Schools' Carbon Footprint Pilot Project

Final report for Auckland Council

Rachel Bolstad

NZCER
Rangahau Mātauranga o Aotearoa

Auckland Council
Te Kaunihera o Tāmaki Makaurau

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1. Summary

Ten Auckland schools piloted a school carbon calculator between June and November 2021. The pilot aimed to build knowledge about how schools can use a School Carbon Footprint calculator, and what support, advice, and resources schools need to use it effectively.

A free online calculator was used, with light-touch guidance and support from Auckland Council's Sustainable Schools team. The pilot began in late June 2021 with an online workshop to introduce participating school staff to the carbon calculator and the aims of the pilot, followed by in-person school visits from the Sustainable Schools team. A planned cluster meeting with all the pilot schools in August had to be cancelled due to COVID-19 lockdown. The next few months of the pilot were challenged by sustained lockdown. A few schools dropped out, but the pilot continued with schools that were willing.

Data were collected at the beginning and end of the pilot through surveys and interviews with participating school staff and the Sustainable Schools team.

Key findings

Schools' interest, motivations, and drivers for using a carbon calculator

Most participating school staff felt the carbon footprinting process aligned with their school's values around sustainability and student-led action. They were motivated by the opportunity to understand and make measurable reductions in the school's carbon footprint. Half said a strong driver was to show leadership in climate action within the school and community.

Schools were at different starting points in terms of their existing school-wide sustainability and climate focus. It was common for schools to have a student environmental team or committee that organised hands-on environmental actions.

Staff use of the calculator

In most pilot schools, only one or two staff members were involved in the pilot, and at least one staff member had used the calculator. Some were further along than others in calculating their school's carbon footprint. The pilot experience was described as "an exercise in doing the calculator", rather than a true baseline, because in many cases the calculation was incomplete, and the month-by-month data during lockdown were not a realistic reflection of the school's activities under normal circumstances. Most had been able to gather and enter their school's energy use data. Some staff had been able to enter additional information about their school's waste, transport, and other variables.

Student use of the calculator

Most schools planned to initially trial the calculator with student environmental committees. While some schools had made a start before lockdown, in many cases this ground to a halt over the lockdown period as these extra-curricular groups could not operate while students were offsite.

Two secondary teachers from different schools had planned to use the carbon calculator with their maths classes. Both teachers saw a strong relationship to the curricular learning goals for mathematics and statistics. In one of these schools there had been interest in a cross-curricular approach involving maths, technology, and science, with some goals already identified around students evaluating the carbon footprints of different school blocks and identifying ways to reduce these.

One primary teacher had managed to use the calculator with a Years 5–6 class during lockdown, although student attendance for online learning was much reduced compared to onsite teaching. It was seen as a "logical next step" for the class because they had been focusing on the topic of climate change for the whole year. The teacher felt it had been a good exercise, but that more work and focus was probably needed to do it justice.

Calculation challenges, limitations, and surprises

The carbon footprint calculation process highlighted a few common challenges. For example, utility bills did not necessarily provide the unit data needed by the calculator. Travel was a particularly complicated emissions component. Most schools did not routinely keep records of travel and transport details needed by the calculator. Some schools were Travelwise[1] schools so did have some information about student travel, but most did not yet have information about staff transport. Participants discussed the social and ethical tensions that could be triggered by asking staff and families for the details of their private transport.

A couple of schools commented on challenges for disaggregating data, such as power use, to get to a level of granularity that they were interested in; for example, comparing the energy efficiency of individual school blocks. At least one school was on a multi-school campus, and utility bills were for the whole campus, rather than for each school.

Some teachers and advisors noted that the calculator didn't seem to account for other contextual details. For example, the calculator assumes all waste other than compost goes to landfill, but schools often recycled paper and other forms of waste. The calculator asks about composting, but not worm farming. The calculator asks about water supply and wastewater, but some schools collected some types of wastewater to use on the school gardens.

Benefits of using the calculator

Due to the circumstances and timing of this pilot project, the key benefits from using the calculator can mainly be expressed in terms of what staff and advisors learnt, and what they think students did or *could* learn.

Staff and advisor learning included:

- **Learning about carbon footprinting.** Staff and advisors said they had learnt something new about carbon emissions and what contributes to them. Some were surprised about specific aspects of their school's footprint.
- **Learning what excites schools, and the importance of school contexts.** The project team was pleasantly surprised by how enthusiastic some school staff were about the opportunity to pilot the calculator, and how quickly they could see opportunities and connections to their school plans and curriculum. School contexts were important, as advisors found different ways to

1 Travelwise is a programme operated by Auckland Transport, focusing on how students travel to school. See https://at.govt.nz/cycling-walking/travelwise-school-programme/about-the-travelwise-programme/

connect carbon calculation with practices or contexts that were already a focus within each school.
- **Learning about the importance of key relationships and active support from leadership.** Teachers noted that relationships with school administrative staff, particularly business and accounts staff, were important for accessing some of the key information needed for carbon footprinting. The Sustainable Schools team noted the value of having some principals and senior leaders actively involved in the pilot.

Student learning and engagement

Where students had been involved, school staff and Sustainable Schools advisors reported good engagement. Staff talked about the carbon footprinting process as a useful way to generate practical, data-based learning that could empower students to identify actions and changes they can make in relation to something they care about. Several interviewees talked about how carbon footprinting could connect to cultural values that were important to students and their communities.

Staff and advisors talked about the pedagogies that should sit around the use of the calculator, to support students' higher order thinking and social decision making. Some staff from primary schools talked about the need to make it relevant, accessible, and engaging for younger students. Foundational understandings of carbon and carbon cycles were felt to be important to support learning.

Students as changemakers

Staff talked about the importance of supporting and empowering students to be active changemakers in their schools and communities. Some staff recognised that students may have different—or even better—ideas for using the carbon calculators or implementing changes in their schools than the adults. They were interested in students being able to gather carbon calculation data over time, and presenting this to school leaders and Boards of Trustees (BoTs) with recommendations for action.

Resource and support needs

Pilot school staff and the project team identified a range of supports, resources, and improvements that could help their school, and other schools, to make effective use of a carbon calculator. These included:
- scaffolding to get started with the calculator
- guides and advice about exactly how to collect data, and use data to take action
- access to local and regional support and expertise
- resources to support knowledge and context understanding
- networking opportunities with other schools and communities, including student networking and conferences.

Looking ahead

Most staff were disappointed that they hadn't been able to achieve what they had hoped in 2021. All the pilot school staff interviewed at the end of 2021 indicated an interest and willingness to keep using the tool in 2022. A few staff had big visions, including building carbon calculation into the school's strategic plan. Some had clear ideas about how school-based emissions reduction innovations could happen on a wider scale and have greater social influence.

The findings of this pilot suggest there is interest and appetite within schools to do carbon footprinting to support student learning and action-taking. However, some schools were more ready than others to connect a carbon calculator to their existing school-wide practices or classroom curriculum.

This pilot also identified areas where data gathering and analysis towards carbon calculation could be supported by wider system-level planning and support. For example, utility providers (energy, waste, water) may be in a position to support widespread carbon footprinting practices across schools, either by proactively providing schools with this data, or by working with schools to reach agreements about system-level aggregation of data from many schools across a region. It was also noted that students, schools, and communities did not necessarily need accurate carbon footprint data in order to make changes towards more sustainable practices. Finally, some participants noted that students', schools', and communities' aspirations to be more sustainable and reduce their carbon footprints were constrained by wider system factors that to change would require government direction, support, and resourcing.

A few participants noted that climate anxiety was something to be conscious about, and emphasised the importance of demonstrating to learners that adults around them are ready, willing, and able to engage with the climate challenge, and work collectively towards solutions.

2. Introduction

Auckland Council's Sustainable Schools team ran a small pilot programme from June to November 2021. The pilot aimed to build knowledge about:

- how schools can use a School Carbon Footprint calculator to understand their school's carbon emissions, build knowledge about climate change mitigation, and take steps to reduce their school's carbon footprint
- what support, advice, and resources schools need to enable them to make effective use of a School Carbon Footprint calculator.

A key driver for the Sustainable Schools team was to see how a carbon footprinting tool and approach could support student engagement in the process, linking carbon footprinting to teaching and learning, and empowering student-led action.

Ten Auckland schools were approached and invited to be part of the pilot, through existing relationships with the Sustainable Schools advisor team. The aim was to work with schools that were ready, willing, and able to pilot the calculator. The schools were selected to provide a range of school types, deciles, and contexts, but were not intended to be a representative sample. The schools were located across four local board areas in central, eastern, and south Auckland. All schools were in urban areas.[2] All schools taught in English-medium, with two schools also offering Māori-medium education within the school. Table 1 shows characteristics of the pilot schools.

2 Under Ministry of Education classification, all pilot schools were designated as sitting within a Major Urban Area.

TABLE 1 **Pilot school characteristics**

	School type	Authority	Gender	Decile	School roll[3]
School A	Secondary (Years 7–15)	State: Integrated	Single sex	1	900
School B	Full primary	State	Co-educational	4	400
School C	Secondary (Years 9–15)	State	Co-educational	8	1,700
School D	Contributing	State	Co-educational	1	200
School E	Contributing	State	Co-educational	10	800
School F	Full primary	State	Co-educational	10	400
School G	Composite	Private: Fully registered	Co-educational	N/A	900
School H	Full primary	State	Co-educational	3	300
School I	Full primary	State	Co-educational	1	600
School J	Full primary	State	Co-educational	8	600

Why calculate a school's carbon footprint?

A carbon footprint represents the amount of carbon dioxide[4] released into the atmosphere as a result of the activities of a particular individual, organisation, or community. Many different activities produce emissions, including energy use, transport, and decomposition of waste materials producing methane and other gases. Some activities—such as planting and regenerating forests—can be emissions-reducing. However, carbon footprints can be difficult to measure accurately, particularly for novices. There is a degree of technical understanding required, and time and know-how are needed to gather all the information required to get a full picture of an organisation's emissions. The Ministry for the Environment's (2020) guides for businesses and organisations seeking to measure their own emissions provide standardised CO_2-e (carbon dioxide equivalents) for different kinds of activities. Many New Zealand organisations that choose to calculate their carbon footprint engage the services of specialist organisations that can support a carbon footprinting process, and in some cases provide certification against recognised standards.

