Sustainable Energy Awareness: Visualizing New Zealand's Electrification Progress

An Interactive Qualifying Project Report

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Ara Ake

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Report Submitted To:

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Meet the Team	Andreas Keating Tue Lac Ben Marsh	
1. Introduction	Ben Marsh	Tue Lac
2. Background		
2.1 Benefits of Electrification	Andreas Keating	Ben Marsh
2.2 Specific Electric Machines	Ben Marsh	
2.3 New Zealand's Opportunity	Tue Lac	
2.4 Literature Review Summary	Tue Lac	
3. Methodology		
3.1 Investigate Metrics	Ben Marsh	
3.2 R&D tool	Tue Lac	Ben Marsh
3.3 Test Tool	Andreas Keating	
4. Conclusion	Andreas Keating	Tue Lac
References	Andreas Keating Ben Marsh Tue Lac	
Appendix A: Expert Interview Consent Form	Ben Marsh	
Appendix B: Expert Interview Questions	Ben Marsh	
Appendix C: Survey Consent Form	Andreas Keating	
Appendix D: User Feedback Survey	Andreas Keating	

Table of Contents

List of Tables and Figures

Meet the Team

Andreas Keating

Hi, my name is Andreas Keating. I am a Computer Science major from Barcelona, Spain, with a minor in Interactive Media and Game Design. I enjoy solving problems and immersing myself in new experiences. I am looking forward to being part of a project that will contribute to advancing New Zealand's energy sector toward a more sustainable future.

Tue Lac

Hi! My name is Tue Lac. I am a Mechanical Engineering student minoring in Robotics Engineering from Ho Chi Minh City, Vietnam. I love hands-on projects and learning new things, and I'm excited to work on a project supporting sustainability efforts. Traveling to New Zealand in the D term will be an unforgettable experience, and I hope our project will support the global push for a greener future.

Ben Marsh

Hi, my name is Ben Marsh. I am a computer science student from Lincoln, Massachusetts, minoring in Chinese. I am excited to be involved in the decarbonization effort in New Zealand. Traveling to NZ will be eye-opening and expose me to topics on sustainability and the country's unique culture.

1. Introduction

Reliance on fossil fuels is one of the most challenging environmental issues in efforts to slow down global warming. Nations worldwide are grappling with the environmental impacts of carbon emissions and are increasingly making the transition to renewable energy sources. This global urgency underscores the need for innovative decarbonization strategies and provides a vital context for examining country-specific efforts.

Aotearoa New Zealand has committed the country to reaching net zero carbon emissions by 2050. The country plans to achieve this by increasing the amount of sustainable power generation and decreasing the number of fossil fuel-burning machines.

Our project has the support of two companies that dedicate their efforts to advancing renewable energy projects to support New Zealand's decarbonization efforts. Their knowledge and tools will be vital for our project. By creating creative energy solutions and connecting specialists, Ara Ake, a government-funded organization, plays a crucial part in transforming the energy sector of New Zealand. The NGO Rewiring Aotearoa focuses on clean energy, climate solutions, and electrification by assisting communities in switching to sustainable energy and reducing dependency on fossil fuels.

Working with Ara Ake and Rewiring Aotearoa, our project team hopes that the research we produce is relevant to the efforts of our sponsors to advance the sustainable future of New Zealand. The goal of our project is to simply and effectively convey NZ’s progress towards nationwide electrification, in a way that is accurate, motivational, and interesting. To achieve this goal, our key objectives include:

1. Investigate metrics that convey the benefits of electrification.
2. Research and develop a visual dashboard product to display nationwide progress in decarbonization.

3. Gather information concerning the effectiveness of the dashboard product as an informative resource for the New Zealand public.

2. Literature Review

Recent research on how electrification lowers energy prices, decreases emissions, and enhances energy security in Aotearoa New Zealand is covered in this chapter. It begins by outlining the four primary sectors, residential, commercial, industrial, and agricultural, where electrification offers general benefits. The chapter then looks at its advantages for public health, energy security, emissions lowering, and economic and energy efficiency. It then examines sector-specific prospects and difficulties including infrastructural constraints, regulatory gaps, financial restrictions, and public awareness concerns. The last part looks at the policy and economic aspects influencing electricity development and prepares the ground for our project's study design and dashboard creation.

