water used than the baseline year. However, this reduction can largely be attributed to the removal of a neighbouring primary school's water consumption from their bills. Up until mid-2016, Banksia SC unknowingly had the primary school's water data included in their bills. From July 2016 onwards, a decreasing trend in total consumption per bill can be seen since the primary school's consumption was removed. When water consumption was calculated per student, it decreased by 65%. Water costs also decreased, saving the school $27.12 per student.

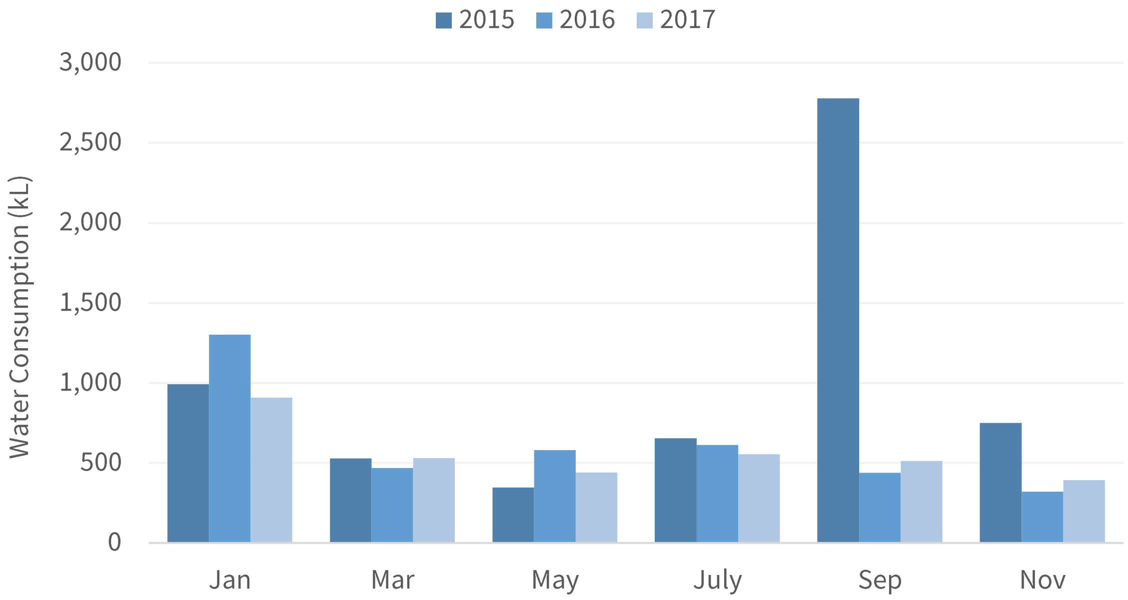


Figure 67: Banksia SC total water consumption (kL) from 2015 to 2017.

Key Finding 6-29: Investigating their water bills enabled the school to discover that they were accidentally paying for a neighbouring primary school's water.

6.5.8 Carbon Emissions

While Banksia SC's total carbon emissions increased between their baseline year (2015) and 2017 by 2%, during their participation in the LCSPP (2016 & 2017) it decreased by 7%, demonstrating a trend in decreasing carbon emissions, as shown in Table 31. This decrease during the program is a significant achievement considering the substantial increase in student numbers during this time. Per student, their carbon emissions decreased by 36%, which was the largest decrease per student than any other school in the program. Table 31 shows their carbon emissions on a total, student and square metre basis.

Table 31: Banksia SC total carbon emissions (tCO2-e) on a total, per student and per square metre basis (2015 – 2017) and the percentage difference between years.

Measurement	2015	2016	2017	Percentage Change (2016/2017)	Percentage Change (2015/2017)
tCO_2-e (total)	599	654	611	**-7%**	2%
tCO_2-e/student	.55	.46	.35	**-24%**	**-35.9%**
tCO_2-e/m^2	.0263	.0277	.0255	**-8%**	**-3%**

6.5.9 Student Leadership & Engagement

Banksia SC is heavily focussed on engaging students, and students primarily are involved in low carbon initiatives through a student Eco Team. The Eco Team works closely with the school’s Low Carbon Committee and some students regularly sit on the committee to provide input. The Eco Team is comprised of two levels, junior and senior, and has a mentoring structure, where the senior members help the junior members keep the initiatives going and show them how to start new ones. The focus groups took place with twelve students from grades 9 to 12.

The school aims to provide as many opportunities for the students to expand their knowledge and gain valuable experiences that cannot be gained from a classroom setting. They provide these opportunities through participation in other initiatives, such as the national Kids Teaching Kids initiative which empowers students to act on local sustainability issues and the Bush Rangers program in WA, which focusses on hands-on environmental restoration and conservation. They also have a student group that focusses on sustainable transport as part of an initiative with the WA Department of Transport. For nature excursions, students have access to the Children’s Forest, a bushland reserve less than an hour from the school that provides outdoor environmental education. Students also attend events, such as student sustainability conferences that allow them to learn from other students and get new perspectives on what is possible. Seth said some of their previous students pursued careers in sustainability after being involved with the Eco Team.

Seth highlighted the importance of diverse experiences for students and the importance of not solely relying on test scores as the determinant of student success in high school.

> *"...universities are no longer relying only on ATAR scores. There are too many different pathways into [tertiary] schools. The schools that capitalise on that and become a little bit more innovative and flexible, they're going to go and have the best outcomes for their kids." – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

Seth also thought putting students first and empowering students was essential for schools to do.

> *"It always needs to be student-centred and the teacher's more of a mentor, a guide, through the learning process. That's how we empower them to be better. But they also empower themselves and they grow confidence in that."– BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

Key Finding 6-30: The Principal and staff believe that focussing on a diversity of learning experiences for students enables students to have a larger positive influence on the community.

When it comes to curriculum, Principal Liam said the school works hard to embed sustainability concepts throughout the whole curriculum of the school, creating a holistic approach to sustainability.

> *"Whether it's math or whether it's inquisitive science, or technologies, there are elements of the sustainability, capability being embedded across it all. And it's an important thing for us." – BSC Principal (Liam, interview, 24 March 2018)*

When the focus groups with students participating in the Eco Team were conducted, it was clear there was a sense of pride from being a part of the Eco Team. One student talked about what the Eco Team meant for her and how her own behaviour had changed over time. She thought it was important to be around people that shared your ideas, and to know that people aren't going to laugh at you for things like picking up rubbish.

> *"I think being a part of the Eco Team has drastically changed not just my views, but my passions and my interests...I think I always cared about the environment*

> *when I was little, but when I came to high school and was in the Eco Team, the leaders in the Eco Team pretty much have shaped my way of thinking, shaped my morals. Not just sustainably, but globally." – BSC Student (Min, focus group, 24 March 2018)*

Another student thought the Eco Team has allowed people that are passionate about sustainability to be less socially isolated. As the group grows, it encourages other people who may not care as much about sustainability to join because they want to be a part of something.

> *"There's actually a group and there are people who don't care about the environment joining as well. And they want to be a part of it because there are so many other people."- BSC Student (Linh, focus group, 24 March 2018)*

Key Finding 6-31: Students report positive personal and community benefits from being involved in the Eco Team.

Students also talked about how the school plays an important role in forming students' experiences with carbon reduction, and some students said schools should take more responsibility in educating students about low carbon topics.

> *"School shapes a lot of what a person is while they're at a young age, they're being influenced a lot by school and so I think there should be ways for education to teach them about like climate change should be implemented at school as well at a young age, to teach them while they're still impressionable, I guess." – BSC Student (Charlie, focus group, 24 March 2018)*

Students thought that there were inconsistences within the school system in regards to learning about climate change and sustainability topics, with one student referencing how students are not taught about the sustainability impacts of the school or the community. Dakota thought learning about climate change "just kind of gets wiped under the mat" for high school students (Dakota, focus group, 24 March 2018).

Another student thought it was the responsibility of the school to teach kids about climate change action because if the school was not going to act on climate change, then the students would be able to.

> *"I think the school should put focus on teaching the majority of kids about that so that, if the school can't do anything, they can influence the students to do that for them." – BSC Student (Min, focus group, 24 March 2018)*

When students were asked whether being able to view or access the school's utility bills would be of interest, most of the students agreed that they would like to see that information.

> *"Because we'd know, we'd be able to say, 'This is obviously wrong.' And we can talk to the teachers about that but we don't know what's going on. So we're not able to come forward and say, 'This is what you guys are doing wrong and we want to change that.' It's just the teacher's responsibility, there's no say for students." – BSC Student (Chris, focus group, 24 March 2018)*

Two students noted the fact that students spend a lot of their time at school and the importance of students learning from all the different people in their lives.

> *"Kids are spending more time at school then they are at home on weekdays. They look up to their teachers like a parental figure and they look up to their peers and siblings, sometimes. It's like everybody needs to help each other. You can't always rely on the parents because the parents may not be educated as well." – BSC Student (Linh, focus group, 24 March 2018)*

Chris however, felt that schools cannot really take responsibility to ensure students are learning about sustainability, largely because the school cannot control how many passionate teachers they get. He believed a school like Banksia SC simply got lucky that they had several motivated passionate staff that are willing to push low carbon initiatives forward. He thought that getting kids involved in low carbon initiatives could be just a case of getting the right teacher.

> *"The school never takes responsibility upon themselves. It's the teachers who actually seek out going, 'Can we have the Eco Team?'...And I'd say most of the students that actually got involved with the Eco Team were Seth's. So it's this case of getting the right teacher. Someone who actually cares in general." - BSC Student (Chris, focus group, 24 March 2018)*

A student also expressed that she thought the school should be more transparent about what the school spends their money on, while another student reiterated this by pointing out that the school had not uploaded their business and budget plan on the website since 2015.

Key Finding 6-32: Students identify gaps in how schools educate about climate change and want to be involved in investigating resource consumption and reducing school carbon emissions.

6.5.10 Student Action & Influence

In both focus groups with students participating in the Eco Team, students expressed a high level of agency, and believed they could do a lot as individuals. Most of the students appeared confident and highly willing to act where needed.

When they were asked about what students could do to act on climate change, they brought up many different ideas across various levels of society. Morgan thought the first step was to talk about the issues at hand, and Chris talked about the importance of a person being educated about their individual impact.

> *"They can start by actually talking, because we tend to listen more towards kids because we always keep pushing toward, we want the younger generation to start doing this..." – BSC Student (Morgan, focus group, 24 March 2018)*

> *"Just be educated as well. Just know what you're doing and what you shouldn't be doing. I think that's where a lot of things go wrong. A lot of kids don't know the impact that they're individually having" – BSC Student (Chris, focus group, 24 March 2018)*

Several students also talked about engaging with their community to try to influence others.

> *"I think they can just like join teams, most of them, like we have done, and contribute in their own community and maybe like influence other people to try and make a change that way." - BSC Student (Tej, focus group, 24 March 2018)*

> *"Helping put in place things locally first. Like things in your community" - BSC Student (Alex, focus group, 24 March 2018)*

Casey talked about lobbying politicians as something a young person can do to address climate change and another student talked about young people becoming a prominent figure in their community around carbon emissions.

> *"…I think all young people should organise and group up to create an organisation where they can lobby politicians. So, they can do something to reduce the carbon emissions." – BSC Student (Casey, focus group, 24 March 2018)*

> *"Maybe become a prominent figure in your community about carbon emissions." - BSC Student (Chris, focus group, 24 March 2018)*

Other ideas that were mentioned involved getting the entire student body to do something together, like pick up litter around the school. Students getting the opportunity to miss out on class was mentioned as a good motivator for students.

Students also thought addressing carbon emissions was highly important in the context of school sustainability.

> *"I think it's key because instead of talking about the impact, it's directly focusing on the cause of that impact. So that instead of just talking about climate change, it's better to talk about what we are actually doing." – BSC Student (Alex, focus group, 24 March 2018)*

6.5.10.1 *Peer and Community Influence*

Most of the students said that they talk to their friends and peers about low carbon living topics and said while their friends do not always listen, sometimes a few of them will.

> *"I'll randomly bring up some rant about why the actions of a particular person is not sustainable and how this is going to affect us in the long run. And then half of them will go 'Alex, what are you even doing?' and the other half will actually go, 'OK, that's a fair point.'" – BSC Student (Alex, focus group, 24 March 2018)*

Min voiced her concern, however, about how pushing your own agenda on others can sometimes even be a risk to the friendship.

> *"And I'm just like, 'You wanna pick that [litter] up?'... you know I guess they do listen, but you're gonna have to accept that there'll be a risk to your friendship. To put things that you want forward, in other people. Cause you can never change another person and make them who you want to be and do things that you want them to do. So you're gonna just have to accept who they are and then do your best. And maybe just pick up the rubbish when they walk away." – BSC Student (Min, focus group, 24 March 2018)*

The students also showed a sense of responsibility for their peers, with many students mentioning if they see someone doing something like littering, they will say something or pick up the rubbish after them.

> *"A lot of people don't care, and so it's just sort of, I find myself constantly watching people what they do and if they don't [pick it up], then I pick it up." – BSC Student (Charlie, focus group, 24 March 2018)*

When it came to what they thought was needed to help change people's behaviour, students talked about making the right thing to do easier, educating people about the repercussions of their actions, or making it fun to be more sustainable. Laziness, habit and lack of money were thought to be the biggest challenges to changing other people behaviours.

> *"I think what we need are like, easy solutions or like ways around just being lazy. Instead of people just taking the easiest route out and dumping litter, we need to make an easy way to get rid of it in a proper way." – BSC Student (Charlie, focus group, 24 March 2018)*

Students mentioned the Great Pacific Garbage Patch and how large the problem is around plastic. Two students added that people need to know what's happening in the world and know the repercussions of their actions.

> *"…the first step is to spread the knowledge about what's actually going on because there's a vast majority that aren't actually learning the full details, they just know that climate change is an issue that's getting worse. They don't know what's happening and why it's happening. So, by spreading that knowledge, [those] initiatives, that thought, to encourage action." – BSC Student (Morgan, focus group, 24 March 2018)*

One student also wondered if educating younger kids about climate change is related to re-examining social norms in society.

> *"It's sort of a case of redefining what's right and wrong, isn't it? Because the habits that have been instilled generationally, you have to learn how to break those and to instil new ones."(most students in the group said yes or nodded in agreement to this statement) – BSC Student (Taylor, focus group, 24 March 2018)*

The idea of social norms was discussed in both focus groups, with one student bringing up the example of wearing hats outside in primary school. He mentioned how students are conditioned to wear hats outside all throughout primary school, to the point where it becomes an automatic habit. However, when they get to high school, the habit is broken because they are no longer mandated by the school, therefore establishing a new social norm of not wearing hats. Another student talked about how people's mentality needs to change and they need to realise it is not socially acceptable to do things like litter.

> *"It's kind of like it's normal now. It's normal now to not recycle and it's normal to litter. I feel like it's gonna be hard to kind of say, 'don't', but it can be slow. There's a process and it can happen." – BSC Student (Chris, focus group, 24 March 2018)*

However, despite the concerns raised about the challenges in changing other people's attitudes and behaviours, most of the students believed they had the ability to influence the people around them and their friends, even on a small level.

> *"I feel like I have a lot to say when I talk to friends and I feel like I've changed a lot of minds about a lot of things. I feel like I have some kind of influence. Like I feel anyone would. You know, your friends telling you to do something and you wanna kind of... [say] 'I guess so, whatever'." – BSC Student (Casey, focus group, 24 March 2018)*

Another student said that it is important for people to step up together, not just separately, because that's where the real change occurs.

> *"A lot of people have kind of the mindset of, well if there are like, 8 billion people doing this, what am I gonna do? What is one person gonna do to change the whole world? But if there are 8 billion people saying, 'Maybe I can make a change', then that's 8 billion people making a change." – BSC Student (Chris, focus group, 24 March 2018)*

Principal Liam also reiterated the potential students have to influence their peers and community.

> *"The kids in general that we have, if they have an appreciation of what it is we are talking about and what we're trying to achieve, there's every likelihood that they carry that on in their own day to day living. And we hope and expect that they'll be influencers now and in the future. Not only in their own homes, but also*

> *more broadly in their community." – BSC Principal (Liam, interview, 24 March 2018)*

Key Finding 6-33: Students involved in the Eco Team were confident about their ability to act on climate change and felt a sense of responsibility for their peers to encourage them to act more sustainably.

6.5.10.2 *Intergenerational Influence*

When it came to family members, all the students in the focus groups said they engaged with their family on some level about a low carbon living topic and discussed topics like recycling or wasting energy. They talked about how they would say something to their family members if someone was wasting resources.

> *"I've pointed out times where they're wasting energy or fuel, whatever. So, if they're doing something that doesn't need to be, like the computer's been left on or something I'll be like, 'Oh, do you need this on?' Or like, if a light's on or a fan's on and anything you're not using. You just turn it off. And just try to get them to do it themselves instead of me having to remind them all the time." – BSC Student (Charlie, focus group, 24 March 2018)*

The students in the first group also believed that they have the power to change their family members behaviour to be more sustainable. One student joked that she asks her family to turn off the lights, then runs away, which the other students laughed and identified with. Another student said that the fact that parents love their kids means they may be more likely to listen to them, and a few other students also thought that their parents would support them around low carbon living because they are so passionate about it.

> *"I don't know. I feel like I have a responsibility. I feel like I shouldn't have, but I do have a responsibility to say, 'This [is] what should happen'. I feel like I do. My parents see that and they're like, 'Okay, if he's passionate about it, then I guess we have to try.' I feel there's a little bit of that." – BSC Student (Min, focus group, 24 March 2018)*

However, one student said that his mum will listen to him, but not his dad, while another student thought it was her younger age that sometimes stopped her family members from listening to her.

> *"It's not like they're damaging the environment on purpose. It's just that whenever you can try to influence your parents, they just don't always want to listen. Especially if you're the youngest." – BSC Student (Ali, focus group, 24 March 2018)*

There was a level of understanding in both groups about why their parents might not always listen to them. They thought that habits and convenience were both hard things to overcome for their family with it came to low carbon living. Taylor also recognised that whether a person will change their behaviour or not is dependent on the attitude of that person.

> *"I feel like with anything, it's going to be hard. It's something that's been embedded in you for your whole life. For some people it's kind of like instant but change needs to happen quickly. It's kind of gotta be." – BSC Student (Chris, focus group, 24 March 2018)*

All students in the focus groups also agreed when asked if they think they had changed their household's behaviours as a result of them learning more about sustainability in the Eco Team or in class.

6.5.11 Role of School Decarbonisation in the Community

When asked what role schools can play in community decarbonisation, it was evident across all the focus groups and interviews that there is a strong sense of community and responsibility for Banksia SC and the local community. The Principal believed the school has a societal responsibility to be sustainable and thought educating students about carbon reduction was an important role the school can play in the community.

> *"I think school's core business is about education, so if we can in some way, shape, or form, help to further educate broader communities about sustainability, sustainable practice, reducing carbon emissions, I think that's where school can have its greatest effect. It's educating our students first and then having our students roll out and educate others."- BSC Principal (Liam, interview, 24 March 2018)*

Principal Liam mentioned on several occasions how he sees the great potential for students to not only further their own individual sustainability journey, but also to influence the people around them in a positive way.

> *"We take the view that sustainability in its broadest sense is the responsibility of everyone, and we see our role in that, in terms of trying to educate and further propagate the ideas around sustainability." – BSC Principal (Liam, interview, 24 March 2018)*

In the focus groups, all the students on the Eco Team felt that schools should play a larger role, not only when it comes to students but the wider community. Many of the climate change actions students suggested young people can take were also community based, further demonstrating this community focus. One student thought the school should work towards creating programs that aim to educate both students and the wider community.

> *"I think the school needs to work with the students and the community to create programmes or events even, that would help educate everyone about carbon emissions." – BSC Student (Chris, focus group, 24 March 2018)*

Another student also recognised that a school itself is a community nested within bigger communities. They noted, however, that most students do not actually recognise or acknowledge this.

> *"A school is a big part of a community. A lot of people contribute to it and a lot of students walk through it and you go through this place every day and a lot of people don't actually, well, students especially don't actually acknowledge it. Rather, because we spend all of our time at school. I don't go anywhere else. (Whole room laughter) ... Their worldview is school. So, they don't really see them having an impact or playing a part in the community. And, if they do, they don't know how they could possibly help all these people who live all these different lives." – BSC Student (Jamie, focus group, 24 March 2018)*

Key Finding 6-34: Students believe schools should play a larger role in educating the community about decarbonisation.

Seth envisioned the school as playing a larger role in society and believes a school should serve as an example of how to be carbon negative for the community. He thinks this is easier for schools to achieve because they can run programs with the students that can help offset their emissions, and there is a lot of potential for expanding community and industry partnerships to refine best practice carbon reduction in buildings and in schools.

> *"In an altruistic sense, I think my vision would be that first of all a school would be an example of how you can run at carbon negative…So, we should be that benchmark, that example for the community. It should be something that community members should be able to come in and our kids can explain but they can come in and they can see aspects of sustainable resource management or design, that'd be even better, through the front end rather than the back end." – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

6.5.12 Challenges

While Banksia SC has seen tremendous success with many of their approaches and initiatives, they still faced many challenges on their carbon reduction journey. A shortage of staff and teacher time to work on advancing low carbon initiatives at the school were mentioned by both Principal Liam and Seth as some of the major challenges.

Seth joked during the interview that if someone saw his calendar, they would be horrified because of the amount of work he commits to. He spoke with admiration about the passion and commitment of the staff, and the extra energy and time they are already willing to put into the school to make initiatives happen. However, despite their commitment, he believed they still need even more staff time. He said that while he receives a budget of $10,000 per year to put towards any sustainability initiatives, he was not interested in increasing his budget and instead would like to have more staff time. There was potential for Banksia SC to get more parent involvement with initiatives. However, the school struggled to get parents involved because parents often have busy schedules.

When asked if professional development (PD) for staff is used to activate more staff members, Seth said he did not use PD in that way because of the staff cynicism that typically surrounded PD sessions. However, he saw value in getting more inter-school knowledge sharing, such as getting staff to attend other school's Low Carbon Committee member meetings. Seth noted that there was often not enough knowledge sharing between high schools because it tended to be more about competition for students and trying to build a better school brand.

Key Finding 6-35: A lack of staff time was a key issue at the school.

Banksia SC also faced a significant financial challenge when changes to high school funding by the Department of Education took place. With the new funding model that went into effect in 2017, schools were funded on a per student basis up to a maximum of 1,200 students. If the school had more than 1,200 students, they were not given money for the additional students. Given that Banksia SC had a total of over 1,500 students at the time the new funding structure went into place, they lost around $800,000 in funding suddenly, similar to the experience of Wattle SC. This meant the school had to drastically reconsider their budget for 2018 and the following years. However, while sustainability became an area given less financial consideration under this revised budget, the school's commitment to carbon reduction and the holistic integration of sustainability remained firm.

While the school worked diligently to integrate sustainability across the school, Seth noted that there were still challenges integrating carbon reduction concepts and activities into the curriculum.

> *"The only challenge with that is how those links are made in curriculum areas...it's partly because you have to have a specialised language and skillset within those curriculum areas. Working to that, and it's to find those connections". – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

The school also faced a number of challenges when they initially were getting the Building Management System (BMS) online, as well as leaks and other operational challenges that occurred from construction and student growth.

6.5.13 The Success of BSC Initiatives

When each of the interviewees were asked about their perceptions of what contributed the most to the success of the school's carbon reduction initiatives, there were many different answers. Community partnerships, the passion and commitment of staff, the use of the LCSPP as an umbrella program, the utilisation of the Building Management System and putting students first were the factors that were most highlighted.

Principal Liam attributed a lot of the success of their carbon reduction journey to the persistence and dedication of a few key players at the school. He thinks these individuals had been particularly instrumental in ensuring the school stayed on course with their goals on sustainability and making the low carbon initiatives happen.