At present, carbon footprinting is typically a voluntary activity. People or businesses may choose to do it for a range of reasons, and the accuracy of their calculations will vary depending on how they go about it. Several New Zealand-based free carbon footprinting calculators have been produced—including by local governments—to encourage and support individuals and households to estimate their own carbon footprints and learn how to reduce these (McDougall, 2020).

The voluntary nature of carbon footprinting can be looked at in the wider context of obligatory global emissions reductions that New Zealand and other governments have committed to. Since the early 1990s, New Zealand has been a Party to The United Nations Framework Convention on Climate

3 Total rolls have been rounded to the nearest 100 to maintain school anonymity.

4 Or equivalent. While carbon dioxide (CO_2) is the most significant greenhouse gas, other kinds of gases such as methane (CH_4), nitrous oxide (N_2O), and fluorinated gases all have a warming effect on the atmosphere. These are measured in terms of carbon dioxide equivalents (CO_2-e).

Change (UNFCCC),[5] an international environmental treaty whose objective is to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (United Nations, 1992, p. 4). Parties meet at Annual Conferences of the Parties (COP) to assess progress. In December 2015 at COP21, a landmark agreement (The Paris Agreement) was reached to accelerate and intensify the actions and investments needed for a sustainable, low carbon future, aiming to "bring all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects".[6] In late 2019, the New Zealand Parliament passed the Climate Change Response (Zero Carbon) Amendment Act,[7] which sets out new emissions reduction targets and other plans and measures to keep New Zealand on track to deliver on its climate commitments.[8]

In November 2019, the Government announced that there would be more support for schools to reduce energy consumption and environmental impact, including a $5million contestable fund for sustainability initiatives such as installing solar panels, replacing inefficient heating systems, and removing coal boilers. In December 2020, the Government announced a goal for the public sector to be carbon neutral by 2025. School BoTs and tertiary providers were included "in principle" as one of the groups that would be directed to measure, verify, and report on emissions. The Carbon Neutral Government Programme (CNGP) aims to accelerate the reduction of emissions within the public sector. A Cabinet paper in June 2021 proposed that:

> The Ministry of Education (MoE) reports on the direct greenhouse gas emissions from fuel use and indirect greenhouse gas emissions from imported energy on behalf of the state schooling sector from the 2022/23 financial year onwards. MoE will also report back by December 2021 to the Minister of Education and Carbon Neutral Government Programme Ministers on what other emissions sources can be collected and reported on, alongside the associated costs and recommendations for further reporting. (Ministry of Business, Innovation and Employment, 2021, p. 24)

The decisions that come from this work could have a big impact for school leaders and BoTs. Educational leaders can be proactive in preparing for what may come next by building their own climate literacy, exploring what schools can do to contribute to reducing Aotearoa New Zealand's carbon footprint, and supporting communities in the transition to a low-emissions future. Several education sector peak bodies, including the primary teacher union NZEI, have publicly pushed for stronger top-down commitments from the Government to decarbonise schools faster.[9]

5 The UNFCCC was developed in 1992, ratified by New Zealand in September 1993, and entered into force on 21 March 1994. As of December 2015, UNFCCC had 197 parties, including all United Nations member states.
6 See https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement
7 See http://www.legislation.govt.nz/act/public/2019/0061/latest/LMS183736.html
8 The Act requires the development of an emissions reduction plan (ERP) for New Zealand. The first ERP was originally meant to be done by late 2021. However, COVID-19 delays have pushed this out, and the ERP is now due to be finalised by May 2022, and from June 2022, agencies and Ministers must be accountable for what it sets out.
9 See https://350.org.nz/more-than-350000-young-people-in-aotearoa-attend-schools-burning-fossil-fuels/

Structure of the pilot

The Zero Carbon Online[11] calculator was used for the pilot. This calculator was chosen because it is designed for a school or business, rather than a household or personal footprint (see Box 1). The calculator is free for public use; however, pilot schools were provided with a special login that gave them access to additional functionality to store their school's monthly data entries and produce charts and tables over time. Schools were asked to try to engage with the calculator at least four times over the pilot period.

Auckland Council appointed a project coordinator to manage the project, providing support and training to the Sustainable Schools advisors, and liaising with the NZCER researcher.

The pilot began in late June 2021 with an online workshop to introduce participating school staff to the carbon calculator and the aims of the pilot. Each pilot school was visited in person by their Sustainable Schools advisor[12] and/or the project coordinator or other members of the Sustainable Schools team, to discuss the school's plans for trialling the calculator. The aim was that advisors would have light contact with their schools at least once every 2 weeks to see how each school was getting on, and provide advice and support as required.

BOX 1

How the Zero Carbon Online calculator works

The calculator is designed to calculate CO_2-e emissions for New Zealand schools and businesses using common 2020 NZ emission factors.[10] The calculator asks users to enter monthly data in each of the following categories:

- Stationary Energy
- Transport Fuels
- Travel
- Air Travel
- Water
- Waste
- Planting.

Some data can be taken directly from utility bills, and other data (such as travel) require some calculation and estimation. Users can enter information in as many or as few categories as they wish. The calculator will generate an estimate of monthly and annual emissions based on the data entered (in kg CO_2-e).

Adapting to COVID-19 lockdown

An after-school face-to-face project cluster meeting was planned for staff from all participating schools on 18 August. The purpose of this meeting was for schools to meet, share, and discuss their goals for the pilot project, and get some additional ideas and support from the facilitation team. Unfortunately, this meeting did not go ahead because New Zealand was going into immediate Level 4 lockdown due to a new outbreak of COVID-19. Auckland remained with Level 4 or Level 3 lockdown restrictions for the remainder of the pilot.

The project slowed down considerably in August and September, recognising the pressures on schools and the difficulties of staff and students not being onsite. Efforts were made to stay in touch with each school and to gauge their interest and ability to continue involvement in the pilot.

One school withdrew from the pilot due to competing priorities. Several schools indicated they were willing to continue. A few schools did not formally withdraw but did not respond to messages and invitations. The team opted to continue to provide support and encouragement for any schools that indicated a willingness to stay engaged, and was careful not to pressure schools.

10 See https://environment.govt.nz/publications/measuring-emissions-detailed-guide-2020/
11 See https://www.zerocarbon.online/calculator-2/
12 Four Sustainable Schools advisors were involved in the pilot, each supporting the pilot school(s) within their local -board area.

Adding online workshops and "office hours"

By early August it was becoming clear that there were some teething issues with using the carbon calculator tool. A few small technical issues were identified by some users (log-in issues, email spam filters). A third-party software issue prevented users from being able to log any data for a 2-week period in August. These issues were passed to developers and most were resolved quickly.

A second issue was that some staff and advisors had not yet engaged with the calculator. It appeared that uncertainty or a lack of confidence to get started was holding novice users back. To overcome this, the project coordinator developed an online workshop session for advisors, using the calculator to work through a set of example exercises together. This approach allowed discussion and explanation about how different sorts of data could be sourced and entered, what assumptions or estimations might be needed to get an estimated carbon footprint for different emissions factors, and how to make sense of the output generated by the calculator (see Appendix 1).

The workshop was received positively by advisors, and it was decided to offer online workshops in September to participating school staff. Two 45-minute Zoom workshops were offered: Getting Started, which covered logging in and entering simple data (e.g., figures from utility bills), and Advanced Data Entry, which went through more complex example exercises. The project coordinator also established a regular "office hours" slot each week for pilot school staff to come along for support, advice, and troubleshooting. Uptake of these opportunities was patchy; however, this was to be expected given the circumstances, and the supports were well-received by those who did attend.

Research questions

Research questions for the pilot were developed by NZCER and Auckland Council to address the key themes of interest for the Sustainable Schools team. The focus of the research was on schools' experiences with using the calculator, and the impacts and benefits of its use, not the actual carbon footprint calculation generated by pilot schools. Given the 6-month time frame for the pilot, and the light-touch support for pilot schools, it was assumed that accurate calculation of baselines, let alone implementation of actions that could measurably reduce schools' footprints, would not necessarily be a realistic goal. Because the focus was on learning and experiences, most of the research questions could still be investigated even with the further disruption of the COVID lockdowns (see Table 2).

TABLE 2 **Project themes and research questions**

Themes	Research questions
The **interest/appetite and drivers** of schools for using a school's carbon calculator to get a carbon footprint and to develop and implement a carbon reduction plan	1) Why are the pilot schools interested in using a carbon footprint tool? 2) How does interest in using a carbon footprint tool align with school values, practices, curriculum drivers, or advocacy/support for climate action within the school or community (e.g., from teachers, students, school leaders, parents/whānau, community)?
How is the tool used in pilot schools, and by whom?	3) How is the carbon calculator tool used within the pilot schools, and who is involved (teachers, learners, senior leadership team (SLT), BoTs, etc.)? 4) How is the carbon calculator incorporated into classroom learning?
The **benefits** of using a carbon calculator for learning, and carbon reduction	5) To what extent does schools' use of the carbon calculator support climate change learning and change initiatives within the school? 6) To what extent does the use of the carbon calculator support student-led climate and environmental action and behaviour change? 7) To what extent does the use of the carbon calculator support measurable carbon reduction in the school?
The **nature of resources and support** required to enable the use of a school's carbon calculator to support schools and students to take climate action, and **enablers and barriers** to schools using a carbon calculator.	8) What resources and support are needed, alongside the carbon calculator, to enable schools and students to take climate action? 9) What features of the carbon calculator hindered or enhanced the students' use of the calculator? 10) What additional resources did teachers need to support learning from the carbon calculator?

Data collection methods

Data were collected from participating school staff, Sustainable Schools advisors, and the project coordinator. All participants were provided with an information letter explaining the purpose of the research, and returned a consent form if they were willing to participate.