2.1. Benefits of Electrification

Electrification, replacing fossil fuels with electricity as the primary energy source, offers a path forward for New Zealand, tackling rising energy costs, and improving air quality, and energy security in the long run. According to *Electric Homes* (Ellison et al., 2024) and *Investing in Tomorrow* (Griffith et al., 2024), swapping out gas heaters, petrol cars, and other fossil-fuel appliances and tapping into the nation's renewable grid can save families over 1,000 NZD a year and cut emissions by 70–90%. These benefits go beyond just lowering utility bills: switching to electric alternatives reduces harmful pollutants, keeps households safer from global price swings, and boosts resilience during severe weather or other disruptions. Viewed from financial, environmental, or infrastructure perspectives, electrification is a powerful strategy in decarbonization and a more secure future for New Zealand residents.

2.1.1. Economic Benefits

As energy prices outpace inflation, New Zealand's annual spending on fossil fuels hovers around 20 billion NZD, most of which the country brings in from overseas (Griffith et al., 2024). By switching to electric alternatives, families can cut their yearly bills by hundreds, or even

thousands, of dollars. *Electric Homes* notes that replacing gas/Liquefied Petroleum Gas (LPG) appliances and petrol vehicles alone can save more than 1,000 NZD per household each year, thanks to efficiency improvements and the customers' reduced exposure to volatile fossil fuel markets (Ellison et al., 2024). Meanwhile, *Investing in Tomorrow* projects that large-scale electrification could save the nation about 10.7 NZD billion per year by 2040, underscoring its significant economic advantages (Griffith et al., 2024).

2.1.2. Energy and Cost Efficiency

In addition to cutting household expenses, widespread electrification significantly increases overall energy productivity. *Investing in Tomorrow* points out that electric heat pumps, induction cooktops, and electric vehicles, especially when coupled with rooftop solar and battery storage, often deliver lower lifetime ownership costs than their fossil-fuel counterparts (Griffith et al., 2024). This efficiency advantage also improves New Zealand's trade balance by reducing the billions of dollars spent on imported coal, gas, petrol, and diesel. Meanwhile, the *Delivered Cost of Energy* demonstrates that distributed generation (such as rooftop solar) can reduce transmission losses and postpone costly infrastructure upgrades, thereby enhancing cost-effectiveness across the entire energy system (Ellison et al., 2024b).

2.1.3. Emissions

Multiple studies show that replacing fossil fuels in transportation, heating, and cooking can dramatically lower emissions (Ellison et al., 2024; Griffith et al., 2024). Relying on gas-fired water heaters and petrol vehicles locks in high carbon output for years to come. Because New Zealand's grid is largely powered by renewables, switching these systems to electricity can slash emissions by 70–90%. (Griffith et al., 2024).

2.1.4. Environmental and Public Health Benefits

Electrifying cooking and heating not only improves indoor and outdoor air quality, but these changes also curb the pollutants that worsen asthma and other respiratory issues. By

replacing gas appliances, especially in kitchens, households can significantly reduce health risks which is an important consideration for families with children or people prone to respiratory problems (Ellison et al., 2024). Beyond individual homes, curbing fossil fuel use lowers greenhouse gas emissions in neighboring communities, yielding widespread health benefits. This progress includes cutting down on particulate matter, toxic residues, and other harmful byproducts that contribute to better overall well-being.

2.1.5. Energy Security and Grid Resilience

By moving away from imported fossil fuels, New Zealand can enhance its energy security and reduce its exposure to volatile global oil and gas prices. *Investing in Tomorrow* notes that generating power locally (especially through rooftop solar paired with batteries) offers households a reliable fallback during severe weather or other grid disturbances (Griffith et al., 2024). Meanwhile, the *Delivered Cost of Energy* report indicates that widespread adoption of home-based generation relieves stress on the grid during peak demand and curtails transmission losses, ultimately improving overall system performance (Ellison et al., 2024). In times of storms or during the many earthquakes in New Zealand, this access to on-site renewable power and storage not only limits outages but also speeds recovery.