> *“I think it's the tenacity with which we and the particular individuals within the grand scheme of things have taken to seeing things through. For me, that's been the telling success in terms of where we've got to today.” – BSC Principal (Liam, interview, 24 March 2018)*

Seth thought that participating in the LCSPP contributed a great deal to the school’s success, because it acted as an umbrella program to unite all the school’s sustainability initiatives. He highlighted how staff running other initiatives can still be a part of the bigger picture and vision with this model.

> *“One of the things that has become successful over the two years, and I think is becoming very successful now, is just the outlook that using the Low Carbon Schools Program as a central thread for all the other sustainability programs... [staff] can take ownership and take that in the direction that it needs to go, but bring it back to the common thread, and know that they are part of the whole.” – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

Seth also believed making students central to their carbon reduction journey and ensuring their programs always included students was highly important. Principal Liam also thought this was an important aspect of their initiatives.

> *“The work with our kids in class across the board, but in specifics around particular projects, et cetera, have also been very successful…continued involvement in a variety of different forms helped to gain greater leverage in terms of carbon emissions solutions. It's been an exciting journey.” - BSC Principal (Liam, interview, 24 March 2018)*

Key Finding 6-36: Putting students at the centre of their low carbon initiatives was one of the schools most successful strategies.

Getting the BMS online was also a key factor in the school's ability to easily monitor and control their resource consumption.

> *"I think that's been critical in terms of not only gathering data, but then continual examination and analysis of data to show where we're making some inroads into carbon reduction." – BSC Principal (Liam, interview, 24 March 2018)*

Seth also noted that despite the traditional systems and processes in place that sometimes limit opportunities for the school, he believed a major aspect of the school's success was the ambition of the Principal and Deputy Principal when it came to pursuing new opportunities and partnerships. From the very beginning of the school, they gave him the freedom to explore how sustainability could look in the school.

> *"…the difference [at Banksia SC], I suppose, is particularly in the leadership, and particularly the Principal and Deputy Principal, to go reach out to people like me and say, 'We want you to come in, and we want you to be a part of our college. We know that you can add good things, but we're not sure what they are'." – BSC Sustainability Coordinator (Seth, interview, 24 March 2018)*

Partnerships also played a large role at the school, and Principal Liam also noted how important the school's community partnerships were in helping to advance the school's initiatives.

> *"…the partnerships have been instrumental, and there's no denying that it's allowed us to move forward with a number of projects, programs, and initiatives. So that's been key to this thus far." - BSC Principal (Liam, interview, 24 March 2018)*

Key Finding 6-37: A key success factor for the school was the willingness of the Principal and administration to embrace new and innovative opportunities for the school.

6.5.14 Text Analysis & Emergent Themes

To understand how the school communicated their low carbon initiatives with the community, their website, annual reports, business plans and other communications were analysed. Within Banksia SC's 2016-2018 Business Plan, they include a section about

“Responsible Management of College Resources”, which described their aims to address school carbon reduction and resource consumption:

- *Increase the range of Sustainability and Carbon Neutral projects and activities across the college” (Banksia Secondary College – Business Plan 2016-2018)*

This focus on carbon neutral projects and activities was also mentioned in their 2016 Annual Report, and in their 2017 Annual Report they highlighted some of their initiative’s success in terms of energy savings.

- *“We have been working on increasing the range of Sustainability and Carbon Neutral projects and activities across the College, resulting in energy savings for 2017 of 15% of the previous energy costs.”*

In their school newsletters, their low carbon initiatives were mentioned in nearly all of their newsletters for 2016 and almost half of their newsletters for 2017. Many of the sections included in the newsletters related to sustainability were about the school’s Year 10 HASS Sustainable Urban Design class. In March of both years, the LCSPP and the school’s goals for sustainability were included, showing the school was keeping the school community informed about their low carbon initiatives.

6.5.14.1 *Emergent Themes across Participants*

In interviews with the Low Carbon Committee, there was a large focus on discussions related to students, with the word “kids” surfacing as the most common word in the interviews. “Sustainability” arose as the second most frequently mentioned term, as seen in Figure 68. There were also many references to the word “system”, referring to the school’s Building Management System (BMS) and Lighting Control System, which the Committee thought was a highly important tool and resource for the school. “Community” was a highly discussed topic, primarily around engaging the community and talking about their community partnerships. As reflected in discussions about barriers, “time” was the fifth most frequently mentioned word across the interviews with reference to how there was a lack of time for initiatives.

Figure 68: Banksia SC 20 most frequently mentioned words in interviews.

In the two focus groups, there was a strong focus on “people”, shown in Figure 69. The concept of “change” was widely discussed, particularly in relation to climate change and changing people’s perceptions of climate change and broader sustainability. The fourth most discussed word was “students”, with many references to the younger students and educating them, as well as setting an example for them to follow. Due to a focus by the school on litter in 2016/2017, students also talked a lot about litter and the amount of littering that occurs on school campus.

Figure 69: Banksia SC 20 most frequently mentioned words in focus groups.

In both the interviews and focus groups, when school stakeholders were asked about success factors, partnerships and the importance of teamwork were common themes. Another primary theme that emerged were ideas around involving students more in the carbon reduction process at the school, and all interviewees and students thought reducing carbon emissions was important to address. There was also a strong theme of empowering students across all the interviews. In the student focus groups, there was a large theme of influencing peers, as well as taking responsibility for these peers and others. Examples of this that were highlighted in the focus groups included things like students on the Eco Team picking up litter after they see another student drop it on the ground. There was also a theme of students reporting change within themselves because of being involved in the Eco Team. The students also largely discussed how creating new social norms can influence attitudes and behaviour change around low carbon living topics. Table 32 shows the breakdown of the coding categories across all interviews and focus groups.

Table 32: Banksia SC summary of emergent themes and number of codes for each.

Category	Theme	Number of Codes
Barriers & Challenges	Crowded Curriculum	2
	Linking Initiatives to Curriculum	2
	Getting School Stakeholders on Board	1
	Lack of Knowledge	1
	Lack of Money	3
	Lack of Time	4
	Policies	3
Behaviour Change Challenges	Convenience	3
	Habits	3
	Old Social Norms	5
Behaviour Change Solutions	Education and Awareness	6
	Leading by Example	6
	New Social Norms	7

School Carbon Emissions	Importance of Measuring CO2	7
	Involving Students	6
	Saving Money	6
School Role in Community Decarbonisation	Educating Community	8
	Educating Kids	4
	Home Behaviour Change	1
	Influencing Parents via Students	8
	Modelling Best Practice Sustainability	1
Social Impact	Community Outreach	4
	Own Attitude and Behaviour Changes	2
Intergenerational Influence	LCL Actions Already Taken as a Family	2
	Student Encourages Family Behaviour Change	5
	Student Talks to Family about LCL Topics	8
Peer Influence	Bring up LCL Topics with Peers	5
	Don't Try to Bring up LCL Topics with Peers	4
	Taking Responsibility for Other People's Actions	6
Student Involvement	Hands-On Learning	5
	Student Empowerment	4
	Sustainability Integration into Curriculum	4
Student Ideas for LCL Action	Community-level	5
	Individual-level	4
	School-level	2
Success Factors	Involving Students	2
	Importance of Policy	2

	Partnerships	5
	Passionate people	4
	Support of Administration/Staff	2
	Sustainability Champion	3
	Teamwork	6
	Whole-School Approach	2

6.5.15 Summary

As a large school, Banksia SC has made huge strides in addressing their operational inefficiencies and adopting a “student-first” approach to their carbon reduction journey. There is an emphasis in the school on creating a solid governance and reporting structure for all their sustainability initiatives, where the school reviews their goals and reports on progress each year and uses the Low Carbon Schools Pilot Program as the umbrella program for other initiatives. This approach is not common in schools and unlike some other states in Australia, Western Australia does not have a unifying program or organisation that can tie together all the aspects of sustainability initiatives in schools. Banksia SC is a prime example of how important it is to have people in the school who understand facility management, which is uncommon in schools. Without Yuan’s extensive knowledge and experience in the area, Banksia SC may have not achieved the efficiency gains they had in electricity.

Their approach to empowering students goes beyond the school walls, by using partnerships and experts to provide students with a variety of real-life education and other experiences. Banksia SC works to create meaningful, real-life scenarios, activities and opportunities for the students, to give them a more nuanced understanding of the issues and opportunities in the world. The students in the focus groups all displayed a high level of agency for acting on climate change and it was evident most of the students had participated in high-level activities and had access to experts in the industry. The school clearly embraces opportunities and innovative thinking wherever possible, as demonstrated by their focus on community partnerships and willingness to embrace outside experts into the school to help achieve their ambitions. The Principal also sees tremendous value in reflection, and endeavours to facilitate this through their participation in activities like implementing low carbon initiatives and being involved in research projects.

6.6 Cross-Case Analysis

A cross-case analysis was conducted between the four case study schools to explore the trends emerging between the schools and the differences between each. This comparison primarily focussed on exploring the strategies each school used and the intergenerational influence reported by parents and students. The following sections discuss the key similarities and differences between school utility consumption and costs, carbon emissions and intergenerational influence.

6.6.1 Consumption, Cost & Carbon Emissions

All four case study schools increased in student numbers between 2015 and 2017. Banksia SC and Acacia PS both experienced a growth of about 60% and each had over 12 transportable classrooms installed to accommodate this growth. Wattle SC and Hill PS experienced smaller increases in student numbers of less than 14% and did not change in square metres (see Table F1 for exact square metres). While all schools approached addressing energy consumption in different ways, they all implemented some form of switch-off protocol and behaviour change initiative to encourage staff and students to use energy more wisely. Of all four schools, Hill PS was the most successful with their switch off protocol, which could be due, in part, to the high staff uptake and support of the school's initiatives. Acacia PS and Wattle PS showed the benefits of getting electricity audits at the school and how audits can help inform additional no or low-cost initiatives (Key Finding 6-8), and Banksia SC demonstrated how a Building Management System (BMS) can help the school achieve significant efficiency gains. While all four schools aspired to install solar PV and switch all their lights to LEDs, only the high schools made advances in investigating solar PV for their schools because high upfront costs made these upgrades too unattainable for the primary schools. The two schools with the largest increase in student numbers (Acacia PS and Banksia SC) increased their total electricity consumption between their baseline year and 2017, whereas Wattle SC and Hill PS decreased. Per student, however, all four schools reduced their electricity consumption, with Banksia SC showing the largest reduction at 30%, as shown in Table 33. There were no notable differences in gas consumption between the schools, aside from a significant spike in consumption by Wattle SC caused by gas leaks.

Water consumption was an area that was targeted the most by the high schools, and all except Acacia PS participated in a water audit and reduced their total water consumption. Following recommendations from the water audit, Wattle SC showed that switching their taps to low-flow can save a significant amount of water and costs on their water bill (Key Finding 6-19: A water audit helped the school identify the presence of inefficient water taps and changes subsequently allowed them to save over 500 litres of water per bill). Banksia SC also highlighted the importance of investigating their water bills as they discovered they were unknowingly paying for the neighbouring primary schools water consumption. On a per student basis, all four schools reduced their water consumption. However, interestingly, the school with the smallest student population (Hill PS) had the highest water consumption (kL) per student. Considering Hill PS used nearly double the amount of water per student than the other case study schools, this could indicate there may be unresolved water consumption or leak issues, which the Principal saying they were investigating.

Table 33: Summary of percentage change between 2015 and 2017 of utility consumption per student, for each of the case study schools.

Utility	Hill PS	Acacia PS	Wattle SC	Banksia SC
Electricity (kWh/student)	-25%	-19%	-9%	-30%
Water (kL/student)	-36%	-23%	-75%	-65%
Gas (kWh/student)	-11%	-35%	-61%	-35%

While waste was not measured or included in carbon emissions calculations, waste was an area the case study schools focussed heavily on and there were many initiatives that the schools had in common. All four schools increased their composting abilities with worm farms or compost heaps and increased paper recycling options on campus. Acacia PS had significant success with their waste free lunch initiative which helped them reduce overall waste at the school. Hill PS also addressed lunchtime waste on a smaller scale. However, neither high school implemented any waste-free lunch initiatives, which could be due to their larger student population, making waste behaviours more difficult to manage.

Every case study school reduced their carbon emissions per student by at least 18%. Banksia SC showed a reduction at 36%, which was the largest reduction out of any school in the study. In addition, out of all the schools in the LCSPP, three of the case study schools (Hill PS, Acacia PS and Banksia SC) were in the top five schools in terms of total carbon emissions saved per student. Table 34 shows the carbon emissions for the schools across three different metrics. Lastly, all four schools reduced their cost per student, with Banksia SC saving the most at $33 per student. Table F2 shows the total cost for all four schools.

Table 34: Percentage difference between 2015 and 2017 for each case study school's carbon emissions on a total, student and square metre basis.

Metric	**Hill PS**	**Acacia PS**	**Wattle SC**	**Banksia SC**
tCO_2-e (total)	-20%	**17%**	-10%	**2%**
tCO_2-e (per student)	-30%	-26%	-18%	-36%
tCO_2-e (per m^2)	-20%	**3%**	-11%	-3%

6.6.2 Intergenerational & Peer Influence

Within the student focus groups, most students said they either talked to their parents about sustainability or encouraged their household to change their behaviour in some way. Common examples included reminding family members to switch off lights, take shorter showers, use less plastic and recycling. Most students also said they discussed these topics with their friends or peers. However, there were mixed responses about whether students thought their friends listened or cared. Out of the four schools, students at Banksia SC showed the highest amount of agency and belief in their ability to influence their family, peers and community. Hill PS students also showed more willingness to discuss LCL topics with others. The high level of agency of students at Banksia SC and Hill PS could be due to the high levels of community engagement students experience. With Banksia SC's partnerships, students are exposed to community stakeholders and unique learning opportunities (Key Finding 6-26). Students at Hill PS also get input and participation from staff across all areas of the school and many members of their parent and neighbourhood community.

However, when it came to leading by example, all students in the four schools showed an understanding of how their behaviour could inspire others, with most groups discussing how their siblings mimic their behaviour at home. The high school focus groups also discussed several aspects of changing their households' behaviour that primary school students did not bring up. Several high school students highlighted the complexities in changing their family members' behaviour, with some of the main issues identified being a lack of awareness, convenience, old social norms and laziness. Both high school groups also mentioned that getting their parents to listen to them could be challenging, particularly if they are the youngest child. However, students at Banksia SC also thought when parents see the passion for the environment their children have, they are more likely to listen and do something. Students at Banksia SC and Acacia PS also appeared to feel a great deal of responsibility for others – both their peers and their parents. When parents or peers did not make the sustainable choice, students took it upon themselves to do things, such as switching lights off after a family member leaves the room or picking up litter after a friend. One student at Wattle SC and another student at Hill PS also described situations where they took responsibility for another person's unsustainable actions.

All three case study schools (Banksia SC had no parent survey responses) showed that at least 35% of their parents reported that their child talked to them about LCL topics. Wattle SC had the most students discussing topics with their parents. In addition, out of all the case study schools, Wattle SC had the most mentions of their low carbon initiatives in their newsletters, which could indicate they were more successful at educating the community about their initiatives. The primary schools reported higher percentages of change in student LCL attitudes and behaviour, with Acacia PS showing the second highest percentage of student change in attitudes or behaviour than all schools in the program, shown in Figure 70. All three schools had around a quarter of parents say their child encouraged their household to adopt new LCL practices, which is slightly lower than the average seen across all schools in the program. It was also evident in the case study schools that the initiatives that the schools were implementing were filtering through to parents, with the majority of parents saying they were either aware of some of their main initiatives or mentioning that their child discussed with them the initiative's topic area. For example, many of Acacia PS's parents mentioned Waste-Free Wednesday, showing that initiative was successfully reaching student households.

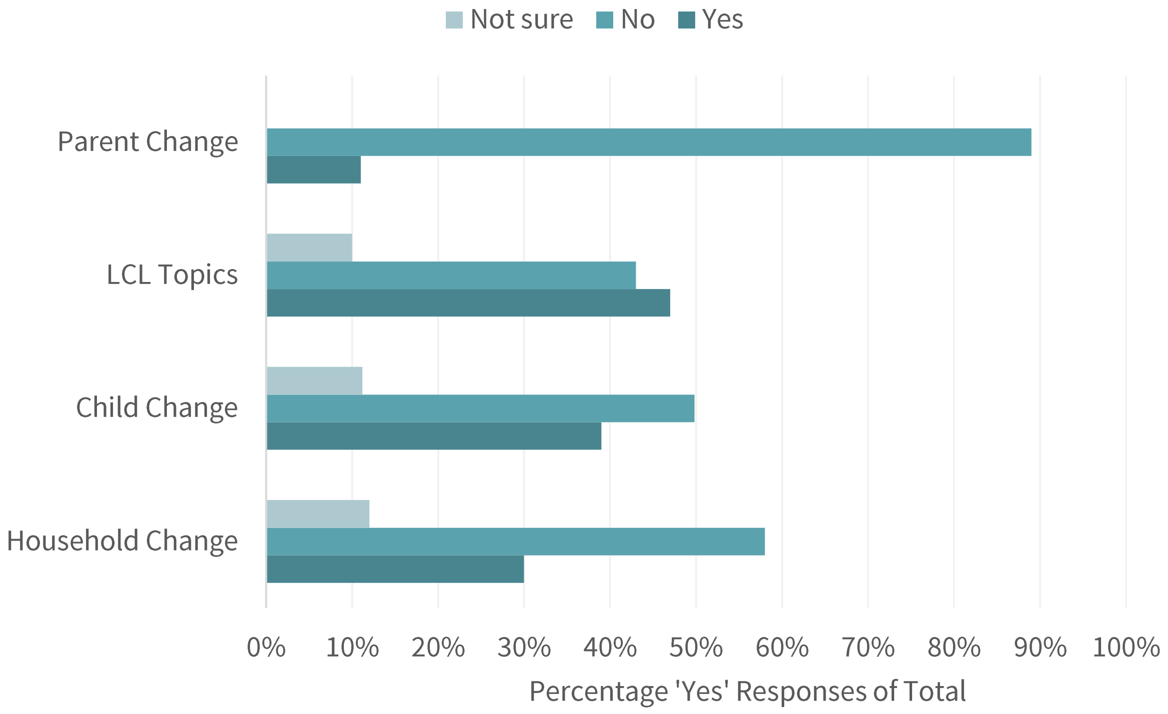


Figure 70: Summary of parent survey intergenerational question responses from all case study schools. Responses are shown as a percentage of the yes responses for each question.

6.6.3 Sustainable School Policies

All four case study schools successfully integrated some sustainability-related targets into their school Business Plan, as shown in Table 35. While each school mentioned their low carbon initiatives in some way, only Acacia PS and Wattle SC mentioned the measurement and reduction of resources. Acacia PS, however, did refer to their Whole School Operational Plan which outlined specific targets. In their 2017 Annual Report, Banksia SC was the only school to talk specifically about any utility or cost savings that was a result of their carbon reduction initiatives. While each school focussed on better integrating their low carbon initiatives across the school, there were varied levels of community outreach and education about school ambitions and initiatives.

Table F3 shows a summary of the results where each school's business plan, annual reports, newsletters and websites were analysed to see if they included any statements relating to sustainability or low carbon initiatives. Acacia PS was the only school to mention their sustainability goals on their website. However, each school did incorporate updates about initiatives and low carbon topics in many of their online newsletters. The schools also used an online platform to communicate with parents provided to them by the Department of Education. Acacia PS also appeared to have the most points of contact with their parents and community through multiple mediums: a sustainability-specific school Facebook page in addition to a general school Facebook page, online newsletters, website information and updates on online platforms.

When it came to school plans specific to sustainability, Banksia SC successfully created a water management plan and sustainable procurement plan and was in the process of completing a renewable energy target and energy transition plan for the school. Wattle SC also implemented a sustainable procurement policy to guide the choices made about the products they purchased for the school. As mentioned in earlier sections, Banksia SC was the only school specifically including utility cost savings that their school had because of low carbon initiatives in their 2017 Annual Report.

Table 35: Sustainability-related targets stated in each case study school's Business Plan.

School	Sustainability Targets in School Business Plans
Hill PS	*“Implement our Sustainability Action Plan which embraces our community partnerships with ClimateClever, Waste Wise, WaterWise and other member schools, and build on the opportunities these relationships provide”*
Acacia PS	*“An ongoing reduction in electricity usage (refer to Whole School Operational Plans for explicit targets)”*
Wattle SC	*“Demonstrate a trend towards reducing the college’s impact on the environment including rehabilitating the natural environment, utilities management and recycling.”*
Banksia SC	*“Increase the range of Sustainability and Carbon Neutral projects and activities across the College.”*

6.7 Chapter Summary

The exploration of the four schools shows the vast potential and different ways schools can achieve carbon reduction. They demonstrate that each school’s carbon reduction journey is different, and they each experienced success in different ways. School stakeholders acknowledged this several times in interviews, talking about the importance of considering the context and situation of each school when creating a low carbon plan. They highlighted there is no “one size fits all” approach when it comes to increasing the sustainability of a school.

Each school had a set of strategies and enablers that allowed them to experience their own version of success when it came to their low carbon initiatives. Hill PS excelled at a whole-school approach to their initiatives, embedding sustainability at each level of the school, including the canteen. Acacia PS showed the potential there is when the Principal is highly engaged and how successful a concerted waste initiative can be. Wattle SC demonstrated the importance of building capacity within school staff members and Banksia SC adopted a partnership approach that gave them immense benefits and learning opportunities. Each of these strategies were effective and specific to the capabilities and context of the school.

However, despite these differences, the schools showed striking similarities in several areas. They experienced nearly identical barriers, such as a lack of time, difficulty getting staff involved, and policy-related barriers, and they all placed a high amount of importance on areas such as student engagement and staff support. Students also demonstrated that they spoke to their family members about LCL topics. Surveys with the school parents confirmed this, and over a third of parents said their child had influenced their household LCL practices. The next chapter discusses the implications of the key findings that emerged from all schools participating in this study.

7 Discussion

This chapter discusses the key outcomes for each of the research questions guiding this research. In this section, all school results, including case studies, are discussed as a whole. The barriers and enablers facing schools, school decarbonisation strategies, and the potential for students to act as sustainability change agents are examined. The chapter concludes with recommendations for further research.

7.1 Barriers & Enablers to School Carbon Reduction

Within both the case study school interviews and surveys with school low carbon committee members, respondents were asked about the types of barriers their school encountered and what enabled the success of their initiatives. Across the schools, there were considerable similarities and primary barrier and enabler themes that emerged, with some differences between schools. The percentages of responses in each barrier/enabler category are shown in Table G1 and

Table G2. These results are discussed, along with their implications in the following sections.

7.1.1 The Importance of Policy

The strongest barrier theme that stakeholders identified were barriers caused by procedures or policies (or lack thereof) by the WA Department of Education (DoE) and/or local, federal or state government, that slowed or even prohibited schools from pursuing low carbon initiatives in some way. For example, most schools were interested in pursuing infrastructure upgrades, such as solar PV and LEDs. However, all stakeholders in interviews discussed DoE issues that prevented these initiatives (Key Finding 6-22, Key Finding 6-16, Key Finding 6-4). At the time of this research, the DoE did not have a policy for the implementation of solar PV in schools which meant schools could not easily get approval for solar PV installation (K. Anketell, personal communication, February 21, 2018). One school still did not receive approval for solar PV installation even after several years, despite having the upfront funds available for the installation, demonstrating this lack of DoE process and procedure (Key Finding 5-4). Other examples of these policy barriers school stakeholders identified included issues getting local government waste services to the school (Key Finding

6-15) and challenges getting recycling bins emptied because of strict job descriptions that did not allow school cleaners to empty recycling bins (Keera, interview, 22 March 2018).