Participating school staff were sent an online survey in the first month of the pilot (June/July) and were invited to take part in a 30-minute phone interview towards the end of the pilot (October/November). Sustainable Schools advisors were given access to an online form to regularly add notes about their engagement with each school, including progress, challenges, or successes. The project coordinator and Sustainable School advisors were also interviewed in October/November. Interviews and advisor notes were analysed and coded thematically using nVivo.

Response rates

Eight schools provided at least one survey response, with 12 surveys received in total.[13] Two schools did not return any survey responses. One school that did return a survey withdrew from the project after entering COVID-19 lockdown. Of the remaining nine schools, seven responded to the invitation to do a final phone interview, and two either did not respond or were not available for interviews.

Interviews were completed with all four Sustainable School advisors and the project coordinator.

13 Five schools returned one survey each, two schools returned two surveys, and one school returned three surveys.

Limitations of the study

Nearly 3 months of COVID-19 lockdown in Auckland during the pilot also had a significant impact on this pilot study. Other limitations include its short time frame (6 months) and the lack of student perspective,[14] and that all participating schools were urban Auckland schools, teaching in English medium. As the schools in the project were already interested in sustainability, they may have been more ready, willing, and able to engage than other Auckland schools. While it had been hoped that the project would engage and involve Māori-medium kaiako and ākonga within the two schools that offered te reo immersion or rūmaki reo, this had not yet happened.

14 Student experiences were already out of scope for the pilot, and would likely have been even more difficult to include due to the COVID-19 lockdown.

3. School contexts, drivers, and existing practices

Staff roles and experience with carbon footprinting

The 12 staff who responded to the survey held a range of roles in their schools. The survey allowed them to select more than one role. Of the seven staff who had a particular leadership role or responsibility in relation to environment or sustainability, one was also a principal, one was a deputy principal, four were middle management or teaching staff, and one was a learning support coordinator (Table 3).

TABLE 3 **Role(s) of participating staff (*n* = 12)**

Role	Responses
Principal	4
Assistant principal or Deputy principal	2
Middle management (Teacher in Charge (TIC) of a subject or Head of Department/Faculty/Learning Area)	3
Classroom teacher	4
Enviro or Sustainability leadership role	7
Learning support coordinator	1

At the beginning of the pilot, nine described themselves as "beginners" in their understanding of carbon footprinting, and three said they were "quite knowledgeable". None described themselves as "very knowledgeable" (Table 4).

TABLE 4 **Staff understanding of carbon footprinting prior to joining the pilot**

Understanding of carbon footprinting	Responses
Beginner/Just getting started	9
Quite knowledgeable	3
Very knowledgeable	0
Total	12

Motivations to trial the school carbon calculator

Staff were asked to rate a list of possible drivers for their school (and themselves) wanting to take part in the pilot (Figure 1). The strongest drivers were alignment with their school's values, and the opportunity to make measurable reductions in the school's carbon footprint. Half said a strong driver was to show leadership in climate action within the school and community. Responses were more equivocal about other potential drivers, with a mix of strong or moderate, and a few identifying these as weak or not a driver. Three staff wrote an additional comment about their drivers for participation:

> Sustainability is one of our core values. The school is a leader in reducing waste to landfill. (Principal, secondary school)

> It will provide a real learning context for learning for some subjects. (Teacher, secondary school)

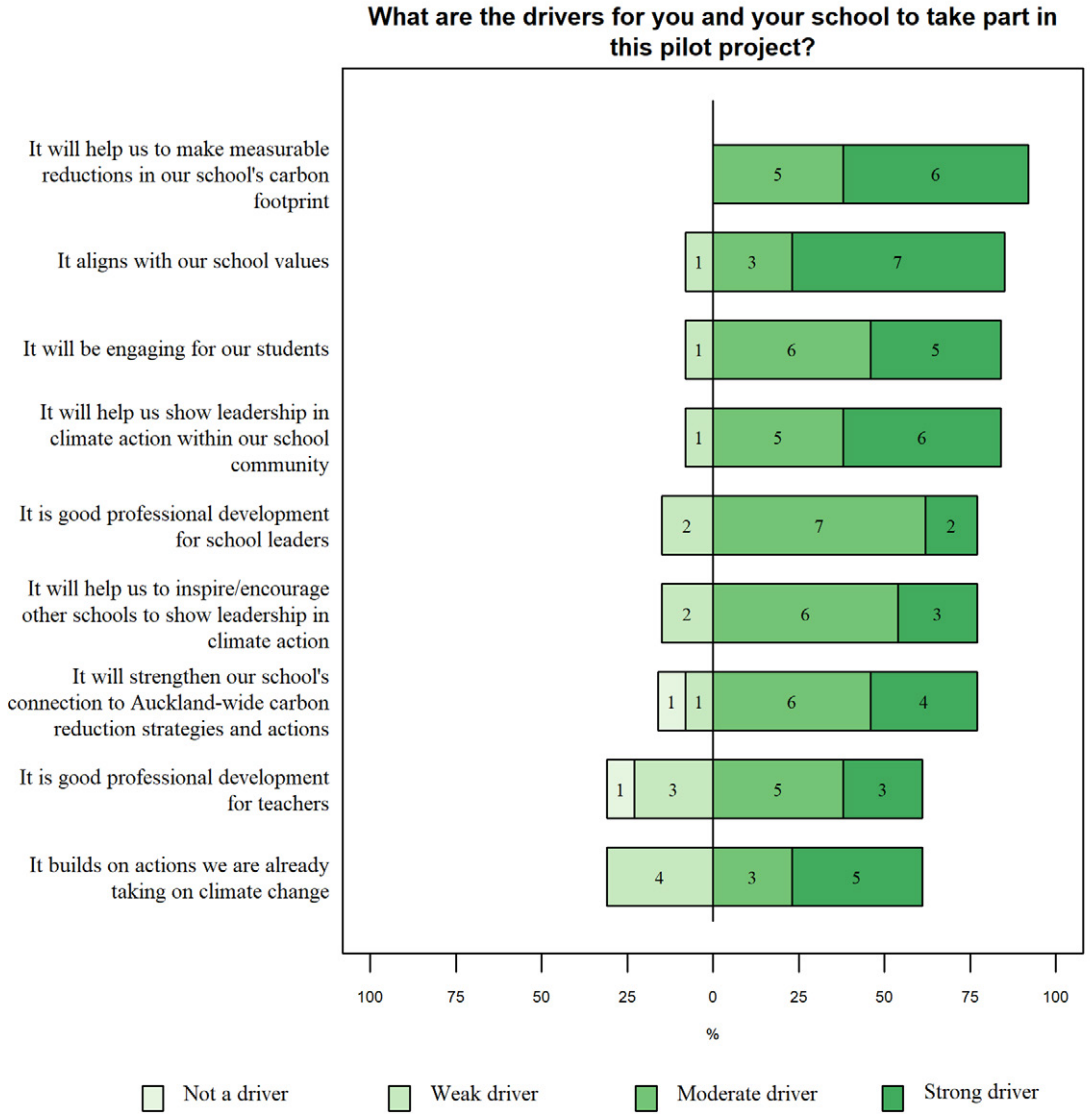
> Students wanting to see school take action. (Deputy principal, secondary school)

Staff and advisor interviews at the end of the pilot provided additional insight into the ways the carbon calculator hooked into each school's values, aspirations, and contexts. A strong theme for several schools was a deep drive to support and empower students to be decision makers and change makers in their own schools and communities:

> Schools are the best place to really get the kids up to speed so that they're able to make changes and influence the changes as well. That's something we try to do here—to create kids who are able to influence, and know how to. (Primary school leader)

Staff in several schools also commented that climate change and the environment was an area that some students were very engaged with and passionate about.

FIGURE 1 **Drivers for schools to take part in the pilot (*n* = 12)**



Student climate and sustainability activities prior to the pilot

Staff were asked what kinds of climate and sustainability activities students they taught were involved with prior to the pilot (Table 5). Most said students were involved in some kinds of climate and environmental actions, such as reducing food waste, or tree-planting. Just under half said students were connecting with local or regional organisations that take action on climate change. A few said students took social actions for the climate or the environment. None said that students were already measuring or calculating their carbon footprints. These themes are further discussed in the next sections.

TABLE 5 **Student climate and sustainability activities prior to the pilot (*n* = 12)**

Student activities	Responses
Taking actions that help mitigate or adapt to climate change (e.g., actions to reduce personal, school, or household carbon footprint, tree planting, wetlands planting, reducing food waste)	9
Taking actions to help the environment in other ways (e.g., reducing plastic use, pest control, monitoring waterways, beach clean-ups)	7
Connecting with local and/or regional organisations that take action on climate change	5
Taking social actions for the climate or the environment (such as letter-writing, climate action marches, social campaigns)	4
Measuring or calculating carbon footprints (e.g., personal, household, or school)	0

School-wide environment, sustainability, and climate practices

Figure 2 shows how staff characterised the status of climate change and sustainability across their whole school at the beginning of the pilot. Most staff strongly agreed or agreed that their school had student-led climate/environment/sustainability groups or leaders, and most indicated a school-wide focus on kaitiakitanga or care for the environment. Sustainability was identified as a school-wide priority in most schools, although only two staff strongly agreed that this was the case. Staff tended to agree (but not strongly agree) that students in their school felt strongly about climate change, and that the school community was supportive of a focus on sustainability and climate change. More than half disagreed that climate change was a school-wide curriculum priority.

In terms of reducing waste and emissions (Figure 3), food waste and paper and consumables waste were the most common existing school-wide focus, followed by e-waste and resource consumption including energy use. Only three staff (from different schools) indicated a school-wide focus on reduction of carbon emissions relating to transport.