There were concerns raised by the LCSPP program coordinator that this lack of processes lead schools to “go rogue” and implement infrastructure changes without official approval from the DoE (K. Anketell, personal communication, October 13, 2017). The significant emphasis from school stakeholders on policy-related barriers shows this is a major issue that needs to be addressed in order to help WA schools decarbonise. This is especially worth noting since other studies exploring barriers to school sustainability had very little emphasis placed on these types of policy related barriers (Evans et al., 2012; Tabesrt, 2009; Tesiero III, Nassif, Singh, & Flurchick, 2014), indicating this is a barrier more specific to schools in Western Australia.

Assertion 1: Clear and targeted government policies regarding infrastructure upgrades are required to support school based actions to reduce carbon emissions.

In addition to barriers related to a lack of formalised DoE processes for school infrastructure upgrades, most schools were unable to implement solar PV or LEDs because they lacked the upfront costs (Key Finding 6-4). In addition, schools had no access to alternative funding arrangements, such as power purchase agreements (PPA’s) and loans for solar PV or LED upgrades because they were prohibited for WA state schools, despite schools being allowed to lease/loan several other items at the school, such as IT infrastructure. This meant unless schools had the upfront funds available, there were no options for them to fund their upgrades other than self-fundraising. While they could apply for some small grants, as Evans et al., (2012) highlight, applying for grants requires the use of valuable staff time, and unless staff contribute their own free time to submit grant applications, these applications can be unmanageable. In addition, considering the high cost of upgrades such as LEDs and solar PV, it is unlikely a school could obtain grants that are large enough, and they would have difficulty fundraising through other means. Most schools also sought to address this lack of funds by pursuing upgrades on a small case-by-case basis, such as replacing LED lights as they break. However, this is not feasible for initiatives such as solar PV, highlighting the importance of schools having access to other funds for these initiatives.

Furthermore, local, state and national governments can play a more active role in driving and enabling school carbon reduction. At the time of this research, the WA state government did not have any state-wide funded solar PV programs for schools. In contrast, as of 2018, several other Australian states had programs specifically targeting energy efficiency and solar PV in schools. Queensland had a program, for example, that provided $97 million to increase efficiency and install solar across state schools. Victoria started a pilot with 100 schools to implement energy efficiency and LED/solar upgrades, and the Northern Territory committed $5 million for up to 25 schools to install solar PV (Clean Energy Council, 2019).

Assertion 2: A lack of access to funding can prevent schools from implementing infrastructure upgrades like solar PV and LEDs.

While the lack of DoE policies and funding options discouraged schools from implementing significant infrastructure upgrades, schools in this research did have a financial incentive to act because the funding structure allowed them to keep financial savings from initiatives for an undetermined period of time. This is not the case for all Australian schools, with several funding structures disallowing schools from keeping financial savings from reduced utility consumption (Rauland et al., 2014). Some school stakeholders identified the financial savings of low carbon initiatives as a motivator for staff and the administration to help progress initiatives. However, despite this financial incentive, the policy barriers facing schools were still too significant and prevented them from implementing certain initiatives. This highlights the important role that government policy can play in school decarbonisation. To encourage bottom-up action from schools around quantifiable sustainability, governments must ensure their policies enable schools to implement initiatives with ease.

Last, while several schools successfully reduced their overall electricity, gas or water consumption, the financial savings were not seen for most schools. Electricity and water prices increased during the program and therefore offset most school’s reduction in consumption (Key Finding 5-10). Increases in electricity costs are expected to continue in Western Australia until at least 2021 (Australian Energy Market Commission (AEMC), 2018), and the amount of energy schools use is also expected to rise as they increase their use of technology, such as on costs for electronic whiteboards (Council of Australian Governments (COAG), 2012). In addition, decreases in water consumption were typically not met with a significant financial savings due to the large fixed costs in the school water bills (Key Finding 5-13). These increasing costs create more of an imperative to ensure school buildings are resource efficient, not only because it will save money for Education Departments, but also for the schools themselves.

Assertion 3: Rising utility consumption and costs makes school decarbonisation increasingly more important for schools and Education Departments.

7.1.2 School Organisational Factors

A lack of time and money to work on initiatives was a key barrier mentioned by school stakeholders, which has also been identified in other studies (Evans et al., 2012; Tabert, 2009). While each school had a core team of staff working on school sustainability, most committee members highlighted difficulties getting enough staff time to implement low carbon initiatives (Key Finding 6-20, Key Finding 6-35). Some Principals spoke about this lack of time in monetary terms. They noted that for staff to work on initiatives, they either had to use their own free time, or they had to be provided with allocated paid time. Several Principals were willing to provide paid time for staff to work on initiatives because they believed it was worth pursuing for the social benefits the school gets. Principals also highlighted that by building capacity in staff, they get more effective at implementing initiatives over time, such as a staff member improving their ability to get other staff on board (Key Finding 6-25). A focus on building capacity in staff has shown to be beneficial to the school culture and is identified as a successful trait of Principal leadership (Gurr, Drysdale, & Mulford, 2005).

Only one high school in the cohort had a paid Sustainability Coordinator who was responsible for managing sustainability across the school. However, the Sustainability Coordinator said that despite his budget to contribute towards initiatives, a lack of other staff’s time was still a key barrier (Key Finding 6-35). This indicates that a school must ensure multiple staff members are provided with paid time to work on initiatives to avoid most of the work falling on a “sustainability champion” (Lewis, Volet, Baudains, & Mansfield, 2013), which in this case was the Sustainability Coordinator. Other schools sought to better involve parents to assist with this lack of time. However, even for schools with a high level of parent support, they still struggled with how to best include parents in low carbon initiatives (Key Finding 6-5). In addition, parents can be difficult to engage in school and student programs due to schools experiencing difficulty making initial contact (Langley et al., 2010). Many schools also do not place a high priority on involving students in school initiatives (McIntosh et al., 2014).

Assertion 4: Schools do not have enough paid staff time to implement low carbon initiatives.

There were also many discussions about the national curriculum being too crowded, with teachers feeling pressure to deliver specific outcomes, such as high numeracy scores (Evans et al., 2012). School stakeholders thought this prevents teachers from attempting to incorporate new material related to their school's low carbon initiatives because it can be perceived as additional work (Key Finding 6-20, Key Finding 6-14) (Hill & Dyment, 2019). However, this perception of a crowded curriculum may simply highlight a lack of understanding by teachers of how to weave in sustainability messaging in the curriculum, which has been highlighted in several other studies (Dyment & Hill, 2015; Evans et al., 2012; Hill & Dyment, 2016).

The consensus amongst the schools in this study of how to get teachers to integrate low carbon initiatives into the curriculum involved making it as easy as possible for them to participate. Examples included having lesson plans and resources pre-made so teachers can integrate them into the classroom with minimal effort. Other solutions to address teacher lack of knowledge about sustainability in the curriculum include professional learning (Dyment et al., 2015), and on-site training by school staff to educate on key sustainability areas (Evans et al., 2012).

Assertion 5: Teachers require resources and further professional learning to link low carbon topics into the curriculum.

While a lack of staff knowledge about building efficiency and how to best implement low carbon initiatives were not barriers commonly mentioned by school stakeholders, it was evident that this is a critical barrier for school decarbonisation. In most schools, the teachers were responsible for investigating utility consumption and identifying efficiency upgrades for the school (e.g. exploring the feasibility of a water audit or investigating light timers). A main issue, however, with teachers taking the responsibility for these actions is the lack of time teachers have, as well as a lack of knowledge about sustainability concepts, as highlighted in earlier sections. Some schools were able to enlist the help of a parent to investigate resource consumption. However, there were still issues with a lack of knowledge in the area, with most schools reporting difficulty with the process of gathering utility bills and entering them into a spreadsheet (Key Finding 5-21).

It could be argued that the tasks of investigating and tracking utility consumption and increasing building efficiency should be the responsibility of the Business Manager (or equivalent role) considering they manage various aspects of the school facilities. However, many school Business Managers do not only manage budget and maintenance, but are also responsible for several other areas, such as managing staff issues, compiling school reports and assisting with event organising (Thomas, n.d.). Like teachers, Business Managers may also face issues with a lack of time and a lack of prioritisation given to school efficiency and sustainability (Aldridge, 2008). One study proposed that facilities managers are the most suited to become advocates for energy efficiency in commercial buildings. However, it was noted that role responsibilities can be a major factor in whether the facility manager is incentivised to pursue efficiency (e.g. a manager that is only responsible for maintenance versus a manager responsible for improving business performance) (Curtis et al., 2017). Other studies reiterated the importance of ensuring school business managers have the agency and input for school strategies to help them take more ownership over school performance (Aldridge, 2008; Southworth, 2010). Research has also shown the school Business Manager (i.e. Bursar) is a key player in addressing school resource consumption (Barr, Cross, & Dunbar, 2014; Carbon Trust, 2010; Moncaster & Simmons, 2015).

Assertion 6: School Business Managers may require time, resourses and training to effectively managing school buildings.

Unsurprisingly, the support of the Principal and the Business Manager at the school was regarded by most committee members as highly important to successful initiatives (Key Finding 6-37: A key success factor for the school was the willingness of the Principal and administration to embrace new and innovative opportunities , Key Finding 6-24). Evans et al., (2012) also cited principal support as a key enabler for school sustainability. However, they emphasised the importance of the level and type of support provided by the Principal. For example, while all participating schools in this research had written support by the Principal for the school to participate in the program, stakeholders reported varying levels of support for low carbon initiatives, indicating there was a difference in levels of principal support for the program versus proposed initiatives. In addition, the top three schools with the highest savings in carbon emissions also had higher levels of reported Principal support than the rest of the schools, which further demonstrates Principal support playing a major role in a school's ability to decarbonise. The Sustainability Coordinator at one high school specifically noted that the progressive thinking by the administration at the school was a major contributor to the success of their initiatives (Key Finding 6-37: A key success factor for the school was the willingness of the Principal and administration to embrace new and innovative opportunities). Several stakeholders also mentioned how important a good relationship with the school Business Manager is.

In addition, committee members also indicated that having a team of passionate staff was highly important to the success of initiatives, as they are the ones carrying out initiatives (Key Finding 5-15). Stakeholders also highlighted the importance of having a diverse skillset within teams and the power of teams of people to affect change at the school versus individuals staff members taking on this role. Within each school's Low Carbon Committee, there were people with various skillsets and interests which allowed each committee to pursue a wide range of initiatives.

Assertion 7: The support of both the Principal and Business Manager is key to successful school carbon reduction.

7.2 School Carbon Reduction Strategies

There were several different strategies and approaches that schools highlighted as being highly effective in assisting with their school's carbon reduction process. Interestingly, there was little in common between the schools, with the methods that worked for each school largely specific to the context and capabilities of that school. Table G3 shows a summary of the main strategy themes that arose for each case study school and the number of codes in that theme. This section describes some of the key strategies schools used.

7.2.1 High-Impact Initiatives

All except two schools conducted both a Level 1 energy audit and basic water audit. A water audit helped some schools save thousands of litres of water and costs on bills (Key Finding 6-19: A water audit helped the school identify the presence of inefficient water taps and changes subsequently allowed them to save over 500 litres of water per bill) and energy audits enabled them to identify high-usage school activities that could be easily addressed, such as turning off unused fridges (Key Finding 5-3) or switching off large cool-rooms for parts of the year (Key Finding 6-8). The use of audits to understand consumption is a critical part of increasing the resource efficiency of a building (Corrado, Ballarini, Paduos, & Tulipano, 2017) and provides valuable insights (AlFaris et al., 2016). Several schools said that conducting audits were highly successful initiatives as it allowed them to better understand their consumption and actions they could implement. It is important to note, however, that for schools in this study, the energy audit was provided free of charge by a partner of the LCSPP and the water audit was provided at a discounted rate. Without these discounts, most schools may not have gone through an auditing process because of associated costs. While schools can successfully conduct energy audits themselves, it requires a concerted effort by several key members of the school, strong leadership within the school and the presence of external motivators (Schelly, Cross, Franzen, Hall, & Reeve, 2011). Alfaris et al., (2016) noted the importance of schools having professional help to conduct an energy audit because of the large amount of time and commitment it requires. This highlights that while audits are highly beneficial for schools, there are knowledge and cost barriers to uptake. This is an area where local, state or national governments could intervene by providing access to free or discounted audits.

Assertion 8: Energy and water audits allow the school community to understand consumption and identify the best initiatives to save money and resources.

Over half of initiatives schools listed on their action plans involved no cost (Key Finding 5-1). Many schools focussed on behaviour change initiatives such as signs to remind staff and students to use less water or switch off lights. Several studies have identified positive environmental outcomes associated with relatively simple behaviour change initiatives (Cornelius et al., 2014; Fernandez, Alferez, Vidal, Fernandez, & Albareda, 2016; Lanzini & Thøgersen, 2014; Steg & Vlek, 2009). However, studies also highlight the importance of implementing interventions on an ongoing basis to ensure behaviours stay changed (Heath & Gifford, 2002; Varotto & Spagnolli, 2017). The most impactful zero-cost initiative that most schools implemented was an end of day and end of school term switch off protocol, which saved schools on average 12% on their electricity consumption over all school holiday periods (Key Finding 5-2, Key Finding 5-11). The success of switch off protocols has been shown in other studies (Corrado et al., 2017; Tesiero et al., 2014) and is a key recommendation of most energy audits (AlFaris et al., 2016). In addition, one secondary school adopted a partnership approach that enhanced their ability to provide hands-on learning opportunities for students. The Principal noted their industry partnerships as one of their most fruitful strategies (Key Finding 6-6). Some studies have noted the significant potential for schools to adopt an industry partnership approach, citing benefits such as in-kind support (Pillay, Watters, Hoff, & Flynn, 2014) and enhanced learning outcomes for students (Leonard, 2011). An approach that the case study schools implemented was incorporating sustainability targets and values into their school business plans. Some schools also created management plans for utilities like electricity or water, as well as sustainable procurement. The creation of school policies related to sustainability is an important part of ensuring the school successfully implements a whole-school approach to sustainability (Tilbury & Henderson, 2004). However, despite schools including sustainability in their plans, only one school listed a target to reduce their electricity consumption, with the other schools broadly stating goals of resource efficiency. The use of specific, measurable, ambitious, realistic, and time-bound (i.e. SMART goals) in organisations has shown to drastically improve sustainability outcomes (Maxwell et al., 2015), showing the importance of establishing specific school emissions targets.

Assertion 9: Zero-cost behaviour change initiatives can have significant impacts on school utility consumption and cost.

7.2.2 Measuring and Comparing Carbon Emissions

Before participating in the LCSPP, all schools were already implementing sustainability initiatives in some way. A strategy several schools reported success with was using the LCSPP as an umbrella program to unite all other school sustainability initiatives (Key Finding 6-36, Key Finding 6-18). The requirement by the program to form a low carbon committee at each school enabled staff working in different sustainability areas to meet regularly to discuss the overarching goals of school carbon reduction. Several schools reported success with this process, showing that carbon emissions measurement can be a useful process for school sustainability. One studied showed that a school’s goal of school carbon emissions reduction can unite the school community with a whole systems thinking approach (Lewis et al., 2014).

In addition, using carbon emissions as a way of measuring operational performance provides the opportunity to calculate the impact of a variety of activities across different sources in a consistent manner (UNEP, 2009).

Assertion 10: Monitoring and tracking school carbon emissions is a holistic and cohesive approach that allows a school to bring all the different areas of sustainability together.

The schools participating in the LCSPP were provided with information and tools to help them investigate and track their electricity, gas and water consumption and costs in order to save carbon emissions. A key aspect of this involved data collection and interpretation at the school level – i.e. school stakeholders were responsible for collecting their data and educated on how to interpret their data. This was designed to help schools increase their knowledge about resource consumption and prompt them to act. Providing information such as electricity consumption to home owners has shown to increase the likelihood of reducing their consumption in several studies (Dolan & Metcalfe, 2013; Jessoe & Rapson, 2012; Karlin et al., 2015) and when school administrators are provided with utility consumption data, they are more likely to take actions to reduce utility consumption (AlFaris et al., 2016; Koumoutsos et al., 2015).

Schools were also provided with comparisons between the schools to allow for an enriched understanding of what consumption and costs were normal or abnormal between similarly sized schools. It is known that social comparisons can have an effect on reducing household electricity consumption (Allcott, 2011; Harries, Rettie, Studley, Burchell, & Chambers, 2013; Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). While this research was unable to measure the direct impact school comparisons had on consumption, nearly all school committee members said comparing their school’s consumption and sharing experiences with other schools was very useful (Key Finding 5-19). One primary school Principal even mentioned that comparing his school’s gas consumption with another school was the reason the school started their carbon reduction journey (Key Finding 6-1). This shows there is significant opportunity and power with enabling schools to compare consumption and costs with one another (Key Finding 5-8).

Assertion 11: Utility consumption and cost comparisons between schools can be a powerful catalyst for school efficiency.

When comparing school utility consumption and cost data, however, there can be challenges due to the differences between each school. Factors such as size of school grounds, classroom density, building age, school student population growth and presence of facilities, such as pools, can all have a significant impact of a school’s utility consumption and costs (Filippín, 2000). When total utility consumption amounts are used, it does not provide any meaningful insights since it does not consider any contextual factors. Within energy efficiency literature, it is common for consumption to be calculated on a per square metre basis for schools (Dias Pereira et al., 2014). While this is useful in some circumstances, there are limitations with this metric when comparing consumption between schools because it does not account for student density and growth.

Considering schools already receive their funding on a per student basis, calculating carbon emissions and resource consumption on a per student basis is a logical method. A per capita approach is already widely used on a global scale to gain insights into the carbon intensity of countries (Raupach et al., 2014). By extension, this research provides evidence to suggest this method of viewing carbon emissions in schools on a per student basis is ideal for gaining insight into how schools compare to one another. However, it should be noted that calculating emissions and consumption on a per student basis does have its drawbacks and should never be the sole metric used. For example, if a school were able to maintain the exact consumption each year and without the implementation of any initiatives, and increased their student numbers, their carbon emissions per student would decrease. If only the carbon emissions per student was observed, this school would appear to be successfully reducing their emissions per student. Therefore, it is important to consider the contexts of each school, consider both the per student and total emissions. Studies looking at benchmarking school energy consumption and greenhouse emissions have also highlighted the importance of using the most appropriate metrics for comparison, citing consumption/carbon emissions per student as the ideal metric for school benchmarking and comparison (Armitage et al., 2011; Filippín, 2000).

Assertion 12: Using per student metrics provides richer insights into school performance and enables easier comparisons between schools.

While many carbon footprints for larger organisations typically include emissions sources from several areas such as energy, water, transport, waste and procurement (Pandey, Agrawal, & Pandey, 2011), the LCSPP only focussed specifically on emissions from electricity gas and water. While some studies have suggested more comprehensive carbon footprints for schools (Global Action Plan et al., 2006), Rauland et al. (2014) suggest that schools lack the time and resources to conduct detailed carbon footprints and therefore the scope should be limited to make it easier for schools. This was confirmed in this study, with many schools expressing difficulties when collecting their bill data due to inadequate record-keeping of utility bills (Key Finding 5-21). This indicates that any additional scope may prove too daunting for most schools. In addition, schools often lack the funds to hire consultancies to conduct more comprehensive carbon footprints, further demonstrating the importance of an achievable carbon footprint scope that is easily managed by school staff, such as teachers. While it is important to include carbon emissions from sources outside of just electricity, gas and water, approaching the process in stages may be the most suitable method for schools (Rauland et al., 2014).

Assertion 13: The carbon footprinting process should be simplified for schools addressing their emissions at the grass-roots level.

7.3 Students as Community Change Agents

The results from parent surveys and focus groups with students clearly showed that students actively discuss LCL topics with their family and can influence LCL attitudes and behaviours within their homes. The topics that students discussed with parents and the changes they had in their own behaviour were similar to the ways they influenced their home, with the results showing that students who changed their own behaviour were six times more likely to change household practices (Key Finding 5-24). This ability for children to influence their parents and family members is well documented (Agarwal et al., 2017; De Mol & Buysse, 2008; Salter, 2013). However, few studies have drawn correlations between a child’s behaviour and similar changes in their household. As the results of this study indicate, however, changes in student behaviour can translate to changes in family home practices. One of the most common ways students influenced households was turning off lights, which has been demonstrated by other researchers (Agarwal et al., 2017; Tabert, 2009). Several students highlighted the potential for leading by example for their family members and students generally appeared to feel positively about their ability to influence their family members around low carbon living

The most common topics students discussed with their parents revolved around waste, which could be due to both the tangible nature of these topics, but also the large focus several schools placed in this area. It was also clear that the initiatives that schools implemented influenced the types of behaviours and topics children discussed with their parents. For example, a school that primarily focussed on waste-free lunches showed that over half of the discussions students had with their parents were related to this initiative. Other studies have shown that school programs can influence student behaviours and discussions with parents around topics ranging from recycling to biodiversity (Ballantyne, Fien, & Packer, 2001a; Maddox et al., 2011).

Assertion 14: Students are active influencers in their households and community around low carbon living.

While only half of the schools indicated that they actively involved students in the carbon emissions reduction process, all committee members said they thought there was a significant potential for students to be involved in the process (Key Finding 5-20). Stakeholders identified opportunities for engaging students, like the monitoring and calculation of resource consumption, which could incorporate maths skills (Key Finding 6-10) which has shown positive effects on student learning (Peck, 2009). Others committee members saw potential for students take more responsibility for identifying solutions and leading low carbon initiatives. A study that involved students in calculating an ecological footprint showed that students that were involved in the footprinting process experienced a higher probability of taking actions around sustainability, both on and off-campus (Gottlieb et al., 2012). Involving students in school energy management can both increase leadership skills for students, but also increase school accountability (AlFaris et al., 2016). This shows there are significant learning opportunities with involving students with the carbon emissions reduction process.

From the perspective of students, they had several ideas about how the school could act on climate change, with many students identifying ways the school could involve the community (Key Finding 6-13). Some high school students even specifically highlighted the lack of information accessible to students about the school's utility consumption and costs and expressed a desire to have access to this information (Key Finding 6-32). Involving students in school programs or specifics of a school can give students a sense of agency and lead to an increased interest or enthusiasm in school activities by students (Broom, 2015; Dimick, 2012). Stakeholders at schools that actively involved students in the process made it clear that student involvement was a key element of the success of their initiatives (Key Finding 6-36, Key Finding 5-16) showing this is a successful approach for school carbon reduction.

Assertion 15: Involving students in the school carbon reduction process is beneficial for students and the school, by giving students agency and fostering intergenerational change.

8 Conclusion

This thesis explored how schools participating in a carbon emissions reduction program could effectively decarbonise and how schools can influence the wider community around low carbon living. A mixed method approach was used to answer the overarching research question: *How can schools reduce carbon emissions and influence community awareness of low carbon living?*

Opportunities for School Carbon Reduction

Energy and water consumption in schools is expected to increase in the coming decades, along with their associated utility costs, putting increasing financial stress on schools. There is also a heightened urgency to reduce global carbon emissions, requiring action from all sectors of the economy. School buildings have an important role to play in reducing emissions, having been identified as offering some of the most cost-effective carbon abatement opportunities within the built environment. The benefits of addressing school carbon emissions are abundantly clear; not only can it have a significant impact on addressing climate change, but it can help to reduce utility costs in schools, increasing their financial resilience. Reducing emissions in schools can also provide hands-on learning opportunities for students, with most school stakeholders highlighting the potential for students to be engaged in more aspects of the carbon reduction process through activities such as electricity monitoring and using maths to calculate consumption. Considering today's youth are the generation that will feel the effects of climate change more than any other generation, and they often feel powerless about their ability to act, involving students directly with school low carbon initiatives can provide them with a sense of agency and purpose towards implementing climate change solutions.

Low Carbon Initiatives to Achieve School Carbon Reduction

Based on the utility consumption and cost data of the schools participating in the Low Carbon Schools Pilot Program (LCSPP) over a three-year period, it was evident that the most impactful initiatives schools implemented were ones that involved no or low cost. Most of the initiatives that school stakeholders chose to implement primarily focussed on behaviour change, demonstrating the power of encouraging school staff and students to act more sustainably. Conducting electricity and/or water audits and the process of investigating utility consumption and cost data was a first key step for many schools. It enabled school staff to discover large inefficiencies that could be addressed, demonstrating how audits can help school stakeholders understand and manage their resource consumption. School stakeholders also found the process of comparing data between schools highly useful. Considering there is very little information available to help them to understand whether their resource consumption is higher than it should be, there is potential for governments to establish a standardised way of enabling data comparisons between schools to encourage increases in efficiency.

Key Barriers Faced by School Stakeholders

While each school approached carbon reduction in a different way, most school stakeholders described similar barriers. Nearly all schools lacked the funds to implement large scale infrastructure initiatives, such as solar and LEDs, and there were no alternative funding arrangements available to schools, such as power purchase agreements or loans from the state or federal government. Even if a school did have the upfront funds for solar PV, the lack of government policies and procedures for solar PV procurement and installation made it highly difficult for it to be implemented. This highlights the importance of governments having the appropriate policies in place to encourage schools to pursue these initiatives and the opportunity for governments to provide additional incentives through establishing alternative funding options for school infrastructure upgrades. A lack of staff time to work on initiatives surfaced for all schools, with many also highlighting the challenges with getting other staff involved in initiatives. Some schools addressed this lack of time through leveraging the participation of parents and community members, while some other Principals provided paid staff time to work on initiatives.

Effective Enablers and Strategies to Implement Low Carbon Initiatives

Having a supportive Principal and Business Manager were identified as key factors to the success of a school’s low carbon initiatives. Schools that had a higher amount of Principal support were more likely to have a higher reduction in carbon emissions, showing Principal support is a key organisational factor. While there was less of an emphasis in the literature on the support of Business Managers, it was evident this was important to school initiatives, particularly when it came to measuring and tracking resource consumption. The use of the LCSPP was successfully used in several schools as an umbrella initiative and helped focus and unite the school’s various sustainability initiatives and staff working on them. Considering many schools already pursue sustainability in some way, measuring and tracking carbon emissions shows potential to not only unify initiatives but also quantify their sustainability efforts, something that is not often done in schools. In-depth analyses on each of the case study schools provided valuable insights into their carbon reduction journeys, showing the perspectives of principals, teachers and students. The case studies highlighted how different each school's journey is, with each taking a slightly different approach to school carbon reduction. Most used a whole-school approach to sustainability, however industry-partnerships and staff capacity building were also shown to be highly effective in helping schools achieve their goals.

Student Influences on Family Low Carbon Living Attitudes and Behaviour

This research showed that students not only talk to their family members about low carbon living topics, but also influence their attitudes and behaviour around low carbon living. The initiatives a school implements also filters through to what students discuss with their parents, further demonstrating the potential schools have to influence the community. The ways that students influence their family members mirror changes in their own behaviour. When extrapolating the impact of a child at a school across hundreds, or thousands, of households connected to the school, the environmental impact of this student-led behaviour change is significant.

Impact of a School-Based Carbon Reduction Program

The LCSPP served as the context for this research and showed that a school carbon reduction program that aims to upskill and empower school stakeholders while creating a community of practice is an effective approach. The program successfully grew the knowledge base of school stakeholders around school carbon reduction. The process of facilitating sharing between schools about resource consumption and their experiences with implementing initiatives was identified by stakeholders as a highly useful part of the process. More importantly, this program shows that school stakeholders are willing and able to take charge of their school's carbon emissions, demonstrating that meaningful quantifiable emissions reduction can occur from the grassroots level.

Generalisability of the Findings and Recommendations

Despite the small number of participants in this pilot program, many of the findings were supported by previous studies and existing literature, demonstrating the generalisability of the research. Many of the initiatives schools implemented in this study would be replicable in most schools around the world and the key success factors that stakeholders identified such as Principal support are relevant to any school. All schools can engage staff and students to think more critically about sustainable behaviours and implement behaviour change initiatives to save natural resources. The approach of using carbon emissions as an umbrella sustainability initiative is significant, and can be applied anywhere by both schools and government. Governments can use carbon emissions as a framework for measuring the environmental impact of schools, similar to how it has been adopted for commercial buildings. A key challenge in this research involved a reliance on school staff who had limited time and resources to collect and measure resource consumption data. Future studies or programs could reduce strain on staff by providing the school resource consumption data in a more accessible way, without relying on school staff to gather, collate and manually analyse utility bills. This would enable school staff to spend more time interpreting and understanding their data and implementing initiatives.

Further Research

Despite the abundant benefits highlighted above, there is astonishingly little action and research focussed on school carbon reduction. At the time of this research, there is no standardised framework for Australian schools on how to approach carbon reduction. There is also no global carbon accounting framework specifically tailored to schools. This is an area which would greatly benefit from further research. In addition, future research could explore the opportunity for schools to not only reduce their buildings carbon emissions but also how they could become examples of best practice for carbon reduction in the community. The school building itself is an underutilised aspect of a school’s teachings, and if utilised can provide opportunities for learning and contribute to positive outcomes in the hidden curriculum, as well as for community education. Future studies could further explore these opportunities and how to approach whole-school sustainability in a way that fully utilises the school building, enabling them to become living laboratories.

A key aspect of this research focussed on how students can influence their family’s attitudes and behaviour around low carbon living. While the research found that students who are empowered and involved in low carbon initiatives can become important influencers in the community around sustainability, this appears to be an underutilised area of action for schools. Future research could explore how schools could better facilitate, and more accurately measure, this intergenerational influence by increasing student involvement in the school carbon reduction process.

Overall, this research clearly shows that reducing carbon emissions in schools not only has abundant environmental and financial benefits, but can have social benefits that stretch far beyond the confines of the school. Considering schools act as centrepoints of our communities across the world, there is a vast potential for schools to not only influence their students and staff, but act as beacons of sustainability within their communities and inspire others to live more sustainably.

9 References

21st Century School Fund, U.S. Green Building Council Inc, & National Council of School Facilities. (2016). *State of Our Schools: America's K-12 Facilities*. https://doi.org/10.1017/cbo9780511499562.004

About ResourceSmart Schools. (2019). Retrieved May 19, 2019, from https://www.sustainability.vic.gov.au/School/About-ResourceSmart-Schools

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*(3), 273–291. https://doi.org/10.1016/j.jenvp.2005.08.002

Afkhamiaghda, M., Keesee, M., & Holiday, L. (2017). Unintentional Sustainability in Schools-A Case Study of a Newly Built School's Accordance with the LEED Rating System. In J. Volz (Ed.), *AEI 2017: Resilience of the Integrated Building* (pp. 1078–1090).

Agarwal, S., Rengarajan, S., Sing, T., & Yang, Y. (2017). Nudges from school children and electricity conservation: Evidence from the Project Carbon Zero campaign in Singapore. *Energy Economics*, *61*, 29–41. https://doi.org/10.1016/j.eneco.2016.10.014

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin, 84*(5), 888–918. https://doi.org/10.1037/0033-2909.84.5.888

Aldridge, M. (2008). *School Business Managers: their role in distributed leadership How can SBMs/Bursars compliment and support distributed leadership*.

AlFaris, F., Juaidi, A., & Manzano-Agugliaro, F. (2016). Improvement of efficiency through an energy management program as a sustainable practice in schools. *Journal of Cleaner Production, 135*, 794–805. https://doi.org/10.1016/j.jclepro.2016.06.172

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics, 95*(9–10), 1082–1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Alshamrani, O., Gala, K., Alkass, S., Galal, K., & Alkass, S. (2014). Integrated LCA-LEED sustainability assessment model for structure and envelope systems of school buildings. *Building and Environment*, *80*, 61–70. https://doi.org/10.1016/j.buildenv.2014.05.021

Armitage, P., Godoy-Shimizu, D., Steemers, K., & Chenvidyakarn, T. (2011). Using Display Energy Certificates to quantify schools' energy consumption. *Building Research and Information*, *39*(6), 535–552. https://doi.org/10.1080/09613218.2014.975416

Armstrong, P., Sharpley, B., & Malcolm, S. (2004). The Waste Wise Schools Program: Evidence of Educational, Environmental, Social and Economic Outcomes at the School and Community Level. *Australian Journal of Environmental Education*, *20*(2), 1–11.

ASBEC. (2016). *Low carbon, high performance: How buildings can make a major contribution to Australia's emissions and productivity goals'*. Retrieved from https://apo.org.au/sites/default/files/resource-files/2016-05/apo-nid64127.pdf

ASBEC. (2018). *Built to Perform: An industry led pathway to zero carbon ready building code*. Retrieved from https://www.asbec.asn.au/wordpress/wp-content/uploads/2018/10/180703-ASBEC-CWA-Built-to-Perform-Zero-Carbon-Ready-Building-Code-web.pdf

Australian Curriculum Assessment and Reporting Authority (ACARA). (n.d.). What does the ICSEA value mean? Retrieved January 19, 2019, from http://docs.acara.edu.au/resources/About_icsea_2014.pdf

Australian Energy Market Commission (AEMC). (2018). *2018 Residential Electricity Price Trends - Final Report*. Retrieved from https://www.aemc.gov.au/sites/default/files/2018-12/2018 Price Trends - Final Report - CLEAN.PDF

Australian Government Bureau of Meteorology. (n.d.). Annual and monthly heating and cooling degree days. Retrieved May 23, 2018, from http://www.bom.gov.au/climate/map/heating-cooling-degree-days/documentation.shtml

Australian Government Department of the Environment and Heritage. (2007). *Caring for Our Future: The Australian Government Strategy for the United Nations Decade of Education for Sustainable Development, 2005-2014*. Canberra.

Australian Government Department of the Environment Water Heritage and the Arts. (n.d.). *Living Sustainably - The Australian Government's National Action Plan for Education for Sustainability*. Retrieved from http://www.environment.gov.au/system/files/resources/13887ab8-7e03-4b3e-82bb-

139b2205a0af/files/national-action-plan.pdf

Ayres, I., Raseman, S., & Shih, A. (2013). Evidence from Two Large Field Experiments that Peer Comparison Feedback Can Reduce Residential Energy Usage. *Journal of Law, Economics, and Organization*, *29*(5), 992–1022. https://doi.org/10.1093/jleo/ews020

Ballantyne, R., Connell, S., & Fien, J. (2006). Students as Catalysts of Environmental Change: a framework for researching intergenerational influence through environmental education. *Environmental Education Research*, *12*(3–4), 413–427. https://doi.org/10.1080/13504622980040304

Ballantyne, R., Fien, J., & Packer, J. (2001). Program Effectiveness in Facilitating Intergenerational Influence in Environmental Education: Lessons From the Field. *The Journal of Environmental Education*, *32*(4), 8–15. https://doi.org/10.1080/00958960109598657

Bamberg, S., & Moser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bandura, A. (2006). Guide for constructing self-efficacy scales. *Self-Efficacy Beliefs of Adolescents*, 307–337. https://doi.org/10.1017/CBO9781107415324.004

Barr, S. (2011). *Green schools that teach: Identifying attributes of whole-school sustainability*. *ProQuest Dissertations and Theses*. Colorado State University, Ann Arbor. Retrieved from http://digitool.library.colostate.edu/exlibris/dtl/d3_1/apache_media/L2V4bGlicmlzL2R0bC9kM18xL2FwYWNoZV9tZWRpYS8xMTU1MDQ=.pdf

Barr, S., Cross, J., & Dunbar, B. (2014). *The Whole-School Sustainability Framework. Guiding Principles for Integrating Sustainability Into All Aspects of a School Organization.* Retrieved from http://centerforgreenschools.org/Libraries/Publications/Whole-School_Sustainability_Framework.sflb.ashx

Barry, N., Harper, C., Berryman, C., & Farley, C. (2016). Role of Self-Efficacy in Reducing Residential Energy Usage. *Journal of Architectural Engineering*, *22*(1), 1–8. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000196.

Bennett, S., Muir, K., Marjolin, A., & Jenkins, B. (2014). *Feasibility Study - Assessing the*

Impact of Community Housing.

Berrang-ford, L., Ford, J., & Paterson, J. (2011). Are we adapting to climate change ? *Global Environmental Change, 21*(1), 25–33. https://doi.org/10.1016/j.gloenvcha.2010.09.012

BizEE. (n.d.). Calculating Degree Days. Retrieved May 24, 2018, from http://www.degreedays.net/calculation

Block, K., Gibbs, L., Staiger, P., Gold, L., Johnson, B., Macfarlane, S., … Townsend, M. (2012). Growing Community: The Impact of the Stephanie Alexander Kitchen Garden Program on the Social and Learning Environment in Primary Schools. *Health Education & Behavior, 39*(4), 419–432. https://doi.org/10.1177/1090198111422937

Boscolo, M. (2010). Monitoring Energy in Schools in the Veneto Region: The Legambiente Campaign `Switch to Savings' (Veneto Region, Italy). In M. VanStaden & F. Musco (Eds.), *Local Governments and Climate Change* (Vol. 39, pp. 403–414). Springer Science & Business Media.

Boudet, H., Ardoin, N., Flora, J., Armel, C., Desai, M., & Robinson, T. (2016). Effects of a behaviour change intervention for Girl Scouts on child and parent energy-saving behaviours. *Nature Energy*, *1*(8), 1–10. https://doi.org/10.1038/nenergy.2016.91

Breadsell, J., & Eon, C. (2019). Interlocking practices and their influence in the home. https://doi.org/10.1177/2399808318824114

Brien, L., Meis, J., Anderson, R., Rizio, S., Ambrose, M., Bruce, G., … Kashima, Y. (2018). Low Carbon Readiness Index: A short measure to predict private low carbon behaviour. *Journal of Environmental Psychology, 57*(July 2017), 34–44. https://doi.org/10.1016/j.jenvp.2018.06.005

Broom, C. (2015). Empowering students: Pedagogy that benefits educators and learners. *Citizenship, Social and Economics Education*, *14*(2), 79–86. https://doi.org/10.1177/2047173415597142

Brossard, D., Lewenstein, B., & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*, *27*(9), 1099–1121. https://doi.org/10.1080/09500690500069483

Carbon Trust. (2010). *A whole school approach: Involving the school community in reducing its carbon footprint*. Retrieved from http://search.informit.com.au/documentSummary;dn=596925274440860;res=IELHSS

Carbon Trust. (2012). *Schools - Learning to improve energy efficiency*. United Kindgom.

Chatzidiakou, L., Mumovic, D., & Summerfield, A. (2012). What do we know about indoor air quality in school classrooms? A critical review of the literature. *Intelligent Buildings International, 4*(4), 228–259. https://doi.org/10.1080/17508975.2012.725530

Chen, H. (2011a). Fundamentals for Practicing Program Evaluation. In *Practical program evaluation* (pp. 4–14). SAGE Publications Ltd. https://doi.org/10.4135/9781412985444.n1

Chen, H. (2011b). Theory-Driven Evaluation. In *Encyclopedia of evaluation* (pp. 416–420). SAGE Publications Ltd. https://doi.org/10.4135/9781412950558

Christenson, M., Manz, H., & Gyalistras, D. (2006). Climate warming impact on degree-days and building energy demand in Switzerland. *Energy Conversion and Management, 47*(6), 671–686. https://doi.org/10.1016/j.enconman.2005.06.009

Chung, M., & Rhee, E. (2013). Development of System-Integrated Design Prototypes for Zero Emission Buildings. *Journal of Asian Architecture and Building Engineering, 12*(1), 133–140.

City of Burne. (2019). Environmental Strategies and Plans. Retrieved February 1, 2019, from https://www.cockburn.wa.gov.au/Waste-and-Environment/Sustainability-and-Conservation/Environmental-Strategies-and-Plans

City of Fremantle. (2019). About One Planet. Retrieved February 1, 2019, from https://www.fremantle.wa.gov.au/one-planet/about-one-planet

Clean Energy Council. (2019). Renewable Energy Powering Australian Education. Retrieved June 19, 2019, from https://www.cleanenergycouncil.org.au/news/renewable-energy-powering-australian-education

Cole, L. (2014). The Teaching Green School Building: a framework for linking architecture and environmental education. *Environmental Education Research, 20*(6), 836–857. https://doi.org/10.1080/13504622.2013.833586

Congedo, P., D'Agostino, D., Baglivo, C., Tornese, G., & Zacà, I. (2016). Efficient solutions and cost-optimal analysis for existing school buildings. *Energies, 9*(10), 1–25. https://doi.org/10.3390/en9100851

Cornelius, M., Armel, K., Hoffman, K., Allen, L., Bryson, S., Desai, M., & Robinson, T. (2014). Increasing energy and greenhouse gas-saving behaviors among adolescents: a school-based cluster-randomized controlled trial. *Energy Efficiency*, *7*(2), 217–242. https://doi.org/http://dx.doi.org/10.1007/s12053-013-9219-5

Corrado, V., Ballarini, I., Paduos, S., & Tulipano, L. (2017). A new procedure of energy audit and cost analysis for the transformation of a school into a nearly zero-energy building. *Energy Procedia*, *140*, 325–338. https://doi.org/10.1016/j.egypro.2017.11.146

Cotton, D., Winter, J., & Bailey, I. (2013). Researching the hidden curriculum: intentional and unintended messages. *Journal of Geography in Higher Education*, *37*(2), 192–203. https://doi.org/10.1080/03098265.2012.733684

Council of Australian Governments (COAG). (2012). *Baseline Energy Consumption and Greenhouse Gas Emissions In Commercial Buildings in Australia*.

Creswell, J., & Plano Clark, V. (2007). *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: SAGE.

CSIRO. (2016). *State of the Climate*. Retrieved from http://www.iom.edu/Reports/2011/Relieving-Pain-in-America-A-Blueprint-for-Transforming-Prevention-Care-Education-Research/Report-Brief.aspx

Curtis, J., Walton, A., & Dodd, M. (2017). Understanding the potential of facilities managers to be advocates for energy efficiency retrofits in mid-tier commercial office buildings. *Energy Policy*, *103*(April 2016), 98–104. https://doi.org/10.1016/j.enpol.2017.01.016

D'Agostino, D. (2015). Assessment of the progress towards the establishment of definitions of Nearly Zero Energy Buildings (nZEBs) in European Member States. *Journal of Building Engineering*, *1*, 20–32. https://doi.org/10.1016/j.jobe.2015.01.002

Dall'O', G., Bruni, E., & Panza, A. (2013). Improvement of the Sustainability of Existing School Buildings According to the Leadership in Energy and Environmental Design (LEED)® Protocol: A Case Study in Italy. *Energies*, *6*(12), 6487–6507. https://doi.org/10.3390/en6126487

Dalla Mora, T., Righi, A., Peron, F., & Romagnoni, P. (2017). Cost-Optimal measures for renovation of existing school buildings towards nZEB. *Energy Procedia*, *140*, 288–302. https://doi.org/10.1016/j.egypro.2017.11.143

Dascalaki, E., & Sermpetzoglou, V. (2011). Energy performance and indoor environmental quality in Hellenic schools. *Energy and Buildings*, *43*(2–3), 718–727. https://doi.org/10.1016/j.enbuild.2010.11.017

de Dear, R., Kim, J., Candido, C., & Deuble, M. (2015). Adaptive thermal comfort in Australian school classrooms. *Building Research & Information*, *43*(3), 383–398. https://doi.org/10.1080/09613218.2015.991627

De Mol, J., & Buysse, A. (2008). The phenomenology of children’s influence on parents. *Journal of Family Therapy*, *30*(2), 163–193. https://doi.org/10.1111/j.1467-6427.2008.00424.x

De Santoli, L., Fraticelli, F., Fornari, F., & Calice, C. (2014). Energy performance assessment and a retrofit strategies in public school buildings in Rome. *Energy and Buildings*, *68*(A), 196–202. https://doi.org/10.1016/j.enbuild.2013.08.028

Dean, K. (2013). The future of Australian education – Sustainable places for learning, 32. Retrieved from http://www.gbca.org.au/uploads/167/34983/Green_Schools_report_2013_Final_for_web.pdf

Department for children schools and families. (2009). *Towards a Schools Carbon Management Plan*. Retrieved from http://www.sthc.co.uk/Documents/SDC_Towards_A_School_Carbon_Management_Plan.pdf

Department for children schools and families. (2010). *Climate change and schools: A carbon management strategy for the school sector*. Retrieved from https://dera.ioe.ac.uk/698/

Department of Education. (2019). Schools Online. Retrieved February 1, 2019, from www.det.wa.edu.au

Department of Environment and Energy. (2017). *National Greenhouse Accounts Factors*. Retrieved from https://www.environment.gov.au/system/files/resources/5a169bfb-f417-4b00-9b70-6ba328ea8671/files/national-greenhouse-accounts-factors-july-2017.pdf

Department of Jobs Tourism Science & Innovation. (2018). *Western Australia Economic Profile*.

Department of the Environment Water Heritage and the Arts. (2010). *Evaluation of Operational Effectiveness of the Australian Sustainable Schools Initiative (AuSSI) - Final Report*.

Dias Pereira, L., Raimondo, D., Corgnati, S., & Gameiro Da Silva, M. (2014). Energy consumption in schools - A review paper. *Renewable and Sustainable Energy Reviews*, *40*, 911–922. https://doi.org/10.1016/j.rser.2014.08.010

Dimick, A. S. (2012). Student empowerment in an environmental science classroom: Toward a framework for social justice science education. *Science Education*, *96*(6), 990–1012. https://doi.org/10.1002/sce.21035

Dobbyn, J., & Thomas, G. (2005). *Seeing the light : The impact of micro-generation on the way we use energy. Qualitative research findings*. London. https://doi.org/10.1007/s00167-005-0710-1

Dolan, P., & Metcalfe, R. (2013). *Neighbors, Knowledge, and Nuggets: Two Natural Field Experiments on the Role of Incentives on Energy Conservation*. *Centre for Economic Performance*. London. https://doi.org/10.2139/ssrn.2589269

Dorer, V., Haas, A., & Feist, W. (2005). Re-inventing air heating : Convenient and comfortable within the frame of the Passive House concept, *37*, 1186–1203. https://doi.org/10.1016/j.enbuild.2005.06.020

Dorizas, P., Assimakopoulos, M., & Santamouris, M. (2015). A holistic approach for the assessment of the indoor environmental quality, student productivity, and energy consumption in primary schools. *Environmental Monitoring and Assessment*, *187*(5), 1–18. http://dx.doi.org/10.1007/s10661-015-4503-9

Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing Scientific Knowledge in the Classroom. *Educational Researcher*, (October), 5–12. https://doi.org/10.3102/0013189X023007005

Dunlap, R., & Van Liere, K. (1978). The “New Environmental Paradigm.” *The Journal of Environmental Education*, *9*, 10–19. https://doi.org/10.1080/00958964.1978.10801875

Duvall, J., & Zint, M. (2007). A review of research on the effectiveness of environmental education in promoting Intergenerational learning. *Journal of Environmental Education*, *38*(4), 14–24. https://doi.org/10.3200/JOEE.38.4.14-24

Dyment, J. E., & Hill, A. (2015). You mean I have to teach sustainability too? Initial teacher education students ’ perspectives on the sustainability cross-curriculum priority. *Australian Journal of Teacher Education*, *40*(3). http://dx.doi.org/10.14221/ajte.2014v40n3.2

Dyment, J. E., Hill, A., Emery, S. (2015). Sustainability as a cross-curricular priority in the Australian Curriculum : a Tasmanian investigation Curriculum : a Tasmanian investigation. *Environmental Education Research*, *21*(8), 1105–1126. https://doi.org/10.1080/13504622.2014.966657

Ebrahim, A., & Rangan, V. (2010). *The Limits of Nonprofit Impact: A Contingency Framework for Measuring Social Performance*. *Social Enterprise Initiative* (Vol. 10). https://doi.org/10.5465/AMBPP.2010.54500944

Ebrahim, A., & Rangan, V. (2014). What Impact? *California Management Review*, *56*(3), 118–141. https://doi.org/10.1525/cmr.2014.56.3.118

Economou, A. (2011). Photovoltaic systems in school units of Greece and their consequences. *Renewable and Sustainable Energy Reviews*, *15*(1), 881–885. https://doi.org/10.1016/j.rser.2010.09.028

Eilam, E., & Trop, T. (2012). Environmental attitudes and environmental behavior-which is the horse and which is the cart? *Sustainability*, *4*(9), 2210–2246. https://doi.org/10.3390/su4092210

Elzeyadi, I. (2009). Retro_Fit: greening educational facilities for carbon neutrality and students' performance. In *ARCC 2009 - Leadership in Architectural Research, betwen academia and the profession* (pp. 15–18). San Antonio.