FIGURE 2 **Whole-school climate and sustainability focuses (*n* = 12)**

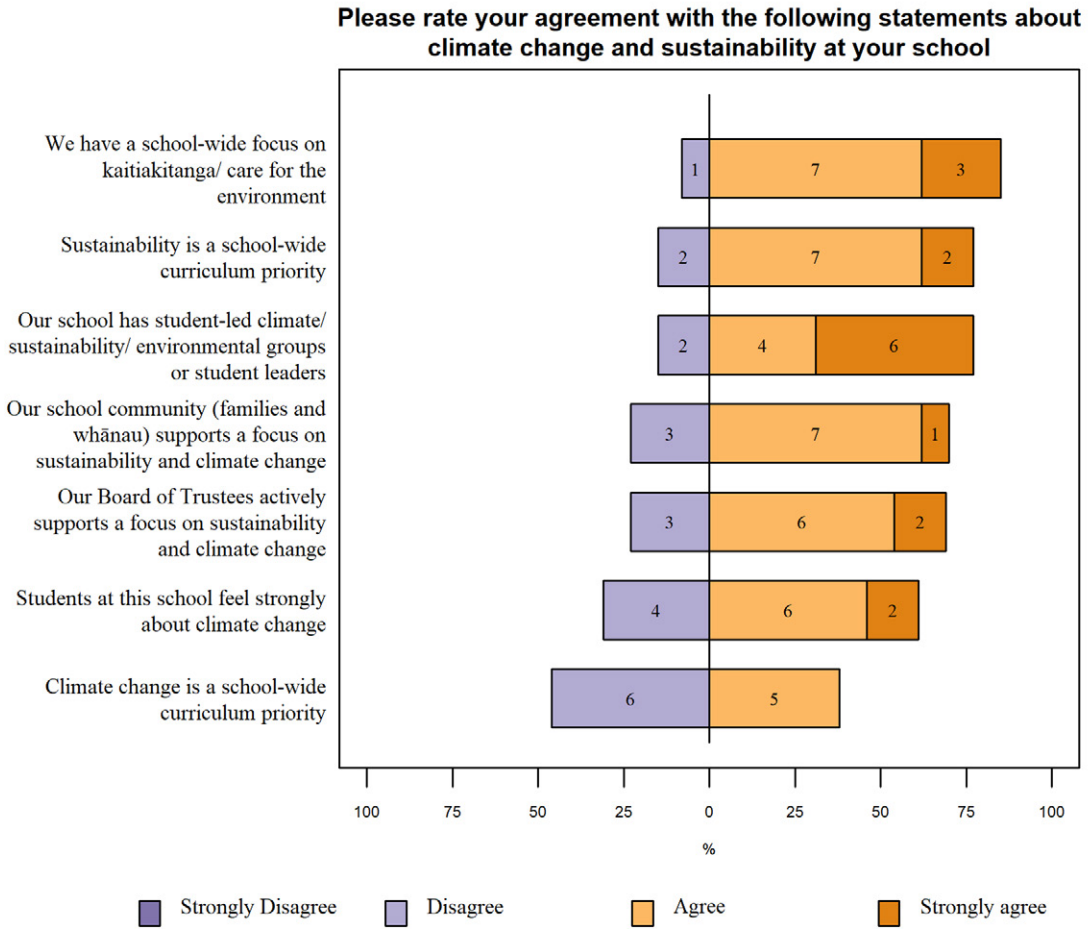
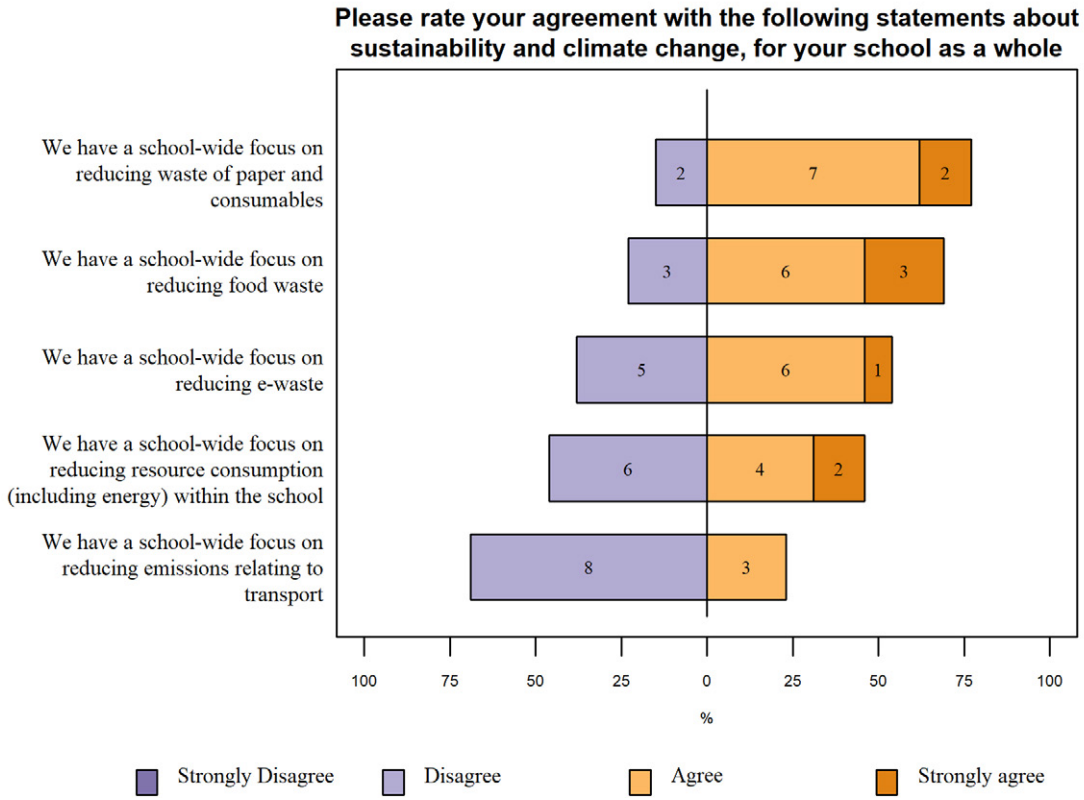


FIGURE 3 **Whole-school waste reduction focuses (*n* = 12)**



Seven staff had oversight of their school's policies and practices relating to property, procurement, and energy use. Of these, three said their school specifies sustainability and climate requirements when making procurement decisions for goods, services, refurbishment, and/or new builds, two said they did not, and two were unsure. Three staff (from different schools) said their school had undertaken a review or audit of their school's energy consumption within the past 2 years. Two schools had undertaken audits of their whole-school sustainability practices. None had previously calculated their school's carbon footprint.

Some schools were involved in a range of projects and programmes including Enviroschools, Wai Care, Garden to Table, and Travelwise.[15] Some had vegetable gardens, composting, and worm farms, and some were engaged with water care projects in the school or nearby. For example:

> [School is involved with] Wai Care. Planting in the [name of] Wetlands. Community engagement with [name of] Wetlands and Healthy Waters—Auckland Council. Bees wax wraps—alternatives to plastic. Gardening and healthy soils (Bokashi and Worm farm castings). (Sustainable Schools advisor notes, School H)

> Sustainability has been a priority for [this secondary school] for the past decade and is part of the school's mission statement. The school has had a sustainability panel since 2008, made up of student leaders, teaching and management staff, caretakers, BOT reps, and external supporters. Much of the school was recently rebuilt and student sustainability leaders presented their wishes

15 https://at.govt.nz/cycling-walking/travelwise-school-programme/about-the-travelwise-programme/

> for sustainable practices to the architects and Ministry of Education in the design phase. The new buildings have solar panels which are currently providing 17% of the school's energy needs. (Sustainable Schools advisor notes, School C)

Challenges for some schools' sustainability were also noted:

> Wai Care has been in the school for many years but stopped for a while when Wai Care changed the operating model and became part of Sustainable School programme. Without a dedicated facilitator the school found it difficult to operate. As a leaking building school, the school had to rebuild and thus lost a lot of their sustainability initiatives and ground area. (Sustainable Schools advisor notes, School F)

> The school has been starting to think about sustainability in the past couple of years, and it has been included in 'school-wide' projects since 2020. [Staff member] mentioned that because [the school] is a Cambridge school, it doesn't typically have NZ content in the curriculum, so this could present an interesting opportunity. (Sustainable Schools advisor notes, School G)

Summary

Most participating staff felt the carbon footprinting process aligned with their school's values around sustainability and student-led action. They were motivated by the opportunity to understand and make measurable reductions in the school's carbon footprint. Half said a strong driver was to show leadership in climate action within the school and community. Schools were at different starting points in terms of their existing school-wide sustainability and climate focus. It was common for schools to have a student environmental team or committee that organised hands-on environmental actions. Carbon footprinting was not reported as part of any pilot schools' previous practice, although some had previously done energy and waste audits.

4. How the calculator was used

The COVID-19 lockdown had a significant impact on the use of the calculator, particularly with students. While some schools had briefly engaged students with the calculator before lockdown, in many cases this ground to a halt over the lockdown period. A few teachers had managed to continue working with students while learning was happening remotely, and a few more hoped to fit in some further activity in the final weeks of term, when students returned to onsite learning. All staff interviewed said they would like to get students using the carbon calculator in the 2022 school year.

Staff use of the calculator

In most pilot schools, at least one staff member had used the calculator. In terms of how far they had got with calculating their school's carbon footprint, staff experiences varied. While some staff said they had been able to gather most of the information they needed, others found it more of a challenge:

> I expected to just collect some bills ... it turned out to be a lot more involved than I was expecting. (Secondary teacher)

The first step was often to ask administrative staff to provide or enter information from utility bills, and then the lead staff member did further work to find data that were not already at hand. Most had been able to access and enter energy use data, although in some cases this was not possible because the paperwork was at school and could not be accessed during lockdown, or email responses were not received from the office administrators until schools were back after lockdown:

> If it had been a normal year [without lockdown] I probably would have chased it harder. Getting the data was harder than I expected. (Secondary teacher)

A few schools had been able to enter additional information about the school's waste, transport, and other variables. The ability to enter information about their tree planting was a pleasant surprise for some schools:

> [We are the] proud owners of a thousand seedlings that we need to go out and plant next year. (Primary teacher)

One staff member described the pilot experience as "an exercise in doing the calculator", rather than a true baseline, because the month-by-month data during lockdown was not a realistic reflection of the school's activities under normal circumstances:

> I just put in an average of what we would normally do in a month [if we weren't in lockdown]. (Teacher, primary school)

Calculation challenges, limitations, and surprises

Availability of unit data

The data entry process highlighted a few common challenges. For example, utility bills did not necessarily provide the unit data needed by the calculator:

> One thing I still have to do is go back to the company to get the weight of our waste to landfill. (Primary school leader)

> We got the water records from [the school], she only got the monetary value of what they paid. The calculator wanted volume. So that was a challenge to go back and see if they could source that information. (Sustainable Schools advisor)

Some data entry involved making estimations after talking with key staff, such as the school caretakers:

> We worked out it was always pretty much the same petrol used in lawnmower per week. We had to guesstimate. (Primary school teacher)

Travel

Travel was a particularly complicated emissions component. This required two layers of consideration. First, which forms of travel would be included or excluded? (For example, would the calculation just include school-based trips, or could it also include student and/or staff travel to and from school?) Second, how could accurate data on travel be gathered?