Emami, N., Marteinsson, B., & Heinonen, J. (2016). Environmental Impact Assessment of a School Building in Iceland Using LCA-Including the Effect of Long Distance Transport of Materials. *Buildings*, *6*(4). https://doi.org/10.3390/buildings6040046

Environment Australia. (2004). *Environmental education for a sustainable future*. Canberra. Retrieved from http://www.tandfonline.com/doi/full/10.1080/15330150490444214

Eon, C., Breadsell, J., Morrison, G., & Byrne, J. (2017). The home as a system of practice and its implications for energy and water metabolism. *Sustainable Production and Consumption*, *13*(November), 48–59. https://doi.org/10.1016/j.spc.2017.12.001

EPA Office of Air and Radiation - Climate Protection Partnerships Division. (2017). *The Light Bulb Revolution: EPA Preducts Widespread Consumer Adoption of LED Lighting by 2020 if Utility Programs Persist*. Retrieved from https://www.energystar.gov/sites/default/files/asset/document/LBR_2017-LED-Takeover.pdf

Erhorn-Kluttig, H., Erhorn, H., Kempe, S., Höfle, C., & Görres, J. (2016). EU Project "School of the Future"-Refurbishment of School Buildings Toward Zero Emission with High-

Performance Indoor Environment. *ASHRAE Transactions*, *122*, 315–325. Retrieved from https://search.proquest.com/docview/1806094265?accountid=10382

Eto, J. (1988). On Using Degree-days to Account for the Effects of Weather on Annual Energy Use in Office Buildings. *Energy and Buildings*, *12*, 113–127.

Evans, N., Whitehouse, H., & Gooch, M. (2012). Barriers, Successes and Enabling Practices of Education for Sustainability in Far North Queensland Schools: A Case Study. *The Journal of Environmental Education*, *43*(2), 121–138. https://doi.org/10.1080/00958964.2011.621995

Fernandez, M., Alferez, A., Vidal, S., Fernandez, M., & Albareda, S. (2016). Methodological approaches to change consumption habits of future teachers in Barcelona, Spain: reducing their personal Ecological Footprint. *Journal of Cleaner Production*, *122*, 154–163. https://doi.org/10.1016/j.jclepro.2016.02.026

Fielding, K., & Head, B. (2012). Determinants of young Australians' environmental actions: the role of responsibility attributions , locus of control, knowledge and attitudes. *Environmental Education Research*, *18*(2), 171–186. https://doi.org/10.1080/13504622.2011.592936

Fien, J. (2003). Listening to the voice of youth. In *Environment, education and society in the Asia-Pacific: ...* (pp. 270–295). Curzon Press Limited. Retrieved from http://site.ebrary.com/id/10097489?ppg=270

Filippi, M., & Sirombo, E. (2015). Green Rating of Existing School Facilities. *Energy Procedia*, *78*, 3156–3161. https://doi.org/10.1016/j.egypro.2015.11.773

Filippín, C. (2000). Benchmarking the energy efficiency and greenhouse gases emissions of school buildings in central Argentina. *Building and Environment*, *35*(5), 407–414. https://doi.org/10.1016/S0360-1323(99)00035-9

Fishbein, M, & Ajzen, I. (2011). Attitudes and Their Determinants. In *Predicting and Changing Behavior: The Reasoned Action Approach* (pp. 75–128). Psychology Press.

Galloway, S. (2009). Theory-based evaluation and the social impact of the arts. *Cultural Trends*, *18*(2), 125–148. https://doi.org/10.1080/09548960902826143

Gamarra, A., Istrate, I., Herrera, I., Lago, C., Lizana, J., & Lechón, Y. (2018). Energy and water consumption and carbon footprint of school buildings in hot climate conditions. Results from life cycle assessment. *Journal of Cleaner Production*, *195*, 1326–1337.

https://doi.org/10.1016/j.jclepro.2018.05.153

Gardner, G., & Stern, P. (2008). The Short List: The Most Effective Actions U.S. Households Can Take to Curb Climate Change. *Environment: Science and Policy for Sustainable Development*, *50*(5), 12–25. https://doi.org/10.3200/ENVT.50.5.12-25

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology*, *65*(September), 541–579. https://doi.org/10.1146/annurev-psych-010213-115048

Gil-Baez, M., Barrios-Padura, A., & Molina-Huelva, M. (2017). Natural ventilation systems to enhance sustainability in buildings: a review towards zero energy buildings in schools. *International Conference on Advances in Energy Systems (ASEE17)*, *00053*. https://doi.org/10.1051/e3sconf/20172200053

Gillis, A. (2016). *Categorizing Pro-environmental Behaviors Using the Laypeople ' s Perspective*. University of North Florida. Retrieved from https://digitalcommons.unf.edu/etd/641

Global Action Plan, Stockholm Environment Institute, & Eco-Logica Ltd. (2006). *UK Schools Carbon Footprint Scoping Study*. Retrieved from http://www.se-ed.co.uk/sites/default/files/resources/GAP-Final-Report.pdf

Global Alliance for Buildings and Construction. (2016). *Towards zero-emission efficient and resilient buildings - Global Status Report 2016*. Retrieved from https://www.worldgbc.org/sites/default/files/2018 GlobalABC Global Status Report.pdf

Golshan, M., Thoen, H., & Zeiler, W. (2018). Dutch sustainable schools towards energy positive. *Journal of Building Engineering*, *19*(May), 161–171. https://doi.org/10.1016/j.jobe.2018.05.002

Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an educational tool: a quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research*, *19*(6), 844–863. https://doi.org/10.1080/13504622.2013.768602

Gottlieb, D., Vigoda-Gadot, E., Haim, A., & Kissinger, M. (2012). The ecological footprint as an educational tool for sustainability: A case study analysis in an Israeli public high school. *International Journal of Educational Development*, *32*(1), 193–200. https://doi.org/10.1016/j.ijedudev.2011.03.007

Grieco, C. (2015). *Assessing Social Impact of Social Enterprises: Does One Size Really Fit*

All? Springer.

Grob, A. (1995). A structural model of environmental attitudes and behaviour. *Journal of Environmental Psychology*, *15*(3), 209–220. https://doi.org/10.1016/0272-4944(95)90004-7

Grodzinska-jurczak, M., Bartosiewicz, A., Twardowska, A., & Ballantyne, R. (2003). Evaluating the Impact of a School Waste Education Programme upon Students', Parents' and Teachers' Environmental Knowledge, Attitudes and Behaviour. *International Research in Geographical and Environmental Education*, *12*(2), 106–122. https://doi.org/10.1080/10382040308667521

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, *15*(3), 199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002

Gurr, D., Drysdale, L., & Mulford, B. (2005). Successful principal leadership: Australian case studies. *Journal of Educational Administration*, *43*(6), 539–551. https://doi.org/10.1108/09578230510625647

Hanss, D., & Böhm, G. (2010). Can I Make a Difference ? The Role of General and Domain-specific Self-efficacy in Sustainable Consumption Decisions. *Umweltpsychologie*, *14*(2), 46–74.

Harries, T., Rettie, R., Studley, M., Burchell, K., & Chambers, S. (2013). Is social norms marketing effective?: A case study in domestic electricity consumption. *European Journal of Marketing*, *47*(9), 1458–1475. https://doi.org/10.1108/EJM-10-2011-0568

Harrington, P., & Toller, V. (2017). *Best Practice Policy and Regulation for Low Carbon Outcomes in the Built Environment*. Retrieved from http://lowcarbonlivingcrc.com.au/resources/crc-publications/crclcl-project-reports/sp0009-research-report-best-practice-policy-and

Heath, Y., & Gifford, R. (2002). Extending the theory of planned behavior: Predicting the use of public transportation. *Journal of Applied Social Psychology*, *32*, 2154–2185. https://doi.org/10.1111/j.1559-1816.2002.tb02068.x

Hehenberger, L., Harling, A.-M., & Scholten, P. (2013). *A Practical Guide to Measuring and Managing Impact. European Venture Philantropy Association*.

Hill, A., & Dyment, J. (2016). Hopes and Prospects for the Sustainability Cross-Curriculum

Priority : Provocations From a State-Wide Case Study. *Australian Journal of Environmental Education*, *32*(3), 225–242. https://doi.org/10.1017/aee.2016.20

Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bindi, M., Brown, S., Camilloni, I., … Zhou, G. (2018). *Impacts of 1.5°C Global Warming on Natural and Human Systems.* Retrieved from https://www.ipcc.ch/site/assets/uploads/sites/2/2018/12/SR15_Chapter3_Low_Res.pdf

Hong, S.-M., Paterson, G., Mumovic, D., & Steadman, P. (2014). Improved benchmarking comparability for energy consumption in schools. *Building Research and Information*, *42*(1, SI), 47–61. https://doi.org/10.1080/09613218.2013.814746

Hong, T., Kim, H., & Kwak, T. (2012). Energy-Saving Techniques for Reducing CO2 Emissions in Elementary Schools. *Journal of Management in Engineering*, *28*(1), 39–50. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000073

Hong, T., Koo, C., & Kwak, T. (2013). Framework for the implementation of a new renewable energy system in an educational facility. *Applied Energy*, *103*, 539–551. https://doi.org/10.1016/j.apenergy.2012.10.013

International Energy Agency. (2017). *Energy Technology Perspectives 2017*. https://doi.org/10.1787/energy_tech-2017-en

Iwan, A., & Rao, N. (2017). The Green School Concept: Perspectives of Stakeholders from Award-Winning Green Preschools in Bali, Berkeley, and Hong Kong. *The Journal of Sustainability Education*, *16*.

Izadpanahi, P., Elkadi, H., & Tucker, R. (2015). Greenhouse affect: the relationship between the sustainable design of schools and children’s environmental attitudes. *Environmental Education Research*, *4622*(September), 1–18. https://doi.org/10.1080/13504622.2015.1072137

Jenkins, D., Peacock, A., & Banfill, P. (2009). Will future low-carbon schools in the UK have an overheating problem? *Building and Environment*, *44*(3), 490–501. https://doi.org/10.1016/j.buildenv.2008.04.012

Jensen, A., Hoffman, L., Moller, B., Schmidt, A., Christiansen, K., Berendsen, S., … van Djik, F. (1997). *Life Cycle Assessment: A guide to approaches, experiences and information sources*. https://doi.org/10.1111/jiec.12157

Jessoe, K., & Rapson, D. (2012). Knowledge Is (Less) Power: Experimental Evidence From

Residential Energy Use, *104*(4), 45. https://doi.org/10.3386/w18344

Ji, C., Hong, T., Jeong, J., Kim, J., Lee, M., & Jeong, K. (2016). Establishing environmental benchmarks to determine the environmental performance of elementary school buildings using LCA. *Energy and Buildings*, *127*, 818–829. https://doi.org/10.1016/j.enbuild.2016.06.042

Ji, C., Hong, T., Jeong, K., & Leigh, S.-B. (2014). A model for evaluating the environmental benefits of elementary school facilities. *Journal of Environmental Management*, *132*, 220–229. https://doi.org/10.1016/j.jenvman.2013.11.022

Kang, H., Lee, M., Hong, T., & Choi, J. K. (2018). Determining the optimal occupancy density for reducing the energy consumption of public office buildings: A statistical approach. *Building and Environment*, *127*(November 2017), 173–186. https://doi.org/10.1016/j.buildenv.2017.11.010

Karlin, B., Davis, N., Sanguinetti, A., Gamble, K., Kirkby, D., & Stokols, D. (2014). Dimensions of Conservation : Exploring Differences Among Energy Behaviors. https://doi.org/10.1177/0013916512467532

Karlin, B., Zinger, J., & Ford, R. (2015). The Effects of Feedback on Energy Conservation: A Meta-Analysis. *Psychological Bulletin*, *141*(6), 1205–1227. https://doi.org/http://dx.doi.org/10.1037/a0039650

Kats, G., Perlman, J., & Jamadagni, S. (2005). National review of green schools: Costs, benefits, and implications for Massachusetts, (December), 66. Retrieved from www.azdeq.gov/ceh/download/natreview.pdf%5Cnhttp://www.azdeq.gov/ceh/download/natreview.pdf

Kats, G., (2006). *Greening America's Schools*. Retrieved from http://immobilierdurable.eu/images/2128_uploads/Kats_Green_schools_reprint.pdf

Katsaprakakis, D., & Zidianakis, G. (2017). Upgrading Energy Efficiency For School Buildings In Greece. *Procedia Environmental Sciences*, *38*, 248–255. https://doi.org/10.1016/j.proenv.2017.03.067

Kempe, S., Hoefle, C., Goerres, J., Erhorn-Kluttig, H., Erhorn, H., & Beckert, H.-M. (2015). School of the Future: Deep renovation of the Solitude-Gymnasium in Stuttgart. In M. Perino (Ed.), *6th International Building Physics Conference (IBPC 2015)* (Vol. 78, pp. 3312–3317). https://doi.org/10.1016/j.egypro.2015.11.743

Kennelly, J., Taylor, N., & Serow, P. (2011). Education for sustainability and the Australian curriculum. *Australian Journal of …*, *27*(02), 209–218. https://doi.org/10.1375/ajee.27.2.209

Kershaw, T., & Simm, S. (2014). Thoughts of a design team: Barriers to low carbon school design. *Sustainable Cities and Society*, *11*, 40–47. https://doi.org/10.1016/j.scs.2013.11.006

Koo, C., Kim, H., & Hong, T. (2014). Framework for the analysis of the low-carbon scenario 2020 to achieve the national carbon Emissions reduction target: Focused on educational facilities. *Energy Policy*, *73*(2014), 356–367. https://doi.org/10.1016/j.enpol.2014.05.009

Koumoutsos, K., Kretsis, A., Kokkinos, P., Varvarigos, E., Nikolopoulos, V., Gkioxi, E., & Zafeiropoulos, A. (2015). Gathering and processing energy consumption data from public educational buildings over IPv6. *Energy, Sustainability and Society*, *5*, 1–12. https://doi.org/http://dx.doi.org/10.1186/s13705-015-0051-y

Langley, A., Nadeem, E., Kataoka, S., Stein, B., & Jaycox, L. (2010). Evidence-Based Mental Health Programs in Schools: Barriers and Facilitators of Successful Implementation. *School Mental Health*, *2*, 105–113. https://doi.org/10.1007/s12310-010-9038-1

Lanzini, P., & Thøgersen, J. (2014). Behavioural spillover in the environmental domain: An intervention study. *Journal of Environmental Psychology*, *40*, 381–390. https://doi.org/10.1016/j.jenvp.2014.09.006

Larsson, B., Andersson, M., & Osbeck, C. (2010). Bringing environmentalism home: Children’s influence on family consumption in the nordic countries and beyond. *Childhood*, *17*(1), 129–147. https://doi.org/10.1177/0907568209351554

Lawson, D., Stevenson, K., Peterson, N., Carrier, S., Strnad, R., & Seekamp, E. (2018). Intergenerational learning: Are children key in spurring climate action? *Global Environmental Change*, *53*(April), 204–208. https://doi.org/10.1016/j.gloenvcha.2018.10.002

Lee, L., Lin, K., Guu, Y., Chang, L., & Lai, C. (2012). The effect of hands-on ‘energy-saving house’ learning activities on elementary school students’ knowledge, attitudes, and behavior regarding energy saving and carbon-emissions reduction. *Environmental Education Research*, *19*(February 2015), 620–638. https://doi.org/10.1080/13504622.2012.727781

Lee, M., Mui, K., Wong, L., Chan, W., Lee, E., & Cheung, C. (2012). Student learning performance and indoor environmental quality (IEQ) in air-conditioned university teaching rooms. *Building and Environment*, *49*(1), 238–244. https://doi.org/10.1016/j.buildenv.2011.10.001

Leonard, J. (2011). Using Bronfenbrenner's Ecological Theory to Understand Community Partnerships: A Historical Case Study of One Urban High School. *Urban Education*, *46*(5), 987–1010. https://doi.org/10.1177/0042085911400337

Lewis, E., Mansfield, C., & Baudains, C. (2014). Ten Tonne Plan: Education for Sustainability From a Whole Systems Thinking Perspective. *Applied Environmental Education and Communication*, *13*(2), 128–141. https://doi.org/10.1080/1533015X.2014.950890

Lewis, E., Volet, S., Baudains, C., & Mansfield, C. (2013). Education for Sustainability at a Montessori Primary School: From Silos to Systems Thinking. *Australian Journal of Environmental Education*, *28*(02), 162–164. https://doi.org/10.1017/aee.2013.8

Logic Model Development Guide. (2004). *Development*. Battle Creek, Michigan.

Lourenço, P., Pinheiro, M., & Heitor, T. (2014). From indicators to strategies: Key Performance Strategies for sustainable energy use in Portuguese school buildings. *Energy and Buildings*, *85*, 212–224. https://doi.org/10.1016/j.enbuild.2014.09.025

Maddox, P., Doran, C., Williams, I., & Kus, M. (2011). The role of intergenerational influence in waste education programmes: The THAW project. *Waste Management*, *31*(12), 2590–2600. https://doi.org/10.1016/j.wasman.2011.07.023

Maréchal, G. (2010). Constructivism. In J. A. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of Case Study Research* (pp. 221–225). Thousand Oaks: SAGE Publications, Inc.

Maxwell, S., Milner-Gulland, E., Jones, J., Knight, A., Bunnefeld, N., Nuno, A., … Rhodes, J. (2015, March). Being smart about SMART environmental targets. *Science*, *347*(6226), 1075–1076. https://doi.org/10.1126/science.aaa1451

McDermott, L., O'Sullivan, T., Stead, M., & Hastings, G. (2006). International food advertising, pester power and its effects. *International Journal of Advertising*, *25*(4), 513–539. https://doi.org/10.1080/02650487.2006.11072986

McIntosh, K., Predy, L., Upreti, G., Hume, A., Turri, M., & Mathews, S. (2014). Perceptions of Contextual Features Related to Implementation and Sustainability of School-Wide Positive Behavior Support. *Journal of Positive Behavior Interventions*, *16*(1), 31–43. https://doi.org/10.1177/1098300712470723

McNamee, S. (2004). Relational Bridges Between Constructionism and Constructivism. In J. Raskin (Ed.), *Studies in Meaning2: Bridging the personal and the social* (pp. 1–19).

Miller, D., & Prentice, D. (2015). Changing Norms to Change Behavior. *Annual Review of Psychology*, *67*(1), 339–361. https://doi.org/10.1146/annurev-psych-010814-015013

Moncaster, A., & Simmons, P. (2015). Policies and outcomes for UK sustainable schools. *Building Research & Information*, *43*(4), 452–464. https://doi.org/10.1080/09613218.2015.1005518

Moore, D., Almeida, S., & Barnes, M. (2018). Education for Sustainability Policies: Ramifications for Practice. *Australian Journal of Teacher Education*, *43*(11), 105–121.

Morse, J., & Niehaus, L. (n.d.). *Mixed Method Design - Principles and Procedures*. New York: Routledge.

Muir, K., & Bennett, S. (2014). *The Compass: Your guide to social impact measurement*. Sydney, Australia. Retrieved from csi.edu.au/media/uploads/CSI_The_Compass.pdf

Mulgan, G. (2010). Measuring Social Value. *Stanford Social Innovation Review*, 7.

Newton, C., Wilks, S., & Hes, D. (2009). Educational Buildings as 3D Text Books: Linking ecological sustainability, pedagogy and space. *Open House International*, *34*(1), 17–25.

Nicholls, A. (2015). *Synthetic Grid: A critical framework to inform the development of social innovation metrics* (No. 14).

Nicholls, J., & Stevenson, R. B. (2015). Queensland Teachers ’ Understandings of Education for Climate Change, *1*, 21–27.

O’Brien, L., & Kashima, Y. (2019). *Transitioning to Low Carbon Living : A Review of Environmental Psychology and Associated Literature*. Retrieved from https://apo.org.au/node/239666

Orr, D. (1997). Architecture as Pedagogy II “ The worst thing we can do to our children is to convince them that ugliness is normal .” *Conservation Biology*, *11*(3), 597–600.

Osbaldiston, R., & Schott, J. (2012). Environmental Sustainability and Behavioral Science: Meta-Analysis of Proenvironmental Behavior Experiments. *Environment and Behavior*, *44*(2), 257–299. https://doi.org/10.1177/0013916511402673

Pandey, D., Agrawal, M., & Pandey, J. (2011). Carbon footprint: Current methods of estimation. *Environmental Monitoring and Assessment*, *178*(1–4), 135–160. https://doi.org/10.1007/s10661-010-1678-y

Park, H., Jeong, K., Hong, T., Ban, C., Koo, C., & Kim, J. (2016). The optimal photovoltaic system implementation strategy to achieve the national carbon emissions reduction target in 2030: Focused on educational facilities. *ENERGY AND BUILDINGS*, *119*(2016), 101–110. https://doi.org/10.1016/j.enbuild.2016.03.029

Pasunuru, R., Hakim, H., Skhalkar, A., Sakhalkar, A., Kibert, C., Srinivasan, R., … McGinnis, L. (2014). Towards net zero energy schools: A case study approach. In I. Tolk, A and Yilmaz, L and Diallo, SY and Ryzhov (Ed.), *Proceedings of the 2014 Winter Sumulation Conference (WSC)* (pp. 3248–3259). https://doi.org/10.1109/WSC.2014.7020173

Peck, R. (2009). Study of the Effects on Student Knowledge and Perceptions of Activities Related to Submetering the 6th Grade Wing of a Middle School, to Displaying the Carbon Footprint, and to Efforts to Reduce Energy Consumption and Greenhouse Gases. *ERIC*. Retrieved from https://eric.ed.gov/?id=ED505893

Pegg, I., Cripps, A., & Kolokotroni, M. (2007). Post-occupancy performance of five low-energy schools in the UK. *ASHRAE Transactions*, *113 PART 2*(2), 3–13.

Pickering, C., & Byrne, J. (2014). The benefits of publishing systematic quantitative literature reviews for PhD candidates and other early-career researchers. *Higher Education Research & Development*, *33*(3), 534–548. https://doi.org/10.1080/07294360.2013.841651

Pillay, H., Watters, J., Hoff, L., & Flynn, M. (2014). Dimensions of effectiveness and efficiency: a case study on industry–school partnerships. *Journal of Vocational Education & Training*, *66*(4), 537–553. https://doi.org/10.1080/13636820.2014.961524

Pinkelman, S., Mcintosh, K., Rasplica, C., Berg, T., & Strickland-Cohen, M. (2016). Perceived Enablers and Barriers Related to Sustainability of School-Wide Positive Behavioral Interventions and Supports. *Behavioral Disorders*, *40*(3), 171–183. https://doi.org/10.17988/0198-7429-40.3.171

Pinto, R. (2012). *Mixed Methods Design*. SAGE Publications Ltd.

Psiloglou, B., Giannakopoulos, C., Majithia, S., & Petrakis, M. (2009). Factors affecting electricity demand in Athens, Greece and London, UK: A comparative assessment. *Energy*, *34*(11), 1855–1863. https://doi.org/10.1016/j.energy.2009.07.033

Ramli, N., Masri, M., Zafrullah, M., Taib, H., Hamid, N., & Mohd, H. (2012). A Comparative Study of Green School Guidelines. *Procedia - Social and Behavioral Sciences*, *50*(July), 462–471. https://doi.org/10.1016/j.sbspro.2012.08.050

Rauland, V., Odell, P., Hall, S., Newman, P., & Lewis, A. (2014). *RP3020 : Carbon Tools & Frameworks for Institutional Precincts Stage 1 : Low Carbon , High Performance Schools*. Sydney.

Raupach, M., Davis, S., Peters, G., Andrew, R., Canadell, J., Ciais, P., … Le Quéré, C. (2014). Sharing a quota on cumulative carbon emissions. *Nature Climate Change*, *4*(10), 873–879. https://doi.org/10.1038/nclimate2384

Rickinson, M., Hall, M., & Reid, A. (2016). Sustainable schools programmes: what influence on schools and how do we know? *Environmental Education Research*, *22*(3), 360–389. https://doi.org/10.1080/13504622.2015.1077505

Rilla, C. (2013). *School Garden Design as Catalyst for Environmental Education and Community Engagement: Los Angeles Unified School District Case Studies*. University of Southern California.

Roach, G. (2011). *Schools for sustainable futures: A study into the concept of bespoke primary school design in South Wales*. *PQDT - UK & Ireland*. Cardiff University (United Kingdom), Ann Arbor. Retrieved from https://search.proquest.com/docview/1685021352?accountid=10382

Robson, C. (2011). Real world research. *Blackwell Publishing*. https://doi.org/10.1016/j.jclinepi.2010.08.001

Rogelj, J., Shindell, D., Jiang, K., Fifita, S., Forster, P., Ginzburg, V., … Tignor, M. (2018). *Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change.*

Rose, J., Thomsen, K., Bergsøe, N., & Mørck, O. (2015). Analysis and Monitoring of Energy Consumption and Indoor Climate in a School Before and After Deep Energy Renovation. *ASHRAE Transactions*, *121*, 323–331. Retrieved from https://search.proquest.com/docview/1725204985?accountid=10382

Salter, Z. (2013). *Impact of Whole-School Education for Sustainability on Upper-Primary Students and their Families*. The University of Western Australia.

Satchwell, C. (2012). “Carbon literacy practices”: textual footprints between school and home in children’s construction of knowledge about climate change. *Local Environment, 18*(3), 1–16. https://doi.org/10.1080/13549839.2012.688735

Schelly, C., Cross, J., Franzen, W., Hall, P., & Reeve, S. (2011). Reducing Energy Consumption and Creating a Conservation Culture in Organizations : A Case Study of One Public School District. *Environment and Behavior*, *43*(3), 316–343. https://doi.org/10.1177/0013916510371754

Scholz, R., & Tietje, O. (2002). Types of case studies (pp. 9–14). SAGE Publications Ltd.

Schultz, P., Nolan, J., Cialdini, R., Goldstein, N., & Griskevicius, V. (2007). The Constructive, Destructive, and Reconstructive Power of Social Norms. *Psychological Science*, *18*(5), 429. https://doi.org/10.1111/j.1467-9280.2007.01917.x

Sekki, T., Andelin, M., Airaksinen, M., & Saari, A. (2016). Consideration of energy consumption, energy costs, and space occupancy in Finnish daycare centres and school buildings. *Energy and Buildings*, *129*, 199–206. https://doi.org/10.1016/j.enbuild.2016.08.015

Senge, P., Cambron-McCabe, N., Lucas, T., Smith, B., & Dutton, J. (2012). *Schools that learn (updated and revised): A fifth discipline fieldbook for educators, parents, and everyone who cares about education*. Crown Business.

Shan, M., & Hwang, B. (2018). Green building rating systems: Global reviews of practices and research efforts. *Sustainable Cities and Society*, *39*, 172–180. https://doi.org/10.1016/j.scs.2018.02.034

Sheehan, D. (2015). *Can secondary school architecture build community, encourage working successfully and enhance well-being?: student and staff evaluations*. *PQDT - UK & Ireland*. University of Exeter (United Kingdom), Ann Arbor. Retrieved from https://search.proquest.com/docview/1780277571?accountid=10673%0Ahttp://openurl.ac.uk/redirect/athens:edu/?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+%26+theses&sid=ProQ:ProQuest+Dissertations+%26+Theses+Global&a

Sheppard, T. (2011). *Ireland's Generic Repeat Design Schools Programme*. *CELE Exchange. Centre for Effective Learning Environments*. Paris: Organisation for Economic Cooperation and Development (OECD). Retrieved from https://search.proquest.com/docview/896960131?accountid=10382

Shove, E. (2007). *The Design of Everyday Life*. Berg.

Skamp, K. (2010). *Critical review of current practice and research of Environmental Education and Education for Sustainability for Kindergarten to Year 12 from 1990*. Lismore, NSW. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Critical+review+of+current+practice+and+research+of+Environmental+Education+and+Education+for+Sustainability+for+Kindergarten+to+Year+12+from+1990#0

Smith, G., Mumovic, D., & Curtis, L. (2013). Comprehensiveness and usability of tools for assessment of energy saving measures in schools. *Building Services Engineering Research and Technology*, *34*(1), 55–71. https://doi.org/10.1177/0143624412468761

Smith, M. K. (2001). "Community." https://doi.org/10.1080/00438240220000007062

Southworth, G. (2010). School Business Management: A quiet revolution - Part 1. *NCSL Publication*, 1–46.

Stake, R. (2006). Multiple case study analysis. In *Multiple case study analysis* (p. 342). Guildford Publications. https://doi.org/ISBN 9781593852481

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309–317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. (2000). New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Stern, P., Dietz, T., Abel, T., Guagnano, G., & Kalof, L. (1999). A Value-Belief-Norm Theory of Support for Social Movements : The Case of Environmentalism, *6*(2), 81–97.

Stuhmcke, S. (2012). *Children as Change Agents for Sustainability : An Action Research Case Study in a Kindergarten*. Queensland University of Technology.

Sustainable Development Commission. (2008). Carbon Emissions from Schools: Where they arise and how to reduce them, 1–34. Retrieved from http://www.sdcommission.org.uk/publications.php@id=765.html

Tabert, S. (2009). *Assessing Energy Behaviours in Queensland Schools: A Study of the Queensland Solar Schools Initiative (2001-2008)*.

Tashakkori, A., Teddlie, C., & Biesta, G. (2015). Pragmatism and the Philosophical Foundations of Mixed Methods Research1. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*, 95–118. https://doi.org/10.4135/9781506335193.n4

Tatchell, A. (2012). *Designing and Constructing an Exemplar Zero Carbon Primary School in the City of Exeter, United Kingdom*. *CELE Exchange. Centre for Effective Learning Environments* (Vol. 2012). Organisation for Economic Cooperation and Development (OECD). https://doi.org/10.1787/5k9b950r9kzt-en

Teeuwen, S., Bruggema, H., & Zeiler, W. (2015). Highly Sustainable Dutch Schools: What About IAQ? *ASHRAE Transactions*, *121*. Retrieved from https://search.proquest.com/docview/1725466136?accountid=10382

Tesiero, R., Nassif, N., Singh, H., & Flurchick, K. (2014). Low-Cost Strategies to Save Energy in K-12 Schools. *American Journal of Engineering and Applied Sciences*, *7*(1), 41–53. https://doi.org/10.3844/ajeassp.2014.41.53

Thewes, A., Maas, S., Scholzen, F., Waldmann, D., & Zürbes, A. (2014). Field study on the energy consumption of school buildings in Luxembourg. *Energy and Buildings*, *68*(A), 460–470. https://doi.org/10.1016/j.enbuild.2013.10.002

Thomas, P. (n.d.). A day in the life: Association of School Business Administrators. Retrieved July 29, 2019, from http://www.educationmattersmag.com.au/a-day-in-the-life-association-of-school-business-administrators/

Tilbury, D., Coleman, V., & Garlick, D. (2005). *A National Review of Environmental Education and its Contribution to Sustainability in Australia*. Canberra.

Tilbury, D., & Henderson, K. (2004). *Whole-school approaches to sustainability: An international review of whole-school sustainability programs*. Retrieved from http://eprints.glos.ac.uk/248/

Tooth, R. (2005). *Self, Others and Place: A Story of Transformative Leadership and Whole School Reform*.

Tucker, R., & Izadpanahi, P. (2017). Live green, think green: Sustainable school architecture and children’s environmental attitudes and behaviors. *Journal of Environmental*

Psychology, *51*, 209–216. https://doi.org/10.1016/j.jenvp.2017.04.003

UNEP. (2009). *Buildings and Climate Change: Summary for Decision Makers*. Paris. https://doi.org/10.1127/0941-2948/2006/0130

Union of Concerned Scientists. (2018). Each Country's Share of CO2 Emissions. Retrieved June 20, 2019, from https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html

Vadney, M., Fox, B., Mosser, M., Fraser, S., & Bernstein, B. (2012). Benchmarking K-12 Schools: How the Building Energy Performance System Continues to Track and Compare Energy Data in the Northeast and Mid-Atlantic. In *ACEEE Summer Study on Energy Efficiency in Buildings* (pp. 367–379).

Varotto, A., & Spagnolli, A. (2017). Psychological strategies to promote household recycling. A systematic review with meta-analysis of validated field interventions. *Journal of Environmental Psychology*, *51*, 168–188. https://doi.org/10.1016/j.jenvp.2017.03.011

Vaughan, C., Gack, J., Solorazano, H., & Ray, R. (2003). The Effect of Environmental Education on Schoolchildren, Their Parents, and Community Members: A Study of Intergenerational and Intercommunity Learning. *The Journal of Environmental Education*, *34*(2), 12–21.

Wargocki, P., & Wyong, D. (2013). Providing better thermal and air quality conditions in school classrooms would be cost- effective. *Building and Environment*, *59*, 581–589. https://doi.org/10.1016/j.buildenv.2012.10.007

Warner, B., & Elser, M. (2015). How do sustainable schools integrate sustainability education? An assessment of certified sustainable K-12 schools in the United States. *Journal of Environmental Education*, *46*(1), 1–22. https://doi.org/10.1080/00958964.2014.953020

Watt, D. (2007). On Becoming a Qualitative Researcher : The Value of Reflexivity. *The Qualitative Report*, *12*(1), 82–101.

Whitmarsh, L. (2010). Behavioural responses to climate change : Asymmetry of intentions and impacts. *Journal of Environmental Psychology*, *29*(1), 13–23. https://doi.org/10.1016/j.jenvp.2008.05.003

Yang, L., Yan, H., & Lam, J. (2014). Thermal comfort and building energy consumption implications - A review. *Applied Energy*, *115*, 164–173.

https://doi.org/10.1016/j.apenergy.2013.10.062

Yin, R. (2006). *Case Study Research - Design and Methods* (Vol. 2). Thousand Oaks: Sage. https://doi.org/10.1016/j.jada.2010.09.005

Zanni, D., Righi, A., Dalla Mora, T., Peron, F., & Romagnoni, P. (2015). The Energy improvement of school buildings: analysis and proposals for action. In L. Corsini, A and Rispoli, F and DeSantoli (Ed.), *ATI 2015 - 70th Conference of the ATI Engineering Association* (Vol. 82, pp. 526–532). https://doi.org/10.1016/j.egypro.2015.11.865

Zappalà, G., & Lyons, M. (2009). *Recent approaches to measuring social impact in the Third sector : An overview*. Sydney, Australia.

Zeiler, W., & Boxem, G. (2009). Effects of thermal activated building systems in schools on thermal comfort in winter. *Building and Environment*, *44*(11), 2308–2317. https://doi.org/10.1016/j.buildenv.2009.05.005

Zeiler, W., & Boxem, G. (2013). Net-zero energy building schools. *Renewable Energy*, *49*(SI), 282–286. https://doi.org/10.1016/j.renene.2012.01.013

Zhao, D., He, B., & Meng, F. (2015). The green school project: A means of speeding up sustainable development? *Geoforum*, *65*, 310–313. https://doi.org/10.1016/j.geoforum.2015.08.012

Zomorodian, Z., Tahsildoost, M., & Hafezi, M. (2016). Thermal comfort in educational buildings: A review article. *Renewable and Sustainable Energy Reviews*, *59*, 895–906. https://doi.org/10.1016/j.rser.2016.01.033

Appendix A

Interview and Survey Instruments

Table A1: Interview questions for case study school Principals and Committee Members

Principal & Committee Member Interview Questions
1. What would you say were was your school's most effective strategies for implementing carbon reduction initiatives? 2. What would you say were the least effective strategies? 3. Does your school have a budget to help implement low carbon initiatives? 4. What would you say has been the most significant contributor to your school's success in implementing initiatives and achieving school carbon reduction? 5. What would you say has been the most significant barriers to your schools carbon reduction? 6. Did your school make any partnerships with businesses or community organisations as a result of the LCSPP? 7. What has been your experience with the partnerships you've formed? 8. How has your school engaged with students around your low carbon initiatives? 9. Has your school specifically engaged with parents around your low carbon initiatives? 10. What role should students play in school-wide carbon reduction? 11. At a community level, do you think schools can or should play a role in reducing carbon emissions? 12. In terms of students, do you think kids can or should play a role in helping communities reduce their carbon emissions? 13. Do you think you have you taken any knowledge home or changed any of your actions around low carbon living as a result of the LCSPP? 14. Is there anything else you'd like to comment on in regards to your schools carbon reduction journey?

Table A2: Interview questions for the case study student focus groups

Student Focus Group Interview Questions
1. Name *(only used to establish rapport – audio recording started after the initial introductions took place)* 2. Where did you learn about climate change? 3. What things do you think you could do to reduce carbon emissions (or make school more sustainable/green/eco-friendly)? 4. What things do you think you could do to reduce carbon emissions at your school? 5. What things are happening in your school to help reduce carbon emissions? 6. Do you talk to any of your friends or classmates about how to stop climate change? 7. Do you talk to your parents about ways you could help to stop climate change? 8. Have you changed your own behaviour since joining the (green team)? 9. How do you think schools can help the community (your neighbours, parents, other schools) reduce their carbon emissions?

Table A3: Survey questions for all school committee members

Committee Member Survey Questions
• [LCRI Questions & Demographic Information] **General Survey Questions** 1. What would you say were the most effective strategies for implementing carbon reduction initiatives and why? (open-ended) 2. What would you say were the least effective strategies and why? (open-ended) 3. Were there any significant barriers your school encountered when trying to implement low carbon initiatives? (Y/N/Not sure) - (if yes) Please explain the barriers your school encountered (Open-ended) 4. What would you say has been the most significant contributor to your school's success in implementing initiatives? (open-ended) 5. Please indicate how much (if anything) you've learned about how to reduce school carbon emissions from being involved in the LCSPP (sliding scale – nothing, a little bit, a lot, quite a lot) 6. Would you say that any of the following are true as a result of participating in the LCSPP? (select all that apply) a. I have increased knowledge about how to reduce school carbon reduction b. I have an increased understanding of school resource use c. I have learned strategies or experiences from other schools around implementing low carbon initiatives d. Other (please specify)

7. Would you say you've experienced any changes in your attitude or behaviour around low carbon living as a result of your school's participation in the LCSPP? (Y/N/Not sure)
8. (if yes) Could you please explain these changes? (open-ended)
9. Did your school create any new partnerships with businesses or community organisations as a result of the LCSPP? (e.g. got discounted lights, or went tree planting with an organisation) (Y/N/Not sure)
10. Can you please briefly explain the notable partnerships your school made? (open-ended)
11. (if yes) What has been your school's experience with the partnerships you've formed? (select all that apply)
    a. We learned a lot from the partnership (e.g. knowledge about LEDs, tree-planting etc)
    b. We got valuable help or expertise through the partnership
    c. The partnership opened the door for other opportunities
    d. The partnership enabled our school to provide additional learning opportunities for students
    e. Other (please explain)
12. How much would you say the partnerships your school has formed has contributed to the success of your school's low carbon initiatives? (sliding scale) - (if yes) Please explain:
13. What partnerships do you think are most beneficial to helping your school achieve its low carbon goals? (open-ended)
14. Did your school share advice or experiences with any other schools in the LCSPP?
    a. Yes, at the workshops or meet-ups
    b. Yes, through the online platform
    c. Yes, we were in contact outside of the workshops and meetups
    d. No
    e. Not sure
    f. Other (please explain)
15. Sharing experiences and forming relationships with other schools is important. (strongly agree, agree, neutral, disagree, strongly disagree)
16. (If strongly agree or agree) Why do you think sharing experiences and forming relationships with other schools is important? (select all that apply)
    a. Allows sharing of ideas and solutions between each other
    b. Enables conversations with like-minded people
    c. Allows for coordination of events
    d. Allows for mentoring opportunities between students
    e. Other (please describe
17. (if strongly disagree, or disagree) Why do you think sharing experiences and forming relationships with other schools is NOT important? (open-ended)
18. Did your school actively engage students in the carbon reduction process as part of this program? (Y/N) - (If yes), please explain:

Table A4: Survey questions for all school parents

Parent Survey Questions

19. [LCRI Questions & Demographic Information]
20. General Survey Questions
21. Were you aware of any of the low carbon initiatives taking place at your child's school over the last 12 months? (Y/N/Not sure)
22. If yes, please indicate how: (more than one answer)
    a. School newsletter
    b. My child told me
    c. P&C member
    d. Teacher, principal or other school representative
    e. School Facebook page/group
    f. Letter to parents
    g. I am on a sustainability or low carbon committee at the school
    h. Other (please describe)
23. (if yes) What initiatives are you aware of? (open-ended)
24. Did your child mention or speak with you about climate change or low carbon living topics in the last 12 months? (Y/N/Not sure)
25. (if yes) What type of things did your child talk with you about? (open-ended)
26. Did you notice any changes in your child's attitude or behaviour around low carbon living over the last 12 months? (e.g. turning off more lights, using less plastic) (Y/N/Not sure)
27. If yes, please describe how: (open-ended)
28. (if yes) What would you say was the cause for these changes in attitudes or behaviour? (select as many as applicable)
    a. They learned it in class
    b. They are involved in a student green team at their school
    c. They are involved in a sustainability/environmental organisation outside of school
    d. A family member encouraged them
    e. Other (please explain)
29. Have there been any changes in your own attitudes or behaviour around low carbon living over the last 12 months? (e.g. turning off more lights, using less plastic) (Y/N/Not sure)
30. (if yes) Please describe how: (open-ended)
31. (if yes) What would you say was the cause for these changes in attitudes and behaviour?
    a. My child
    b. Another family member
    c. A friend or co-worker
    d. A news article (online or tv)
    e. An event or organisation
    f. Other (please explain)

32. Has your child encouraged your household to adopt any new or additional practices around low carbon living over the last 12 months? (Y/N/Not sure)- (if yes) Please describe these changes:
33. (if yes to child raising climate change topics) Have you spoken to colleagues, friends or family members about low carbon living topics as a result of your child raising these topics over the last 12 months? (Y/N/Not sure)

Appendix B

Heating Degree Days and Cooling Degree Days

The following graphs demonstration the relationship between the number of Heating Degree Days and Cooling Degree Days per month and the monthly electricity and gas consumption. Figure B1 shows there is a significant correlation between monthly gas consumption and the number of HDDs in that month. The number of CDDs and monthly gas consumption has a negative relationship, with the hottest months showing the lowest gas consumption. Figure B2 shows there is no significant relationship between HDDs or CDDs and monthly electricity consumption.

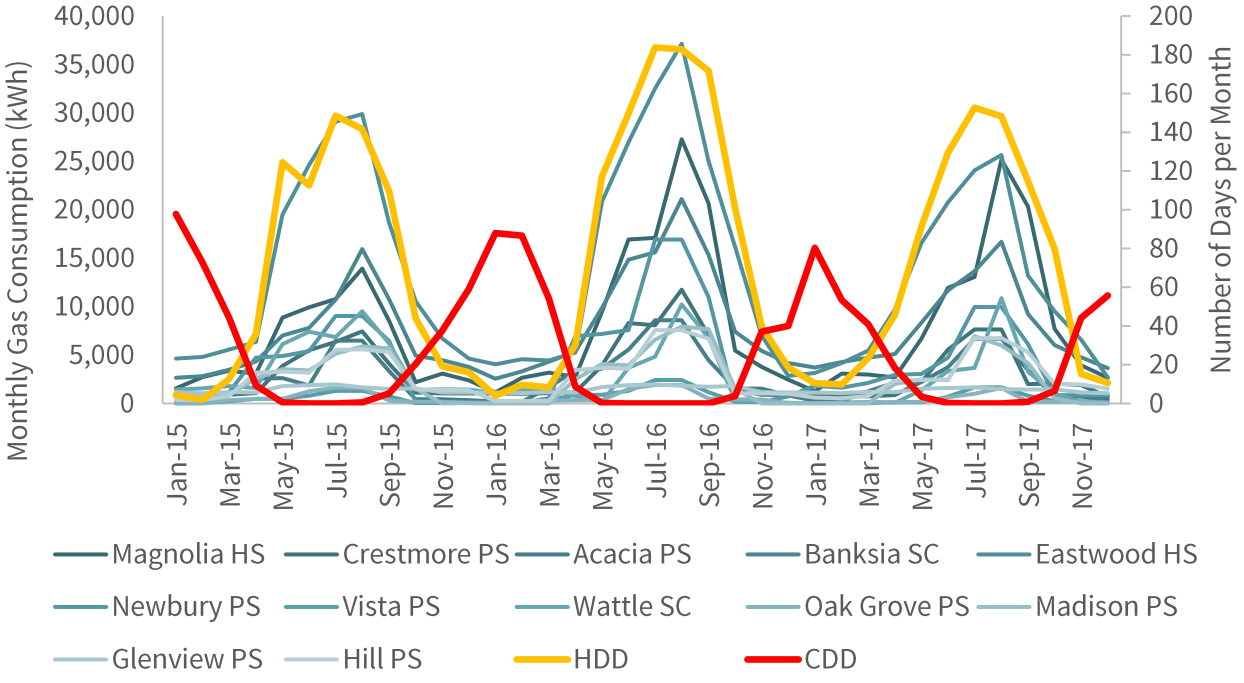


Figure B1: Monthly total gas consumption and relationship to number of Heating Degree Days (HDD) and Cooling Degree days (CDD) per month for all schools.