For school-based trips, advisors observed that most schools did not routinely keep records of details needed by the calculator:

> Going on school trips, you need to know details about the motor [diesel, petrol, electric], the size [in cc], all the extra work you have to do to find all that detail is quite arduous. You have to be aware of and capture it at the time, to do that after the date is almost impossible. (Sustainable Schools advisor)

Another advisor suggested that one way to build this into schools' routines and make it easier for teachers might be to include these fields in RAMS[16] forms.

Gathering data about staff and student travel to and from the school was also challenging for both practical and social reasons. In carbon accounting terms, emissions such as staff or student commutes are known as "Scope 3" emissions,[17] and these are notoriously challenging, even in corporate contexts that are well-resourced for carbon accounting.

Some pilot schools were Travelwise schools; therefore they did have some information about student travel:

> We have a walking school bus—and we do Travelwise. We do an audit a couple of times a year to see how many children ride bikes, how many parents drop them off. (Primary teacher)

16 Risk assessment and management strategies forms used in the planning of education outside the classroom (EOTC), such as fieldtrips.

17 Scope 3 emissions are those that occur because of the activities of the organisation, but are generated from sources that the organisation does not own or control. See Ministry for the Environment, (2020, p. 14)

It was suggested that Travelwise could be integrated into the school carbon calculator:

> Even a yes/no question [in the calculator] like 'Do you have walking buses?', 'Are you a Travelwise school?', 'How often do you do audits?' (Primary teacher)

Staff travel was another challenge. Most pilot schools had not looked at this because of the complications of lockdown, although a teacher at one primary school had sent out a survey to staff asking how many kilometres they travelled. A teacher at a secondary school had intended to do this, expecting that staff travel "would be one of the bigger impacts [on emissions]". Because of lockdown, this had not yet happened.

Several teachers and members of the pilot project team discussed the social and ethical tensions that could be triggered by asking about personal travel, noting that it was a "weird area" that could "shame people", and some staff—or parents—"may not be overly forthcoming" about their vehicle use:

> We have some diesel cars, some gas-guzzlers. (Primary teacher)

> Some live a long way away and they don't want to feel bad about that. (Sustainable Schools advisor)

Some participants discussed the need to protect individuals by collecting anonymised data. Staff at a primary school serving a low-income community noted that, if students were using transport data to identify actions that could be taken to lower carbon footprints, "they can't go home and tell parents to buy an electric car".

Disaggregating data

A couple of schools commented on challenges for disaggregating data, such as power use, to get to a level of granularity that they thought might help them understand, implement, and track a specific action students might take in the school. One secondary school aspired to be able to compare the carbon footprints of different school blocks' energy use, but they could not disaggregate the school's energy data to this level:

> [A staff member] envisaged a competition between faculties about who could reduce the most, house competitions between students. We put a proposal to our Board to get different meters that would allow us to do that for each building. (Secondary teacher)

Similarly, another secondary school was part of a large campus that included four separate schools—but only one was part of the pilot project:

> Our bills are for the whole campus. This makes things tricky for us if we want to put in data and other data like transport, that we would only collect for the college. If it was to be a true representation—we would need to get the other schools on board, and I haven't talked to them yet. (Secondary teacher)

Capturing other contextual details

Some teachers and advisors noted that the calculator didn't seem to account for contextual details that they thought might be important. For example, the calculator assumes all waste other than compost goes to landfill, but schools often recycled paper and other forms of waste. The calculator asks about composting, but not worm farming. The calculator asks about water supply and wastewater, but some schools collected some types of wastewater (e.g., from drinking fountains) to use on the school gardens.

A Sustainable Schools advisor made a comparison to a recent professionally conducted school energy audit that picked up "those behavioural things you can't pick up by entering the data [in the carbon calculator]":

> Like in [the energy audit] they picked up every single heatpump remote to see what the last setting it was on. There was anecdotal evidence about people having the windows open and heatpumps on. Or in summer, it was set on heat rather than cooling. Walking through classrooms and seeing there is a giant hole in the wall. (Sustainable Schools advisor)

Planned use with student envirogroups and student leadership groups

In many pilot schools, the intention had been to first use the calculator with extra-curricular student environmental groups. This was an appealing option for many schools for two reasons. First, it was an opportunity to work with students who were already interested and motivated. Second, it did not require negotiating with other teachers or subject areas, asking them to add something new or unplanned into their programmes at short notice.

Student envirogroups were typically "opt-in" groups, involving students from multiple year levels, who met regularly to organise and take practical "hands-on" environmental action:

> I have regular enviro meetings with Year 1–8, we try to meet once a month, we do planting around the school. We got given 30 trees as a reward—we do planting and mulching, junior playground, vege gardens … Most of it is around planting and seed saving, litter and what have you. We do beach clean-ups. (Primary teacher)

> It is seen as a prestigious group to be involved with. The main action is, we have a stream running though our school, they do a huge amount of work around native planting, water testing, monitoring. (Secondary teacher)

One primary school had planned to use the carbon calculator with two student groups: the school's Years 4–6 enviro team and another student leadership group called student advocates. The latter group includes two children selected from each class, representing Years 0–6. The purpose of the student advocates group was explained as a way to "give students a voice in the school" and "allowing them the opportunity to see the processes and how to make changes and see that they can make a difference":

> If there was something in the school [students] saw, they could take it to student advocates, who have weekly meetings. Discussions about things in the school, problems [brought forward by students] and how are they going to solve it? The teacher coordinator] will say 'you might need to go to BoT, or principal, or look outside the school to find solutions'. (Primary teacher)

Actual use with envirogroups and student leadership groups

Unfortunately, in most cases, progress in using the calculator with student envirogroups or other student leadership groups was curtailed due to lockdown. One primary teacher had managed to do one session with the student advocate group prior to lockdown:

> I did an introduction to 'What are carbon footprints?'. They thoroughly enjoyed how I introduced it to them. A student had created a carbon footprint survey/activity. That was one of our Year 5 students; she produced it with her own class to find out in terms of how much use of carbon in her own home. That's as far as I've gone. (Primary teacher)

Generally, extra-curricular groups simply did not continue while students were learning from home.

At one primary school, an effort was made to squeeze in some student engagement late in the pilot, before the school year ended. A special 1-hour Zoom session was offered to interested Year 7 and Year 8s very at the request of the principal who was leading the school's engagement. The project coordinator planned and presented a bespoke teaching session, with support from the principal, to introduce the students to carbon footprint calculation and initiate discussions about why it was useful, and how it might be used in the school. Three Year 8 students attended the session, and the project team felt there had been good engagement. However, little else had happened after this, with the complications of returning to school after lockdown and the short time left in the term. The principal, like staff in other pilot schools, hoped to be able to try again in 2022.

Planned use for classroom learning

Some schools planned to use the calculator in classroom learning, though in some cases it had been anticipated that this might happen after testing it out with envirogroups.

Secondary school classroom use

Two secondary teachers from different schools had planned to use the carbon calculator—or the data that it produced—with their maths classes. Both teachers saw a strong relationship to the curricular learning goals for mathematics and statistics. The idea of solving problems using "Relevant real-world" data, taking measurements, and then looking for ways to improve things was described as "quite a mathematical way of doing things" and "a good way to think about learning":

> [Gathering travel data would be] a mathematical modelling exercise. That would be a cool activity, [looking at] the assumptions we make and how we might model that. (Secondary teacher)

> In our maths classes senior students were looking at time series data ... this would have fitted in perfectly. (Secondary teacher)

In one of these secondary schools, there had been a desire for a long time to achieve greater connection across the curriculum, using authentic projects that wove through multiple learning areas with topics that were engaging and relevant for students. The carbon footprinting pilot appeared to have been a catalyst for realising this goal, with teachers from mathematics, technology, and science engaging with the calculator in the early stage of the pilot. However, because of lockdown, classroom use with students had only started in senior mathematics classes:

> They collected the school's electricity use and used that to map out what that would mean for carbon footprint. Not much beyond that as it came to a screeching halt due to COVID. The technology class was going to look at vehicle use and waste audits, but didn't get to it. (Secondary teacher)

The pilot teacher said the next steps would have been to involve science, and also looking at the possibilities for connection with other learning areas, including social science, English, and religious education. Social justice values were described as being important for the school's special character, and some students were especially "passionate" about climate and sustainability.

In another secondary school, the main focus was on collaboration within departments, with as yet very little movement towards cross-curricular learning. However, this teacher had planned to encourage and support use of the carbon calculator data across the maths department, and described what maths classes might have done if lockdown had not interrupted their plans:

> Let's say we did a survey of staff travel distance and modes, then maybe our Year 10s, even if it was just a sample of anonymised data, they could use the sample to try to work out the overall carbon footprint of travel. That might take a couple of lessons. And then talk about, what are some of the changes that might need to happen? What are some of the system changes that would need to happen so that workers, or schools, or whatever, can improve that? (Secondary teacher)

In a third secondary school, opportunities to use the calculator for classroom learning were felt to be constrained because the school taught the Cambridge curriculum, and "there is little to do with this in our curriculum". The student environmental committee therefore provided the best option for active student engagement with the calculator.