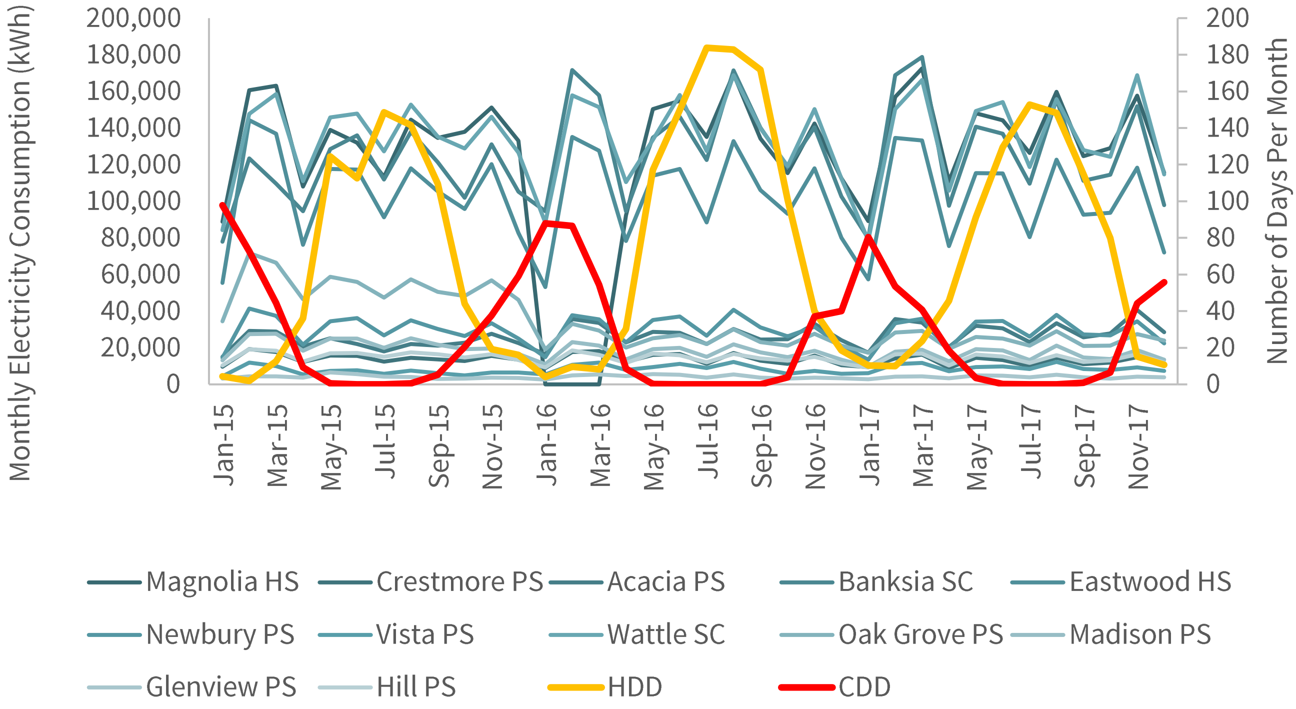


Figure B2: Monthly total electricity consumption and relationship to number of Heating Degree Days (HDD) and Cooling Degree days (CDD) per month for all schools.

Appendix C

School Utility Consumption, Costs & Carbon Emissions Results

Electricity consumption

Table C1: Total electricity consumption (kWh) per school (2015 - 2017) and percentage difference between 2015 and 2017. Schools are ordered top to bottom from smallest to largest student numbers.

School	2015	2016	2017	Difference (2015/2016)	Difference (2016/2017)	Difference (2015/2017)
Glenview PS	24,661	25,575	24,439	4%	-4%	-1%
Sierra PS	25,165	26,573	23,511	6%	-12%	-7%
Vista PS	42,505	52,947	54,626	25%	3%	29%
Hill PS	93,946	85,669	80,032	-9%	-7%	-15%
Madison PS	129,406	99,882	98,417	-23%	-1%	-24%
Crestmore PS	85,979	84,210	74,662	-2%	-11%	-13%
Newbury PS	182,975	179,763	171,458	-2%	-5%	-6%
Oak Grove PS	158,796	149,070	144,621	-6%	-3%	-9%
Acacia PS	135,970	162,157	174,438	19%	8%	28%
Eastwood HS	630,734	621,873	605,460	-1%	-3%	-4%
Magnolia HS	808,614	849,668	818,351	5%	-4%	1%
Wattle SC	818,378	806,866	813,699	-1%	1%	-1%
Banksia SC	689,951	798,060	772,596	16%	-3%	12%

Table C2: Electricity consumption per student for all schools (kWh/student) (2015 -2017) and the percentage difference between years. Schools are ordered top to bottom from smallest to largest student numbers.

School	2015	2016	2017	Difference (2015/2016)	Difference (2016/2017)	Difference (2015/2017)
Glenview PS	308	294	263	-5%	-11%	-15%
Sierra PS	201	213	188	6%	-12%	-7%
Vista PS	240	283	255	18%	-10%	6%
Hill PS	385	326	290	-15%	-11%	-25%
Madison PS	392	299	285	-24%	-5%	-27%
Crestmore PS	245	226	207	-8%	-8%	-16%

Newbury PS	351	359	374	2%	4%	7%
Oak Grove PS	361	352	311	-2%	-12%	-14%
Acacia PS	358	331	290	-8%	-12%	-19%
Eastwood HS	847	826	717	-2%	-13%	-15%
Magnolia HS	563	580	551	3%	-5%	-2%
Wattle SC	559	539	510	-4%	-5%	-9%
Banksia SC	632	560	445	-11%	-21%	-30%

Table C3: Electricity consumption per square metre (kWh/m2) for all schools (2015 - 2017) and the percentage difference between years. Schools are ordered top to bottom from smallest to largest student numbers.

School	2015	2016	2017	Difference (2015/2016)	Difference (2016/2017)	Difference (2015/2017)
Glenview PS	15	15	15	4%	-4%	-1%
Sierra PS	32	34	30	6%	-12%	-7%
Vista PS	12	13	14	13%	3%	16%
Hill PS	21	19	18	-9%	-7%	-15%
Madison PS	28	21	21	-23%	-1%	-24%
Crestmore PS	16	15	14	-2%	-11%	-13%
Newbury PS	17	17	16	-2%	-7%	-8%
Oak Grove PS	40	38	37	-6%	-3%	-9%
Acacia PS	26	30	30	13%	0%	13%
Eastwood HS	37	36	35	-1%	-3%	-4%
Magnolia HS	33	35	34	8%	-4%	4%
Wattle SC	29	29	29	1%	1%	1%
Banksia SC	30	34	32	12%	-4%	7%

Carbon Emissions

Table C4: Total carbon emissions (tCO2-e) for all schools (2015 – 2017) and percentage difference between 2015 and 2017.

School	2015	2016	2017	Difference (2015/2016)	Difference (2016/2017)	Difference (2015/2017)
Glenview PS	26	24	22	-6%	-8%	-13%
Sierra PS	21	21	18	1%	-15%	-14%
Vista PS	37	43	43	17%	-2%	15%
Hill PS	89	77	71	-14%	-8%	-20%
Madison PS	116	86	84	-25%	-3%	-27%
Crestmore PS	81	77	67	-5%	-13%	-18%
Newbury PS	165	158	145	-4%	-8%	-12%
Oak Grove PS	137	121	112	-12%	-7%	-18%
Acacia PS	121	138	141	14%	2%	17%
Eastwood HS	566	529	494	-7%	-7%	-13%
Magnolia HS	697	703	653	1%	-7%	-6%
Wattle SC	698	648	625	-7%	-3%	-10%
Banksia SC	599	654	611	9%	-7%	2%

Table C5: Total carbon emissions per student for all schools (tCO$_2$-e/student) (2015 - 2017) and percentage difference between 2015 and 2017.

School	2015	2016	2017	Difference (2015/2017)	Difference (2015/2017)	Difference (2015/2017)
Glenview PS	0.32	0.28	0.24	-14%	-14%	-26%
Sierra PS	0.17	0.17	0.15	1%	-15%	-14%
Vista PS	0.21	0.23	0.20	11%	-14%	-5%
Hill PS	0.36	0.29	0.26	-20%	-12%	-30%
Madison PS	0.35	0.26	0.24	-26%	-6%	-31%
Crestmore PS	0.23	0.21	0.18	-11%	-10%	-20%
Newbury PS	0.32	0.32	0.32	0%	0%	0%
Oak Grove PS	0.31	0.29	0.24	-8%	-15%	-22%
Acacia PS	0.32	0.28	0.23	-12%	-17%	-26%
Eastwood HS	0.76	0.70	0.58	-8%	-17%	-23%

Magnolia HS	0.49	0.48	0.44	-1%	-8%	-10%
Wattle SC	0.48	0.43	0.39	-9%	-9%	-18%
Banksia SC	0.55	0.46	0.35	-16%	-24%	-36%

Table C6: Water consumption per student for all schools (kL/student) (2015 - 2017) and percentage difference between 2015 and 2017.

School	2015	2016	2017	Difference (2015/2017)	Water Leaks
Glenview PS	1.9	2.4	2.3	-60%	None
Sierra PS	5.8	2.5	2.0	26%	None
Vista PS	2.7	1.7	1.1	-66%	None
Hill PS	13.4	9.2	8.6	-36%	None
Madison PS	3.8	4.9	10.8	182%	Known Water Leak
Crestmore PS	4.8	5.2	7.0	46%	Unconfirmed Water Leak
Newbury PS	7.8	7.7	12.3	57%	Unconfirmed Water Leak
Oak Grove PS	4.0	3.4	3.0	-24%	None
Acacia PS	5.2	4.2	4.0	-23%	None
Eastwood HS	5.0	6.8	5.1	2%	None
Magnolia HS	5.5	7.4	5.5	0%	None
Wattle SC	4.8	2.8	1.2	-75%	Known Water Leak
Banksia SC	5.5	2.7	1.9	-65%	Known Water Issue

Table C7: Gas consumption per student (kWh/student) for all schools (2015 - 2017) and percentage difference between 2015 and 2017.

School	2015	2016	2017	Difference (2015/2017)
Glenview PS	283	196	180	-36%
Sierra PS	0	0	0	n/a
Vista PS	15	23	13	-14%
Hill PS	146	117	130	-11%
Madison PS	104	83	70	-33%

Crestmore PS	110	106	98	-11%
Newbury PS	83	118	88	7%
Oak Grove PS	17	16	10	-41%
Acacia PS	74	75	48	-35%
Eastwood HS	259	210	172	-33%
Magnolia HS	58	64	71	22%
Wattle SC	37	18	14	-61%
Banksia SC	87	68	56	-35%

Appendix D

Committee Member & Parent Survey Responses

Table D1: Committee member survey responses about the most successful strategies their school implemented.

School	Most Successful Strategies
Acacia PS	“Involving students & educating them on low carbon topics” “Celebrating successes & be strategic with initiatives”
Crestmore PS	“getting students to be involved in reducing the carbon footprint of the school in waste, electricity,waste and taking the skills and messages home”
Eastwood HS	“Regularly communicating with staff about carbon reduction initiatives” “Regularly communicating with multiple people (i.e. making teaching staff responsible for switching off unneeded lighting)”
Hill PS	“Being held accountable at LCSPP meetings and with the student committee “Getting staff involvement” “Educating kids”
Magnolia HS	“Convincing people that individuals can make a difference to carbon reduction” “Getting solar PV”
Newbury PS	“Education of the younger generations” “Sharing strategies and ideas with family and friends”
Oak Grove PS	“Educating children at an early age so they see it as normal”
Sierra PS	“Having an energy audit that indicated where the biggest savings could be achieved, along with the payback periods made lighting upgrades an obvious step for management.” “Implementing a bin sorting system”
Vista PS	“Inspiring passion in staff”
Wattle SC	“Getting support from other staff and getting the Business Manager on board” “Looking at bills and doing audits, and linking carbon savings to cost savings “Getting sustainability in business plan” “School-wide education about carbon reduction”

Table D2: Committee member survey responses about the least successful strategies to their school's low carbon initiatives.

School	Least Successful Strategies
Acacia PS	"Any strategy that relies on parent participation to be successful because for many of the parents in this area it is not a concern and they will keep doing what is convenient and easiest for them now." "A 'big stick' and negativity" "an adhoc and inconsistent approach"
Crestmore PS	"Just giving the students information without the practcle side of sustainability measures" "Assuming that the rest of the school community knows what a good job is being done to reduce Carbon emissions and wholeheartedly supports you. If they don't know, the majority won't make an effort to find out and won't think that your activities have any relevance to them."
Eastwood HS	"Dealing with Building Managment and Works with respect to getting solar PV installed." "Where a committee member implemented themselves without the support of others. (ie getting the canteen (Private Contractor) to switch off equipment."
Glenview PS	"everything does something to contribute no matter how small if we can all mindfully and constantly attend to it"
Hill PS	"I would say one thing is being time poor - but Im not sure if this is a strategy."
Magnolia HS	"Just telling people the importance of reducing carbon doesn't work because they are either too busy to listen or don't believe that they can make a difference." "waste disposal"
Oak Grove PS	"penalties for not doing it- gets peoples backs up so they dont really partake"
Sierra PS	"We have a number of initiatives that are not yet working well, but I find it hard to identify specific strategies that have been ineffective."
Vista PS	"Pressure such as 'you must send your child to school with no waste'"
Wattle SC	"Just applying rules without giving reasons" "Trying to get teachers involved - it was hard to engage a wider group of teachers, but they need to be involved as they are the ones 'operating' classrooms and making designs around appliance use and waste. I think there needs to be a way to give incentives to teachers for carbon reductions, as currently they are not the ones paying the utility bills or getting any rewards for doing more about it; P&C - Canteen has been hard to get onboard as being a high school there is a large disconnect between parents and the school."

Initiatives Parents Were Aware Of

Parents were asked whether they were aware of any low carbon initiatives taking place at their child's school, and 48% said they were aware of some initiatives with 32% learning about these initiatives from the school newsletter and 21% because their child told them. Only a few parents mentioned the LCSPP specifically, however many referenced initiatives that were influenced by the program (i.e. pursuing initiatives such as LEDs, solar PV, water audits). Nearly all school parents were aware of some type of garden and/or waste initiative and most brought up the school's student green team. 59% of the initiatives that parents were aware of were mostly in relation to waste - recycling (19%), waste (22%), garden (9%) and composting (9%). When the emissions categories of each school's action plan was compared to the initiatives that parents brought up, there were virtually no consistencies. However, some schools such as Acacia PS (a case study school), focussed heavily on their Waste Free Lunch initiative during their participation in the LCSPP and most parents at Acacia PS that completed the survey mentioned this initiative.

Table D3: Summary of parent survey responses (n=144) about how they heard about their school's low carbon initiatives.

Answer	Percentage	Count
School newsletter	32.8%	123
My child told me	21.1%	79
School assembly	11.2%	42
Teacher, principal or other school representative	10.4%	39
School Facebook page/group	8.2%	31
P&C member	8%	30
Letter to parents	4.2%	16
I am on a sustainability or low carbon committee at the school	2.1%	8
Other (please explain):	1.6%	6

Child Influences on Parent Low Carbon Living Attitudes/Behaviour

Over half of parents (59%) said they experienced a change in their attitudes/behaviour around low carbon living in the last 12 months. The causes for these changes in their behaviour were primarily caused by media/film (27%), such as watching a news segment or reading an online article, and personal beliefs to act more sustainably (24%). 18% (n=32) of parents said the changes in their attitude/behaviour was attributed to their child (see Figure D1), with 85% describing changes in behaviour and 15% describing a change in attitude.

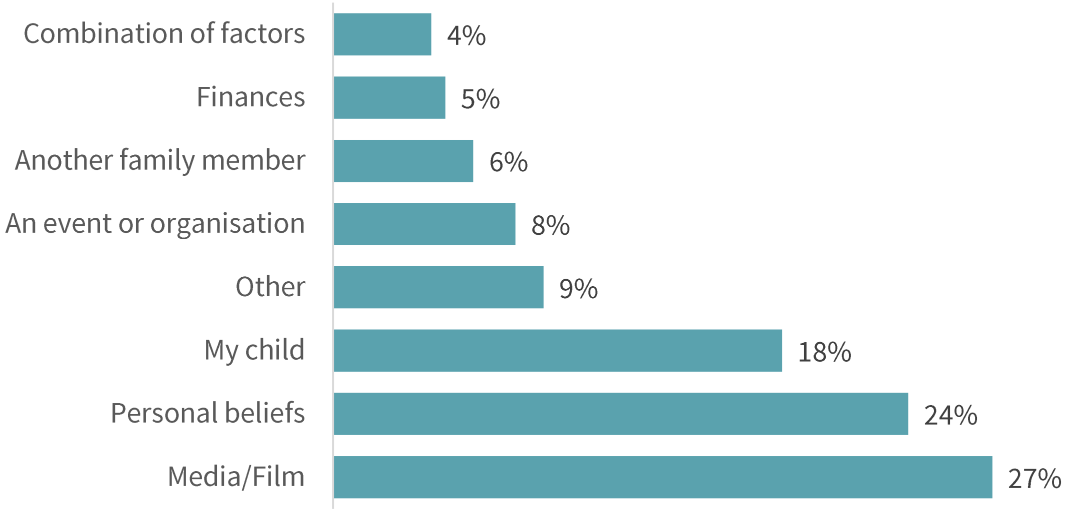


Figure D1: Percentage breakdown of the total causes of parent responses to what caused their change in low carbon living attitude/behaviour (n=174).

Table D4: Parent responses about the types of changes in their LCL attitudes/behaviours they experienced as a result of their child's influence.

Changes in Parent LCL Attitudes/Behaviour
"Feeling more supported by my children in my actions at home to save the environment"
"Having school be involved in the change is a great help in reinforcing my goals at home"
"Supporting the initiatives the school is putting in place"
"We have implemented a household goal to reduce rubbish going into landfill successfully by 60%"
"From their plastic free Tuesday's I now try and avoid any plastic wrap etc in their lunch boxes."
"Just being more aware! Firstly trying to reduce the amount of energy consumed as a family - we only used air conditioning once this summer! Instead we opened windows, doors when the sea breeze was in to reduce the temp of the house"
"a better attitude to environmental issues"
"encourage myself and others to have a mind change about environment"
"I have become more aware of the wastage of so much packaging around Easter/Christmas"
"stopped using single use plastic bags, referring to local council waste collection rules"
"Think twice before darting off to the shops in the car"
"Buying food from bulk stores / plastic free other than dairy and meat. Changed cleaning and toiletries to plastic free alternatives. Better at bringing own water bottle, coffee cup and bags."
"Less time in the shower, washing clothes using cold water, recycling more, walking rather than driving"
"We are slowly becoming as plastic free as possible, actively use our compost bin, reduce shower times etc"
"More conscious of energy use and household waste"
"Not using dryer changed light globes turning off power switches"
"More careful about using water; more conscientious about recycling; try to use less plastic in lunch boxes."
"We take more care in everyday activities at home. We are solar now"
"We recycle as much as possible. Use a lot less lighting"
"Waste free lunch boxes"
"Being more aware of items that can be recycled and not wasting water"
"less plastic, recycling - new wheelie bins in my suburb, trying new things for bin liners"
"no single use plastics"
"using reusable packaging for lunches, reducing electricity use, walking to school"
"just trying to minimise waste of energy resources"
"Buying bread bags, not buying vegetables or fruit in plastic, riding to school more"
"better in every way!"

Table D5: Parent responses about how children influenced family members to be more sustainable.

LCL Topics	**Child Behaviour**	**Household Changes**
“becoming a plastic bag and straw free family” *“recycling within the home”* *“Exploring ideas, suggestions to reduce wastage at home in terms of food, electricity and water”* *“Ensuring we are participating in Waste Free Wednesday”* *“We watched Plastic Ocean together”* *“What aspects of daily life we could change in our home to reduce our current carbon footprint”* *“My son had us all do an online carbon check to ascertain our home’s carbon score”*	*“Reminds us to turn off lights and close the fridge door and to recycle”* *“She points out when the tap runs longer than necessary”* *“Just openly reminding the family and myself as a parent where we can reduce, reuse or recycle!”* *“More attention paid to others behaviours in the house hold, reminding extended family members etc”* *“always tells me not to water the garden”* *“Nagging me about using air con in car”* *“she spoke up more about turning off lights”* *“She is always keeping our family accountable for our carbon generating actions”* *“Reminds us to turn off lights and close the fridge door and to recycle”* *“Turning off any electric power we don't use”*	*“reminding me to only run the dishwasher when full!”* *“choosing to buy food that's not wrapped in plastic”* *“putting waste water on plants instead of down sink”* *“making the household more aware of the reasons for recycling and the items that can be recycled”* *“walking instead of using the car”* *“buying second hand products on gumtree”* *“never EVER letting the tap run”* *“turning electricity off at the socket when not in use”* *“encouraging others to turn off lights”* *“Greater effort by all in the household, enthusiasm”* *“Completing Plastic Free July and subsequent reduction in single use plastic.”*

Proenvironmental Attitude and Intergenerational Influence Variables

When correlation analyses were conducted, it showed there was a strong positive correlation between parents reporting that they saw a change in attitudes/behaviour in their child and the child influencing household practices (r_{φ}=.60) as well as a moderate positive correlation (r_{φ}=.47) between the child discussing low carbon living topics with the parent and the child influencing household practices (shown in Table D6). There was also weak/moderate correlation between a child changing their behaviour (r_{φ}=.36) and their parent changing their behaviour.

Table D6: Summary of open-ended responses to barriers school committee members encountered and the key success factors.

School	Barriers	Enablers
Acacia PS	*“The time to spend on the topic with the students. A lot of it is done in addition to specific curriculum outcomes required to be met so needed to be done out of normal teaching time.”*	*“Our Principal's passion and the support of several other staff members”* *“student involvement, passionate and dedicated staff”* *“support of a couple of staff … including the gardener”*
Crestmore PS	*“Four different Principals in two years means lack of continuity in application of leadership policies.* *“Lack of knowledge of the subject of sustainability and see no particular reason to learn about it.”*	*“A team of interested people such as teachers, parents, students and community members including a supportive Principal”* *The times when the school has been successful were when the Principal and Deputy Principals saw the value in the initiatives and supported them*
Eastwood HS	*“Our biggest barriers were timeframe for projects initiated with BMW (Solar PV) over 1 year in and the project still hasn't been completed”*	*“The two active members on the committee the progress made so far would not have been achived.”* *“The two main members of the committee were the main drivers of all the initatives”*
Glenview PS	*(no barriers identified)*	*“champion for the cause who directs her energy to then summarise and make practical suggestions for all staff/classes* *contribution from all individuals of ways to apply in classes - general and specialist;* *creating and maintaining info to the wider school community;*
Hill PS	*“We are still trying to figure out why our water bill is so high”*	*“energetic and committed group of teachers sharing the load”* *“Our motivated staff team”*
Madison PS	*“Behaviour change particularly from some staff.”*	*“Our [student] Green Team's positive approach to monitoring energy and water use throughout the school.”*
Magnolia HS	*“Admin seemed too busy with the day to day running of the school - sustainability was not a priority.”*	*“Having a sustainability champion able to lobby the business manager - persistence.”*
Newbury PS	*“Lack of interest by other staff,* *“time involved in implementation of projects with students takes away time on curriculum needs mandated by department”*	*“Enthusiasm and support by all on committee”*

Oak Grove PS	*(no barriers identified)*	*“whole school and community support and belief”*
Sierra PS	*“Lack of time and people. Lots of quirky things that make our school 'different'”.* *“Teacher resistance”*	*“The skills, passion and persistence of the sustainability committee.”* *“The Sustainability Committee”*
Vista PS	*“Time, money, administrators beliefs in the relevant importance”*	*“Creating the Student Green Team”*
Wattle SC	*“Not able to get a message out amongst so many others”* *“DoE BMW processes; existing waste contracts in place; inflexible opportunities to retrofitting buildings; lack of parent involvement”*	*“One main teacher spearheading and coordinating all our efforts”* *“Our trusty leader who has championed ALL initiatives and made them happen with support of others, along with our Business Manager who has been fully supportive and critical in getting ideas implemented on the ground.”*

Table D7: Quotes from parents about the climate change topics their child discussed with them (Parent survey responses, 8 May 2018).