Primary school classroom use

Only one primary teacher had managed to use the carbon calculator with students during lockdown. This was with her Years 5–6 class. It was seen as a "logical next step" for the class because they had been focusing on the topic of climate change for the whole year:

> We started with weather, season weather, what is climate change? They [students] probably didn't know very much—they might have seen bad floods, or bad fires, on the news. (Primary teacher)

Earlier in the year, inquiry processes were used to support students to "head in whatever direction they liked". They had looked at fuel, and in a visit to MOTAT students had "touched coal" which was described as a highlight of the visit for some. The teacher had filled the class with books and *School Journals* borrowed from National Library:

> I had kids coming in every morning—Miss!! Did you know this?? They have been really excited and interested in the topic. We need to bring it back to us, what does it mean for us? (Primary teacher)

This teacher had come to the online training sessions with the project coordinator in September, and used the example exercises in online sessions with her students shortly after—noting that "I had 9 kids [attending] on a good day" during lockdown and "being online it's been a bit weird".

The teacher and students had looked at emissions and the carbon calculator "2–3 times and then moved on":

> If we'd been in the classroom [it would have been better]—a bit stilted online. There were some good discussions. They are getting better at discussing stuff between themselves—letting them lead their conversations themselves, which is a hard thing for teachers to do! They may have got the idea that electric cars are less than fuel. They were better at picking the [calculator exercise] tasks apart in a logical fashion. (Primary teacher)

At the time of the interview (mid-November) students hadn't yet returned for onsite learning and teaching, but would be soon. The teacher thought that there was more that could be done, but it was difficult to make plans until schools reopened:

> We probably still need to do some work on carbon emissions and what that means. We know we need to lower our carbon footprint, but yeah. We could see that using a petrol vehicle or fuel vehicle makes a difference. (Primary teacher)

Summary

The pilot experience was described as “an exercise in doing the calculator”, rather than a true baseline, mostly due to the challenges of lockdown, and, to some degree, the challenges of getting all the necessary data for the first time. Most participating staff had been able to gather and enter their school’s energy use data. Some staff had been able to enter additional information about their school’s waste, transport, and other variables.

Use of the calculator with students was majorly reduced in most schools due to COVID-19 lockdown. However, where this occurred, student engagement was reported to be good. Teachers and school leaders could see a range of ways the carbon calculator could be linked to the curriculum, and to existing school goals around sustainability and student-led environmental action.

5. Benefits of using a school carbon footprint calculator

Due to the circumstances and timing of this pilot project, the key benefits from using the calculator can mainly be expressed in terms of what staff and advisors learnt, what they think students learnt (if they had used the calculator), or *could* learn (if they had been able to use it as the school had intended).

Many staff talked about their next step goals and what they hoped to be able to achieve with a fresh start in 2022. The use of the calculator had not really led to specific emissions-reduction actions or plans, but some staff talked about areas they and students could investigate next year.

Learning for staff and advisors

Learning about carbon footprinting

Staff and advisors said they had learnt something new about carbon emissions and what contributes to them. Some were surprised about specific aspects of their school's footprint:

> [I learnt] that we're an incredibly expensive organisation in terms of energy and carbon footprint! And there are really simple things we could do. (Secondary teacher)
>
> An aha moment [for me was] that water has a fixed waste component. (Sustainable Schools advisors)
>
> We have got 16 solar panels, and they don't generate much energy—I was surprised about that. We have had them for a long time as well. (Primary teacher)
>
> I didn't think about the whole transport thing [before using the calculator]. I had thought about the gas. Being able to enter trees planted was something I had not considered before. (Secondary teacher)

The project coordinator and advisors said they were not experts in carbon emissions at the start of the pilot, and some still felt it was a bit outside their comfort zone. However, the pilot helped them to see how it connected to many different areas, including those where they did already have expertise (e.g., waste minimisation), and areas they were less familiar with:

> I probably learned how many topics it can cover. (Sustainable School advisor)
>
> What I have learned is the relevance of this. (Sustainable Schools advisor)

Learning what excites schools, and the importance of school contexts

The project coordinator and advisors were pleasantly surprised by how enthusiastic some school staff were about the opportunity to pilot the calculator, and how quickly they could see opportunities and connections to their school plans and curriculum:

> I was impressed by how easily the teachers in their planning, at [name of school] saw this as a really positive opportunity. (Sustainable School advisor)
>
> The initial [meeting at a pilot school], that they were so willing and could see so many opportunities, that was really heart-warming. (Sustainable School advisor)

The project coordinator noted the importance of understanding that there might be many different entry points to carbon footprinting:

> I thought it would naturally be boilers, electricity [that schools would focus on]. I learned that you need to understand the school's values and context and anything that they'd previously focused on. Like when we went to [name of school] I said 'Oh even composting has emissions' ... [the teacher] said 'Well, food waste is something that really resonates with us' ... well this is an angle, we could really focus on food waste reduction. (Project coordinator)

Learning about the importance of key relationships and active support from leadership

Teachers noted that relationships with school administrative staff, particularly business and accounts staff, were important for accessing some of the key information needed for carbon footprinting. While some teachers couldn't get the data they needed during the pilot due to lockdown, the process of requesting it had established a path for getting it the next time:

> Now I have the business manager responding to say 'Hey this is an important thing and I think we should try to keep the data flowing in the future', so that's a relationship I have now. (Secondary teacher)

The Sustainable Schools team noted the value of having some principals and senior leaders actively involved in the pilot. In some schools, school leaders were passively supportive, but weren't directly engaged in the process. A few staff commented that active "top-down" support was useful, as it could help to facilitate the involvement of a wider range of staff:

> It has to be seen as a priority by the school—so the admin and caretaker people would see it as an important part of their job as well to pass on that data. (Secondary teacher)

A few staff were largely working on their own. The opportunity to talk about the pilot project, or get other staff interested and engaged, just had not yet happened. This was partly due to COVID-19, and partly due to a familiar scenario in which sustainability and environmental activities are largely driven by one or two committed members of staff:

> I've been thinking for a while, I want to get more classes involved ... But you see, I do it, and then no-one else does it. I keep trying, we'll see. (Primary teacher)

Student learning and engagement

In the few cases where students had managed to use the calculator, or see what it was all about, teachers and Sustainable Schools advisors reported good engagement. Many talked about the carbon footprinting process as a useful way to generate practical, data-based learning that could empower students to identify actions and changes they can make in relation to something they care about:

> Often kids say, 'What's the purpose of learning this?' 'Why do we have to learn maths or science?' Using a tool like this brings in real-life learning, in an area that is culturally inclusive and curriculum delivery that is culturally responsive. (Primary school leader)

One secondary teacher said the school carbon calculator was engaging for students because they could see themselves in it:

> They had a general understanding of what a carbon footprint was but to actually go through the process and see this action leads to this much carbon, those things were really powerful. Previously we might look at the footprint of transport in NZ or agriculture in NZ [whereas with this] the students can see 'Oh, this is [the carbon impact of] me, in my classroom, working on my laptop'. Seeing their impact, but also the things they can do. (Secondary teacher)

Several interviewees talked about how carbon footprinting could connect to cultural values that were important to students and their communities:

> Our school is 33% Māori, they are really attached to the land, the whenua. Mātauranga Māori carries respect for the environment [for example] the traditional purpose of rāhui—recognising that we are protecting that space. (Primary school leader)

One primary school had a lot of engagement with the local iwi and marae, and local environmental projects by the iwi. Students were already used to gathering and using environmental monitoring data (such as water quality) through these projects, and the principal was keen to explore whether students begin to gather and monitor the carbon emission impacts and benefits too.

The specific impacts of climate change for students and communities from particular places and cultures such as Pacific nations were important drivers for some students and schools that served large Pacific communities.

Some interviewees observed that the calculator was likely to be particularly appealing to learners who enjoyed "the mathematical side of things". One teacher noted that what students could learn from the carbon calculator "depends on how the teacher lets them use it". One teacher thought they might be more likely to give the data generated by the calculator, rather than having students do the calculations themselves, in order to ensure they were getting accurate data. An alternative idea was to have a smaller group of trusted students (such as the environmental committee) do the calculations for the school, knowing these students would "take it seriously".

Staff and advisors talked about the pedagogies that should sit around the use of the calculator, so that it was not just a mathematical activity:

> [To achieve] the higher order thinking, social decision-making, how it relates to them. (Primary school leader)

> To me it's about prompting, provocation, so they think 'Oh why's that? What's happening from that?' Prompts to ask deeper questions and ask why. (Sustainable Schools advisor)

Some staff from primary schools talked about the need to make it relevant, accessible, and engaging for younger students:

> Often these things are not presented for the younger children—we need to capture those children. How do we capture the young ones? The concepts are quite tricky. (Primary teacher)

> It's kind of a big thing [climate change]; you have to be careful you don't float around the large topic of it. We could easily bring it in to looking at our school environment, look at the outputs and inputs of that. That would be doable. (Primary teacher)

Foundational understandings of carbon and carbon cycles were felt to be important to support learning through carbon calculation. At one primary school, prior to this pilot project, a science teacher and their class had been learning about the carbon cycle, and, as an outcome of their

learning, a large mural of a carbon cycle was painted in the school. A photo of this mural was shared with another primary school in the pilot, who seemed interested in doing something similar in their own school.

Students as changemakers

Staff talked about the importance of supporting and empowering students to be active changemakers in their schools and communities:

> We are really keen to see real-life data that is real and relevant for our students, to use in our classroom. We are really keen on all these opportunities where students can have control over the teaching and learning. Some of the students are really passionate about this—and you can see the difference in engagement when that happens. (Secondary teacher)

Some staff recognised that students may have different—or even better—ideas for using the carbon calculators or implementing changes in their schools than the adults:

> Experience tells me they will have better ideas than me! (Primary school leader)

At one secondary school, the initial work students had done to investigate energy use and energy efficiency prior to lockdown had already led to the identification of lots of little things that could change:

> Simple things like signage in rooms about turning off lights, closing doors. The solutions weren't huge changes like replacing [heating systems]. It was simple things like giving guidance to other students and teachers about best practice. (Secondary teacher)

Some staff talked about the importance of having students being part of change processes within the school. This included interest in students being able to gather carbon calculation data over a period of time and presenting this to school leaders and the BoT with recommendations for action, and ensuring that actions that schools and their boards were already taking—like upgrading school lighting to LEDs—were visible to students:

> I was talking to our principal about actually connecting the students into that. The BoT is being a good board trying to make best use of the funding they receive, but there is a huge opportunity for students to learn at the same time. That could be as simple as juniors observing lights being changed over in a block and going 'Oh why is that happening?' (Secondary teacher)

Looking ahead

Most staff were disappointed that they hadn't been able to achieve what they had hoped in 2021:

> I am just sort of gutted that it fizzled because we are not at school—but never mind, we did something at least. (Primary teacher)

All the pilot school staff interviewed in October/November indicated an interest and willingness to keep using the tool in 2022:

> We have work to do with our systems at school. The whole awareness of energy and waste, it's an ongoing thing. It's in our strategic plan. For next year we may have to be a bit more explicit about the calculator in there if it's something we are going to pursue. (Primary school leader)
>
> Definitely want to look into it next year from the start of the year with the enviro committee. (Secondary teacher)

> I think there's definitely an excitement about a year where we can actually get these things done. (Secondary teacher)

Thinking big

A few staff had big visions and ambitions. They were already thinking about how school-based emissions reduction innovations could happen on a wider scale. In one school, recent plans for a new build in the school had led to big conversations about transport:

> The plan says we need 50 carparks—at the board meeting I said 'Well do we need that many carparks if Auckland public transport has a plan for public transport, or transport that may be autonomous?' That would be one of the single biggest ways as a city we can lower emissions. So, should we be encouraging people to drive cars by having carparks? Or what about investigating using solar energy to have some electric car charging stations? (Primary school leader)

The principal talked about some of the systemic issues that seemed to limit these kinds of innovations—such as a lack of integrated planning and funding between different government departments responsible for housing, education, and transport, and missed opportunities for innovation:

> If we want to create a science/tech makerspace in our new build next year, well why can't sustainability be part of the build as well? Water stackers on the back that could power your toilets—using grey water off the roofs. Why can't the whole roof have solar panels as well? Well they said, 'No the Ministry doesn't fund that'. I said 'Well maybe they should because the Government has this goal of reducing its carbon emissions by x%'. And I can tell you that the Kainga Ora houses [near the school] don't have solar panels. (Primary school leader)

He envisaged ideas like school-based energy microgrids, where the school's solar power array could be channelled to local low-income homes in the community during the school holidays when the school didn't need the energy. The principal was inspired by the approach of an international green school principal who talked about the value of schools using the resources of the community and vice versa:

> He didn't put a library in the school because there was a public library 500 metres away. What are the places, spaces, and who are the experts you can get in locally? A school can look normal and traditional, but we can be innovative in terms of design, in terms of programmes, and in how we use experts [in the community].

Summary

Participating staff and members of the Sustainable Schools team all learnt more about carbon footprinting from their involvement in the pilot, though some did not get as far as others. The importance of school contexts was evident, as there were different ways to hook the carbon calculator onto existing school goals and priorities, and social and cultural contexts. Support from leadership and good relationships with administrative and finance staff were also important.

Although student use of the calculator did not get far in most schools, staff and advisors could see the potential for student learning and engagement. They valued carbon footprinting as a tool for generating authentic, local data that students could "see themselves in". Staff were keen to empower students to gather, interpret, and present data that could support them to be changemakers and influencers of decision making in their schools and communities.

6. Support and resources

Pilot school staff and the project team identified a range of supports, resources, and improvements that could help their school, and other schools, to make effective use of a carbon calculator.

Scaffolding to get started with the calculator

Carbon calculation appeared quite technical to some users, who were more used to "hands-on" environmental and sustainability approaches, and different styles of facilitation. Several teachers and advisors said that the introductory Zoom meetings with the project coordinator had been extremely helpful:

> The meeting we had prior was really useful. I still go back to my notes. (Primary teacher)

> The meetings with mock data—that was the best thing that could have happened. That made things a lot clearer. (Secondary teacher)

It was suggested that the calculator's interface was quite minimalist, and could be made more visually appealing or user-friendly:

> I think the tool itself could use glamming up—colour for different sections, or pictorial things so you can get to a section nice and quick. Hover-overs to provide definitions. (Secondary teacher)

Some staff and Sustainable Schools advisors needed a bit more help to get started and feel confident:

> I learned that you need to start with where people are even if that is how to open a browser. You have to slow right down. Find out what they are confused about, and what appeals to them. (Project coordinator)

Guides and advice about how to collect data

Several participants recommended having additional guides to help people understand what data to collect, and how to go about this in a typical school environment:

> A how-to guide about how to get the data without too much fuss. Like 'typically you would ask this person this question, this is the kind of bill you would go looking for'. (Secondary teacher)

> [Guidance like] you could ask the accountant lady for all the bills for this year, then you just put them all into a row and boom you do it. It's possible to do in a day if you know how to do it. (Sustainable Schools advisor)

Access to local and regional support and expertise

Some staff said they appreciated the ongoing access to the advisors and project coordinator:

> Having that external support out there which can be as simple as contact and continuous contact. Practical things like suggestions about how to step up the way that you use it [would be useful]. (Secondary teacher)

> [Name of advisor] is just a tremendous asset. She is really encouraging, she can pick when there is stuff bubbling away in schools. Often the change you get in a school, in my faculty, someone will get an idea, and teachers don't always feel empowered to make change, she is really encouraging, she sees that, and then networks vigorously to support it. (Secondary teacher)

One school leader discussed the importance of schools having easy access to experts in different areas like science, energy, transport, urban planning, environmental restoration, and mātauranga Māori to help them with ambitious goals, visions, and actions for making their schools and communities more sustainable.

Resources to support knowledge and contextual understanding

Staff talked about the value of resources that could help teachers and students build their contextual knowledge and understanding. Some commented that these resources were probably already out there, but would appreciate help with knowing how to find them, or having everything in one place:

> Follow-up reading and articles that explain it in a different way. I am sure I could find YouTube clips, *School Journals*. When I am being lazy I want someone else to find the resources for me and put it together! (Primary teacher)

> Resources that are tangible, big, not just on a screen. It's a pretty complex thing isn't it—yeah. I don't really understand it. I could probably do with some upskilling to be honest, to do some professional development around how the carbon cycle actually works. (Primary teacher)

Staff talked about support and resources that could show how their own school carbon footprinting data fitted in to the "bigger picture":

> It would be good to have information about like the draft climate agreement, New Zealand's emission targets. To see how does that all weave in? (Primary school leader)

Networking with other schools and communities

Several participants lamented the cancelled cluster meeting in August that would have brought all the pilot schools together to network and share ideas and ambitions:

> I think we would have managed to get everyone together in one room and have a nice platform from which to start. It's always good when teachers talk to other teachers, see possibilities. (Sustainable Schools advisor)

Staff thought it would be useful to learn from other schools that might be ahead, and find out what they were doing, and how they did it:

> Support to actually go to a school to see how it's happening. To take pictures, observe, and to show the students I am working with 'this is what has happened at another school'. 'What does it look like?' We can invent all these things but I don't know—it's useful to see what lies ahead of us. (Primary teacher)

The idea of climate clusters was appealing:

> We have Kāhui Ako—we could compare what we are doing at different sites. (Primary school leader)

It was suggested that students themselves could be learning and networking with students from other schools:

> Are there schools already out there with students who could be ambassadors for it, or even working alongside us? Our school is a digital hub, even if there is a school up in the North or South—we could connect. Especially if it is a New Zealand context they can relate to. Or connecting with other schools overseas—even in the Pacific—that they can make a connection to. (Primary teacher)

Summary

The pilot identified useful supports and resources to enable schools to use a carbon calculator effectively, even with the limited use that schools had been able to make of the calculator during this pilot project. Further opportunities to use the calculator with students as schools had intended may identify additional ideas from students about what could support their involvement in school carbon footprinting and taking climate action.

7. Discussion

The findings of this pilot suggest that:

- There is interest and appetite within schools to do carbon footprinting to support student learning and action-taking.
- School staff could see how its use could be integrated with school-wide environmental and sustainability activities led by students.
- Some schools were more ready than others to connect a carbon calculator to their existing school-wide practices or classroom curriculum.
- Some initial support is needed to build staff confidence and capability to use a calculator.
- Schools benefit from access to additional guidance and on-demand support for some of the technical details for data entry and making sense of data outputs.
- Experienced environmental and sustainability education advisors and facilitators also need initial support, guidance, and encouragement to understand how to use a carbon calculator, and to see how this connects with areas they are already highly experienced in facilitating.

System-level data and supports

The pilot identified areas where data gathering and analysis towards carbon calculation could be supported by wider system-level planning. For example, utility providers (energy, waste, water) may be in a position to support widespread carbon footprinting practices across schools, either by proactively providing schools with these data, or by working with schools to reach agreements about system-level aggregation of data from many schools across a region. Similarly, programmes that already support, encourage, and enable schools to self-audit their travel and transport practices (e.g., Travelwise) could be integrated into a school's carbon calculator, and/or data from many participating schools could be aggregated to provide a wider set of data for a region.

Road transport accounts for approximately 18% of New Zealand's GHG (greenhouse gas) emissions and, with the growth in road transport, is one of the five main contributors to the increase in New Zealand's overall emissions since 1990 (Ministry for the Environment & Stats NZ, 2019). School transport patterns have changed significantly over the past few decades. The New Zealand Health Survey identified a "dramatic drop" in active transport (walking, cycling, scooters) to school from the late 1980s to the mid-2010s.[18] The 2018 census found that half of New Zealand students now travel to school in a private vehicle (Theunissen, 2019). Further analysis by Auckland Transport (2020) suggests that, for Auckland children under 13, this could be more like 65%.