Topics on Climate Change Discussed with Parents
“About the green house effects and pollution”
“About what they learnt in school about climate change”
“afraid from the effects of climate change”
“Causes of global warming”
“global warming, ice melting, sea level rising”
“Just generally mentioning/discussing Climate Change, Climate refugees etc.”
“Mentioned that they talked about these topics in class, and in particular, some misconceptions regarding global warming.
“Impact of climate change on weather and how environmental changes affect animals”
“My son had us all do an online carbon check to ascertain our home's carbon score”
“sea level rises”
“The effect of climate change on flora and fauna”
“Weather changing”
What aspects of daily life we could change in our home to reduce our current carbon footprint”

Table D8: Total survey responses from each school.

School	Committee Survey Responses (#)	Parent Survey Responses (#)	End of Year Survey Responses (#)
Acacia PS	3	23	2
Banksia PS	0	6	1
Crestmore PS	2	0	2
Eastwood HS	1	25	1
Glenview PS	1	24	2
Hill PS	2	39	2
Madison PS	1	24	1
Magnolia HS	2	21	1
Newbury PS	1	2	3
Oak Grove PS	1	41	1
Sierra PS	2	14	1
Vista PS	1	15	2
Wattle SC	3	61	1

Table D9: Summary of all parent survey responses to intergenerational questions. Shown by percentage of "yes" responses to the total number of responses for each school.

School	LCL Topics	Household Changes	Child Changes (all)	Child Changes (bc school)	Parent Changes (bc child)
Acacia PS	48%	23%	43%	30%	23%
Eastwood HS	25%	17%	25%	4%	4%
Glenview PS	48%	35%	43%	35%	21%
Hill PS	39%	28%	45%	37%	13%
Madison PS	64%	41%	68%	45%	9%
Magnolia HS	57%	35%	35%	20%	5%
Oak Grove PS	48%	38%	36%	28%	10%
Sierra PS	69%	43%	50%	33%	21%
Vista PS	36%	21%	36%	14%	1%
Wattle SC	53%	23%	28%	16%	7%

Averages	49%	30%	41%	26%	11%

Table D10: Examples of how children discussed low carbon living topics with their parents.

LCL Topics Discussed with Parents
“Mentioned that they talked about these topics in class, and in particular, some misconceptions regarding global warming.”
“Exploring ideas, suggestions to reduce wastage at home in terms of food, electricity and water”
“throwing the rubbish in the right garage bin especially aware of what is recycled and what is not”
“Using the washing machine during the day only as we do have solar PV”
“Our oceans full of waste and using reusable products”
“Walking rather than driving wherever possible”
“the (utmost!) importance of not littering”
“using less plastic becoming a plastic bag and straw free family”
“Asking about recycling every time they dispose of rubbish”
“Likes to do further research on the internet and tell us facts she's found”
“discussing impact of high electricity and water usage and ways to reduce these given we don't have solar PV”
“Talks about what they do in her role [in green team]”
“talking about ocean pollution and plastics”
“Wanting waste free lunch”
“talk[s] about climate change”
“discussing alternatives to plastic”
“frequently asking which bin do items go in”
“My child was distressed over climate change.”

Table D11: Summary of the behaviour change categories children encouraged in the household across all parent responses.

Type of Action	Number	Percentage
Use of Infrastructure/Energy Use	57	49%
Waste Management	38	31%
Recurrent Purchase	9	7%
Infrastructure	7	6%

Other	6	5%
Alternative Transport	4	3%
Energy Source	3	2%

Parent attitudes towards low carbon living descriptive norms (i.e. what they think is normal for other people to think or do) and child influencing household practices was weakly correlated (r=.25) and no other parent attitude indicator was correlated with any of the other intergenerational influence measures (e.g. LCL topics, child change and parent change).

Table D12: Correlation matrix with all parent attitude/behaviour measures and intergenerational influence question results.

	LCRI (Mean)	**Energy Efficiency Goals (Mean)**	**LCL Social Norms (Mean)**	**LCL Topics (Y/N)**	**Child Change (Y/N)**	**Parent Change (Y/N) (bc child)**	**Household Change (Y/N)**
LCRI (Mean)	1.00	0.78	0.04	0.14	0.22	0.06	0.19
Energy Efficiency Goals (Mean)	0.78	1.00	0.03	0.16	0.20	0.07	0.16
LCL Social Norms (Mean)	0.04	0.03	1.00	0.18	0.21	0.04	0.25
LCL Topics (Y/N)	0.14	0.16	0.18	1.00	0.62	0.25	0.47
Child Change (Y/N)	0.22	0.20	0.21	0.62	1.00	0.36	0.60
Parent Change (Y/N) (BC CHILD)	0.06	0.07	0.04	0.25	0.36	1.00	0.33
Household Change (Y/N)	0.19	0.16	0.25	0.47	0.60	0.33	1.00

Appendix E

Acacia PS

Table E1: Acacia PS examples of actions listed on their low carbon action plan (completed or ongoing).

Emissions Area	Action	Category
Energy	Assess energy tariff	Investigation
	Campaign to turn off lights (student-led)	Behaviour Change
	Campaign to turn of electronics (student-led)	Behaviour Change
	Conduct energy audit (external consultant)	Investigation
	Purchase power use monitoring device	Investigation
	Turn off cool-room	Infrastructure
	Schedule computers for auto shut-down	Infrastructure
	Enact school holiday shutdown	Behaviour Change
	Turn off water coolers at fountains	Infrastructure
Water	Check leaking toilets	Investigation
	Ensure fountain taps are off (students to check)	Behaviour Change
	Waterwise incursion	Educational Activity
	Waterwise competitions	Educational Activity
	Create sustainability Facebook page	Outreach
	Place Waterwise signs around school	Behaviour Change
	Put waterwise information in newsletter	Outreach
Waste	Paper recycling responsibilities assigned to classrooms	Educational Activity
	Introduce Waste Free Wednesday for students	Educational Activity
	Conduct rubbish audit with students	Educational Activity
	Investigate joining recycling organisation	Investigation
	Encourage staffroom recycling	Behaviour Change

	Investigate school can recycling	Investigation
	Trial recyclable containers in canteen	Behaviour Change
Transport	Implement “safety house” program to help students be safer getting to school	Educational Activity
Other	Plant fruit trees	Infrastructure

Table E2: Acacia PS changes in childhood attitudes/behaviour around low carbon living as reported by parents in the parent survey.

Changes in Child LCL Attitudes/Behaviour
“Less waste”
“No rubbish Wednesday. Home reduction is plastic use. More recycling. Shorter showers, reduced electricity usage”
“Recycling. We had a change of body soap in the house”
“More mindful of their usage”
“Turning off lights, saying no to straws, cycling to school”
“She points out when the tap runs longer than necessary, we always pick up litter on our walks, she actively reuses and recycles”
“Wants to put the garbage in the right bin”
“Noticing his own behaviours”
“Wanting waste free lunch”

Table E3: Acacia PS low carbon living topics children discussed with parents.

LCL Topics Children Discussed with their Parents
“Conserving water and electricity, the (utmost!) importance of not littering, humankind destroying nature”
“Turning off lights. Using the correct bins for rubbish”
“Exploring ideas, suggestions to reduce wastage at home in terms of food, electricity and water”
“Recycling reducing packaging reusable shopping bags reducing energy use”

“Speaks about healthy food junk food whats recyclable putting rubbish in the bin not throwing it away”
“Waste free”
“Recycling and ensuring we were participating in Waste Free Wednesday”
“Reducing waste”
“Saving water and conserving energy”

Table E4: Acacia PS total utility (electricity, water and gas) and per student cost per year (2015 – 2017).

Utility	**Measurement**	**2015**	**2016**	**2017**	**Difference (2015/2016)**	**Difference (2016/2017)**	**Difference (2015/2017)**
Electricity	*(total kWh)*	135,970	162,157	174,438	19%	8%	28%
	(total cost)	$34,418	$40,842	$47,676	19%	17%	39%
Water	*(total kL)*	1,965	2,036	2,391	4%	17%	22%
	(total cost)	$34,835	$37,264	$41,056	7%	10%	18%
Gas	*(total kWh)*	28,121	36,555	29,121	30%	-20%	4%
	(total cost)	$2,993	$3,307	$2,697	10%	-18%	-10%

Hill PS

Table E5: Hill PS student low carbon living topics discussed with parents from parent survey.

Low Carbon Living Topics Students discussed with Parents	
• *“Not leaving the tap running while brushing teeth, reducing length of showers, recycling, walking rather than driving wherever possible”* • *“Turning lights off, solar PV”* • *“Afraid from the effects of climate change”* • *“Being wasteful inc not using air con in car”* • *“Not using plastic bags / bottles etc”* • *“Energy usage, plastic pollution, fast fashion, climate change.”* • *“Recycling water usage and plastic use”*	• *“Wasting water, recycling, composting* • *“Composting and recycling”* • *“Nude lunch box, natureplay, gardening, worm farm”* • *“Climate change”* • *“Their participation in these programs”* • *“What aspects of daily life we could change in our home to reduce our current carbon footprint”* • *“Power and where it comes from”* • *“Toilet flushing, water use”*

Table E6: Hill PS parent open-ended responses about how their child's low carbon living attitudes/behaviour changed.

Descriptions of Changes in Children’s Low Carbon Living Attitudes/Behaviour	
• *“More aware”* • *“Plastic consumption, water and emissions awareness”* • *“Sorting her rubbish in our bins, helping to feed our home worm farm”* • *“More attention paid to others behaviours in the house hold, reminding extended family members etc”* • *“More energy efficient”* • *“Nagging me about using air con in car, happy to ride to school more”* • *“More conscious of waste and where it goes - ie landfill”* • *“My child was distressed over climate change. We completed plastic free July so we could make positive changes.”* • *“Actively asking which bin to place rubbish in, turning lights off, asking for a waste free lunch box.”*	• *“They talk about climate change and also try to have short showers, recycle and think about what they put in the bin.”* • *“She is an active part of the school carbon team and is always keeping our family accountable for our carbon generating actions”* • *“Haha, tells me off for leaving lights on or tv on”* • *“More aware of environmentally friendly practises”* • *“Improved recycling, water use and plastic use”* • *“Reminds us to turn off lights and close the fridge door and to recycle”* • *“No flushing the toilet when done a pee, tap off during brushing of teeth, very good separating waste.”*

Table E7: Hill PS utility costs on total, student and square metre basis.

Measurement	2015	2016	2017	Percentage Change (2015/2017)
Cost (total)	$58,472.56	$49,650.62	$54,320.67	-7%
Cost/student	$239.64	$188.79	$196.81	-18%
Cost/m^2	$12.87	$10.93	$11.96	-7%

Table E8: Hill PS total consumption and costs by utility (electricity, water and gas) from 2015 to 2017.

Utility	Measurement	2015	2016	2017	Difference (2015/2016)	Difference (2016/2017)	Difference (2015/2017)
Electricity	Consumption *(total kWh)*	93,946	85,669	80,032	-9%	-7%	-15%
	Cost *(total $)*	$27,032	$20,330	$22,494	-25%	11%	-17%
Water	Consumption *(total kL)*	3,276	2,424	2,368	-26%	-2%	-28%
	Cost *(total $)*	$26,799	$25,416	$27,133	-5%	7%	1%
Gas	Consumption *(total kWh)*	35,602	30,642	35,787	-14%	17%	1%
	Cost *(total $)*	$ 4,642	$3,904	$4,694	-16%	20%	1%

Table E9: Hill PS's completed and ongoing low carbon actions from 2015 to 2017.

Emissions Area	Action Description	Category
Energy	LED lights fitted into refurbished staff room	Infrastructure
	Install timer switches to hot water urn in staff room	Infrastructure
	Put up signs to remind people to turn off lights in classrooms, toilets and other communal areas	Behaviour Change
	Principal discussing options for school-wide LEDs with Education Department	Investigation
	Year 6 students count number of security lights in the school	Investigation
Water	Plan a Water Wise assembly	Engagement

	Install a water filter in staffroom sink to reduce waste of plastic containers	Infrastructure
	Year 6s to read water meter each morning/afternoon	Investigation
	Plumber to complete water audit	Investigation
Waste	Conduct Waste Wise audit with students	Investigation
	Collect batteries for recycling	Educational Activity
	Introduce reusable cutlery for canteen	Infrastructure
	Promote use of comingled recycling and educate students about what can/can't be recycled	Behaviour Change
	Install worm farm	Infrastructure
	Misprints from photocopier room to be collected and reused	Behaviour Change
	Students collect worm buckets with food scraps and deliver to worm farm	Educational Activity
Transport	Encourage students to walk and cycle to school	Behaviour Change
Other	Student Sustainability Committee to increase awareness about initiatives through posters and mini assemblies	Educational Activity

Table E10: Hill PS correlation matrix (Pearson's r) of intergenerational variables from parent survey.

	LCRI	**LCL Topics**	**Child Change**	**Parent Change** *(bc child)*	**Household Change**
LCRI	1.00	0.29	0.24	0.08	-0.01
LCL Topics	0.29	1.00	0.71	0.47	0.28
Child Change	0.24	0.71	1.00	0.43	0.49
Parent Change (bc child)	0.08	0.47	0.43	1.00	0.61
Household Change	-0.01	0.28	0.49	0.61	1.00

Wattle SC

Table E11: Wattle SC total consumption and costs by utility (electricity, water and gas) from 2015 to 2017.

Utility	Measurement	2015	2016	2017	Difference (2015/2017)
Electricity	Consumption *(total kWh)*	818,378.34	806,865.70	813,698.50	-1%
	Cost *(total $)*	$181,289.88	$191,658.99	$211,095.90	16%
Water	Consumption *(total kL)*	7,044.33	4,124.09	1,942.21	-72%
	Cost *(total $)*	$79,081.92	$75,547.57	$73,521.85	-7%
Gas	Consumption *(total kWh)*	54,051.22	26,802.82	23,075.35	-57%
	Cost *(total $)*	$6,830.30	$3,630.54	$3,192.46	-57%

Table E12: Wattle SC total, per student and per square metre utility cost (electricity, water, and gas) and the percentage difference between 2015 and 2017.

Measurement	2015	2016	2017	Percentage Difference (2015/2017)
Cost (total)	$267,202.10	$270,837.10	$287,810.21	8%
Cost/student	$182.39	$180.92	$180.22	-1%
Cost/m^2	$9.54	$9.78	$10.39	9%

Table E13: Wattle SC responses from parents about the types of low carbon living topics their children discussed with them.

Low Carbon Living Topics Children Discussed with Parents	
“global warming”	*“Solar and wind generated power”*
“Effected world areas”	*“sea level rises”*

“Recycling, use less bottled water, saving water”	*“About what they learnt in school about climate change”*
“Reducing plastics - there was a documentary watched in science class last week.”	*“climate change, wind and solar energy, recycling”*
“Reducing waste, energy efficient homes”	*“Recycling coffee pods”*
“Roe Highway clearing is around us to excess. They cleared 83 hectares of land so our impact on the areas we touch has been paramount in our lives since last December through to March, especially. It changed ALL our attitudes 😕”	*“Using the washing machine during the day only as we do have solar PV, participating [in] waste free day at school, carrying around a drink bottle when go out to not buy plastic drink bottles, throwing the rubbish in the right garage bin especially aware of what is recycled and what is not”*
“Sea level increase, emissions, energy saving”	*“Recycling, climate change”*
“Vehicle usage and reduction, energy saving globes, solar energy”	*“Renewable Energy, introduction of EV's, plastic pollution in the food chain”*
“The effect of climate change on flora and fauna”	*“not eating meat and dairy products”*
“Recycling reducing water and energy use, reducing plastic waste, etc”	*“Reducing electricity consumption, increased recycling, reduced water usage”*
“climate change, caring for the environment, not throwing food away, using only what you need, buying local in-season produce, not to worry if fruit has a mark, still tasty”	*“Causes of global warming, problems with lack of action. Recent discussion over news with the idea from some Liberals to have state sponsored coal fired power.”*
“rainfall and water, battery recycling, energy production”	*“just the plan to have more vegetarian meals at the canteen.”*
“changing habitats for native animals and plants”	*“Climate change”*
“Cutting back on car journeys, using less plastic”	*“Single use plastic, recycling, solar energy”*
“sea level, species extinction, electric cars, batteries, solar etc”	*“Recycling (which we always do), water usage, noticed solar PV elsewhere”*
“solar PV, recycling, wind”	

Table E14: Wattle SC parent responses describing the changes in their child's attitude/behaviour around low carbon living.

Changes in Children Low Carbon Living Attitudes/Behaviour
"An eagerness to participate in clean up Aust day. Didn't want a plastic bag when we bought dinner last night. Picking up rubbish"
"aware of the importance of using less plastic"
"Concerned about the future"
"Just openly reminding the family and myself as a parent where we can reduce, reuse or recycle!"
"Likes to do further research on the internet and tell us facts she's found"
"More aware of the environment around them"
"More aware, more interested, active in selecting the recycle bin when throwing away recyclables."
"Positive and worthwhile"
"Turning off air conditioning, saying no to single use plastic items"

Table E15: Wattle SC parent responses of how household practices changed because of their child's influence.

Changes in Household Practices
"across all aspects"
"awareness about recycling"
"Just refusing the amount of water and energy we consume and the amount of plastics we purchase"
"less plastic in lunchboxes"
"No single use plastic etc (see previous answers)"
"Not darting off to Bunnings at the drop of a hat"
"recycle everything possible, reduce plastic use, turn off lights, conserve water"
"Recycling toothpaste tubes and brushes. We are still to adopt the bucket in the shower to save water through."
"shorter showers, buying only the food we will eat.

“using less packaging and plastic”
“we bought a soda stream to reduce use of plastic bottles”
“We collect the toothbrushes for the school and everything else that the school recycles, which we have done before, we only bring it to the school now…”

Table E16: Wattle SC correlation matrix with Pearson’s r of intergenerational influence parent survey questions (n=62).

	LCRI	**LCL Topics**	**Child Change**	**Parent Change** *(bc child)*	**House Change**
LCRI	1.00	0.18	0.16	-.02	0.13
LCL Topics	0.18	1.00	0.60	0.23	0.47
Child Change	0.16	0.60	1.00	0.42	0.90
Parent Change *(bc child)*	-.02	0.23	0.42	1.00	0.48
House Change	0.13	0.47	0.90	0.48	1.00

Banksia SC

Table E17: Banksia SC carbon emissions from electricity, water and gas per student from 2015 to 2017.

Utility	2015	2016	2017	Percentage Difference (2016/2017)	Percentage Difference (2015/2017)
Electricity (tCO2-e/student)	0.524	0.443	0.338	-24%	-36%
Water (tCO2-e/student)	0.006	0.003	0.002	-30%	-65%
Gas (tCO2-e/student)	0.017	0.014	0.011	-17%	-35%

Table E18: Banksia SC total utility consumption and cost for electricity, gas and water from 2015 to 2017.

Utility	Measurement	2015	2016	2017	Percentage Difference (2015/2017)
Electricity	*(total kWh)*	689,951	798,060	772,596	12%
	(total cost)	$169,943.33	$200,770.06	$212,976.31	25%
Gas	*(total kWh)*	94,716	96,373	97,350	3%
	(total cost)	$11,251.68	$11,162.10	$11,591.46	3%
Water	*(total kWh)*	5,968	3,894	3,318	-44%
	(total cost)	$63,718.35	$53,118.08	$54,284.19	-15%

Table E19: Banksia SC examples of low carbon actions (ongoing or completed) from 2015 to 2017.

Area	Action	Category
Energy	Repair building management system	Infrastructure
	Connect building management system	Infrastructure
	Review building management system performance	Infrastructure

	Energy saving signage in classrooms	Behaviour Change
	Arrange an energy audit	Investigation
	Transition of fluorescent lighting to LED	Infrastructure
	Develop policies/standards to require the minimum amount of energy to be used to deliver a service (e.g. light levels in classrooms and corridors)	Policy
	Create an energy policy for the college	Policy
	Create a targeted Operational Plan for transition to sustainable energy infrastructure	Policy
Water	Get water audit	Investigation
	Create a waterwise committee	Policy
	Get water audit professional to present findings to classroom	Educational Activity
	Monitor water consumption monthly	Investigation
Waste	Create 3 year waste management plan	Policy
	From waste wise committee	Policy
	Audit litter each term and provide feedback	Investigation
	Create composting system for organic food scraps	Infrastructure
	Create ethical and sustainable purchasing policy	Policy
	Put recycling system in staff room/offices	Infrastructure
	Implement a Green Ambassador program to collect/monitor paper waste from classes	Educational Activity
	Do waste wise workshops for local primary schools	Outreach
Transport	Collect regular walk or ride to school data	Investigation
	Put travel time stencils in local community	Outreach
Other	Form low carbon committee	Policy

Appendix F

Cross-Case Analysis

Table F1: Total square metres of all buildings at each case study school (2015 – 2017).

School	2015	2016	2017	2017 Green Spaces	Transportables Installed (2015 – 2017)
Hill PS	4542	4542	4542	12422	0
Acacia PS	5164	5444	5864	15674	14
Wattle SC	27700	27902	27902	21850	3
Banksia SC	22797	23636	23916	29188	13

Table F2: Total utility cost (electricity, gas and water) per student for all case study schools (2015 - 2017).

School	2015	2016	2017	Percentage Difference (2015/2017)
Hill PS	$239.64	$188.79	$196.81	-18%
Acacia PS	$190.12	$166.15	$151.87	-20%
Wattle SC	$182.39	$180.92	$180.22	-1%
Banksia SC	$224.28	$186.13	$160.44	-28%

Table F3: Analysis of the mention of sustainability or low carbon initiatives across each of the school's communication platforms.

	Hill PS	Acacia PS	Wattle SC	Banksia SC
Mission Statement (2016-18)	No	Yes	No	No
Values (2016-18)	Yes	Yes	No	No
Annual Reports	2016 – No 2017 - Yes	2016 – Yes 2017 - Yes	2016 – N/A 2017 – Yes	2016 – Yes 2017 - Yes
Business Plan (2016-18)	Yes	Yes	Yes	Yes
Newsletters	not available	2016 – N/A 2017 - 50%	2016 – 65% 2017 – 70%	2016 – 83% 2017 – 36%
Website (2018)	No	Yes	No	No

Appendix G

Barriers and Enablers to School Carbon Reduction

It is evident in Table G1 that policy barriers and time were the two major barriers facing schools. However, there were some differences in responses between the case study school interviews and the committee member survey. Most survey respondents indicated the main issue as a difficulty getting other staff involved whereas all four case study schools identified a lack of time as a primary barrier.

Table G1: Summary of the number of codes for each barrier theme (i.e. the number of times each participant mentioned the theme) across each of the four case study schools.

Barrier	Acacia PS	Banksia SC	Wattle SC	Hill PS	Committee Member Survey	Percentage of Total
Policies	5	6	15	3	2	26%
Time	5	6	10	4	5	26%
Crowded Curriculum	9	3	8	3	3	22%
Staff buy-in	2	1	2	2	7	12%
Money	3	1	3	3	0	9%
Knowledge	3	1	1	1	0	5%

Table G2: Summary of number of codes at each carbon reduction enabler themes in the four case study schools.

Theme	Acacia PS	Banksia SC	Wattle SC	Hill PS	Committee Member Survey	Percentage of Total
Supportive Principal & Administration	5	4	2	5	5	42%
Passionate Staff & Team	6	3	2	8	8	38%
Sustainability Champion	0	0	4	0	6	20%

Table G3: Summary of effective strategy themes and number of codes for each case study school.

Theme	Hill PS	Acacia PS	Banksia SC	Wattle SC	Committee Member Surveys	Percentage of Total
Educating and Involving Students	2	3	4	1	8	41%
Uniting Staff towards a Goal	2	4	3	3	0	27%
Conducting Audits	0	2	3	2	2	20%
Investing in Staff	1	1	2	1	0	11%