Developing system-wide approaches to reduce schooling-related travel emissions requires future-focused urban planning, transport design, and consideration of the cumulative impacts of individual people's travel needs and options. Auckland Transport's analysis notes that there is no simple "solution" to the problem of car dependency (Auckland Transport, 2020, p. 24). However, changing transport patterns for education and work travel could make a big difference. Devonport (2017)

18 See https://www.ehinz.ac.nz/indicators/transport/active-transport-to-and-from-school/#dramatic-drop-in-active-transport-use-to-school-from-198990-to-201014

modelled the potential for a sizeable reduction in carbon emissions in Christchurch if secondary students attended their closest schools, rather than driving or being driven to schools further away.

While schools can encourage low-carbon options such as walking, cycling, and public transport, these options are not always available for all families and whānau, and are interlinked with many other factors including housing, employment, public transport infrastructure, and school choice. This pilot study, and another recent study (Newdick, 2020), highlight the social and ethical challenges associated with investigating staff and learners' personal and household emissions, and the need for sensitivity and messaging that emphasises collective and structural solutions, not just individual consumer choice or behaviour change.

Is carbon footprinting schools an effective way to reduce emissions?

This study was unable to address research question 7: "To what extent does the use of the carbon calculator support measurable carbon reduction in the school?" However, a recent, similar Australian pilot study found that schools reduced their carbon emissions on average by 20% on a per student basis and saved an average of 15% in costs (Odell et al., 2021). More than 70% of the actions identified by the Australian schools were low or zero cost.

On the whole, participants in the pilot saw the benefits of school carbon footprint calculation for student learning and practical action-taking within schools and communities. However, one question that arose was how to find the right balance between the need for accuracy in measurement and tracking of a school's carbon footprint, and the need to excite and empower students and schools to be actively involved in making changes that would, by definition, be more sustainable and climate friendly. As one participant said, "You don't need accurate baseline data before you take action." It was suggested that having accurate data motivates some people, but it doesn't resonate with others. Participants indicated that there was value in everyone in a school community (including learners, teachers, school leaders, boards, and communities) having a better understanding of climate emissions and what factors contributed to these. However, this alone would not necessarily drive changes in behaviours leading to reduced carbon footprints, "especially for young people who have limited control". Where schools did have clear visions and goals around sustainability and carbon footprint reduction, these often hit wider system barriers including system-level funding structures, and lack of integration between different parts of government.

Supporting student learning, action, and wellbeing

Although student use of the calculator was limited in the pilot, school staff could see how its use could be integrated with school-wide environmental and sustainability activities led by students. They also saw potential for this to be embedded in classroom curriculum, across many learning areas.

It is important to acknowledge the scale and complexity of the climate challenge, and what effects this may have for young people as they learn about the causes and impacts of climate change. While some adults have the instinct to shield and protect young people, research indicates that it is important for learners—and people of all ages—to be supported to engage with these complexities (Hipkins, 2021), and have meaningful opportunities to engage in optimistic, solution-focused learning and action (Bolstad, 2020; Ross et al., 2021). Learners—and people of all ages—need exposure to activities that "enlarge the imagination" about what kinds of futures are possible, and help them to see what actions they can take to help build more positive futures (Levrini et al., 2020).

Sustainable Schools advisors and several school staff noted that carbon calculation offers one opportunity for learners to understand systems and identify tangible ways they can influence these systems. Several participants discussed the importance of framing carbon footprinting in ways that demonstrated to learners that adults around them were ready, willing, and able to engage with the climate challenge, and work collectively towards solutions:

> Emphasising we are all in it together. We need to make students aware that we [as adults] are aware this stuff is heavy. To send the message 'we are looking after you, we are here for you'. A supportive network of adults holding you as we look together at these things. (Participant)

The international literature emphasises that children and young people not only have a right to be involved in decisions and actions that impact their lives and future, they also have enormous value to offer in terms of creative, innovative, and socially just solution-finding.

Global climate action policy and research literature indicates that a systemic educational response to climate change and wider global sustainability issues needs to include policy-level changes, curriculum innovation, rethinking the infrastructure and operation of learning environments, adopting whole-school approaches, building the capacities of educators, engaging with communities, and empowering and mobilising young people as leaders, innovators, and beneficiaries of positive sustainability action (UNESCO, 2014, 2015).

Future research should build on the findings of this pilot and draw on the existing literature to examine the teaching and learning practices that can be built around school carbon footprint calculation in diverse New Zealand schools, the impacts of these learning experiences for diverse students, teachers, and communities, and the extent to which these can support local, regional, and national climate action and sustainability goals.

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Appendices

APPENDIX 1: Calculator example exercises

These exercises were developed by the project coordinator, and used in online workshop sessions with Sustainable Schools advisors and participating staff.

QUESTION 1

The school accountant has tracked down the following figures from utility bills:

January – kWh electricity 10620, kWh gas mains 701

February – kWh electricity 12360, kWh gas mains 572

March – kWh electricity 14328, no gas data

Month	kWh electricity	kWh gas mains
January 2021	10620	701
February 2021	12360	572
March 2021	14328	Cannot find invoice yet

How do you enter this data? Can you input it into the calculator?

QUESTION 2

In April, one of the school's caretakers went to get some fuel from Z Energy for the lawn mower. She takes the receipt to the school accountant to get reimbursed. The receipt says she purchased 45L of ZX Premium Unleaded petrol.

Create an entry for April 2021 and enter this into the calculator. What are the carbon emissions from this?

QUESTION 3

The accountant has found the gas invoice for March 2021. The kWh was 607.

Can you edit your stationary energy data to add this into the natural gas section? Which month has the most carbon emissions from stationary energy – January, February, or March?

QUESTION 4

The biology teacher has taken students on some tree planting trips to a local reserve. In the first trip, in early June, 30 students came on the trip, and the teacher and each student planted approximately 10 trees. In the second trip, in late July, a larger group of 55 students came along and two additional teachers. Each participant planted about 5 trees.

How many trees were planted in June? How many trees were planted in July? How would you input this data into the calculator? What are the carbon savings for each month?

QUESTION 5

A maths class is going to do a project on staff commuting and want to know the carbon impact of maths teachers' journeys. There are three maths teachers. Two catch the bus to school, and one drives a very small petrol car. The teachers who bus both live about 5km from school. The driver lives further away, with a one-way trip of 17km.

What are the carbon emissions from the return trips of all three teachers? How would you enter this data?

QUESTION 6

Two senior management staff fly from Auckland to Wellington twice a year to conferences. The principal would like to know the carbon impact of these trips. They catch a cab (electric vehicle) from the Auckland Town Hall to Auckland Airport (domestic terminal), fly economy class to Wellington and catch another cab (electric vehicle) from Wellington Airport (domestic terminal) to Oaks Wellington Hotel in the CBD.

Which calculator sections would you use? What other information do you need? What tools do you need to use in addition to the calculator? Can you calculate the carbon emissions from the transport of this trip?

QUESTION 7

The social science teacher has tracked down some waste data for July 2021.

The school has a commercial compost collection with SuperTrash alongside waste and recycling collections. However, the invoices from SuperTrash only have the cost of the collection based on bin lifts, not the weight of the waste.

The caretaker says he always tries to make sure they send out full bins to save on the cost of lifts.

Let's say the average bin weight for general waste is 10kg, and the average bin weight for food scraps is 30kg. In July, there were 25 general waste lifts and 4 compost bin lifts.

What are the carbon emissions from these?

APPENDIX 2: Interview questions

Interview questions for participating staff

Who was involved and how the carbon calculator was used

1. Who was involved in piloting the School Carbon Footprint calculator in your school, and what did that involve? *(Prompt: Yourself, other staff, students, anyone else? If students, which group(s), ages, how many, etc?)*
2. If used with students, how did it connect with your curriculum or other learning goals?
3. *If not used with students, do you think it will be used with students in your school in the future?*

Learning for staff and students

4. What did you learn from using the Carbon Footprint calculator? (*Were there any surprises or a-ha moments for you?)*
5. (If applicable) What do you think students learned from using the Carbon Calculator? Did it support your learning or action goals for students? *(Prompt: What did students say? What did students do?)*

Challenges and next steps

6. What, if any, challenges did you, other staff, or students have with calculating your school's carbon footprint?
7. Has the use of the Carbon Footprint tool led to any actions, or plans for action, that will help to reduce your school's carbon footprint?
8. Do you have any other next steps planned in your school or in your teaching, as a result of this pilot project?
9. Will you continue to use the Schools Carbon Footprint Calculator in your school? (Why/why not?)

Support and resource needs

10. What kinds of support or resources would help you and your school, or other schools, to use a School Carbon Footprint Calculator effectively to support climate action within your school and community? *(e.g. resources/supports for teachers, for students, school leaders, BoT, community?)*
11. Is there anything else you would like to say?

Interview questions for Sustainable Schools advisors and project coordinator

What you learned from being involved in this pilot

1. What did you learn from your involvement in this pilot?
   a. About Carbon Footprint calculation?
   b. About how to support teachers and students to use a carbon footprint calculator?
2. Did anything surprise you, reflecting on your experience of being involved in the pilot? *(Surprises or a-ha moments? Connections to other work, how is this different from your other work?)*
3. What challenges did you, or the schools you worked with, experience in piloting the Schools Carbon Footprint Calculator?

Learning for staff and students

4. What do you think staff in the schools you worked with learned from their involvement in the pilot? (*Were there any surprises or a-ha moments for staff you worked with?)*
5. (If applicable) What do you think students learned from using the Carbon Calculator? *(Prompt: What did students say? What did students do?)*

Challenges and next steps

6. What, if any, challenges did you think schools face in calculating their school's carbon footprint?
7. For the school(s) you worked with, has the use of the Carbon Footprint tool led to any actions, or plans for action, that will help to reduce schools' carbon footprints?

Support and resource needs

8. What kinds of support or resources do you think schools need in order to use a School Carbon Footprint Calculator effectively to support climate action within schools and communities? *(e.g. resources/supports for teachers, for students, school leaders, BoT, community?)*
9. As a facilitator, what kinds of support or resources do you think you need in order to support schools with carbon footprinting and climate action?
10. Is there anything else you would like to say?

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