2.2. Household Appliances

To better understand the demand side of the energy sector in New Zealand, this section examines the use of appliances throughout the country. Figure 2.1 shows water and space heating’s combined usage percentage represents almost half of a typical household's total energy demand. Note that these two areas have the potential for energy and cost savings because of proven technologies that have reduced household energy requirements (Machine Count, n.d).

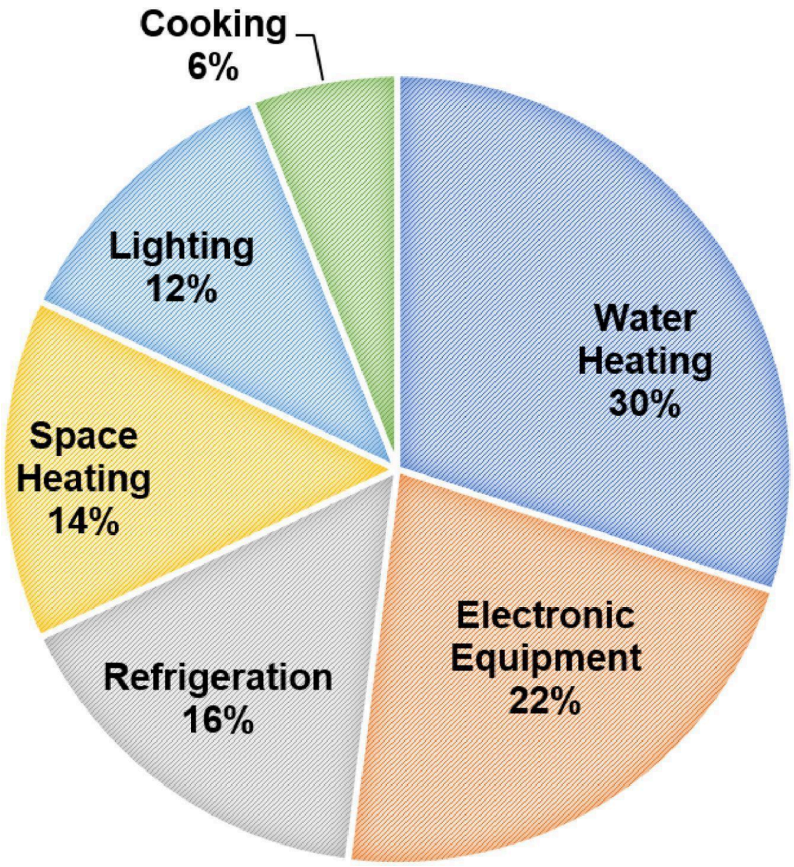

Figure 2.1: A typical New Zealand household's electricity consumption (Khan et al., 2019).

2.2.1. Space Heating Appliances

Based on sampling done by Machine Count, wood is the primary fuel source of space heaters in NZ (J. Sahng, personal communication, March 19, 2025). The sustainable alternative is ground-source heat pumps (GSHPs) (Barr & Talwar, 2025), appliances that transfer heat to or from the ground. GSHPs are one of the most energy-efficient and cost-effective ways to manage air temperature. Transitioning from air-source heat pumps to GSHPs reduces monthly running costs from 340 to 170 NZD due to their lower electricity consumption (Barr & Talwar, 2025). Additionally, installing modern building insulation can further enhance efficiency and reduce carbon emissions.

2.2.2. Water Heating Appliances

Water heating represents another 30% of household energy demand in New Zealand (see Figure 2.1). Currently, approximately 80% of NZ's water heaters are electric, with natural gas accounting for about 16% of installations. Although the water heaters are electric, the majority are electric resistance water heaters (ERWH). Replacing the ERWHs with heat pump hot water (HPHW) systems offers significant financial advantages. This transition would save the typical consumer about 600 NZD and reduce energy consumption by about 2.4 MWh per year (Armstrong, 2013).

2.3. New Zealand's Electrification Opportunity

New Zealand has great potential for complete electrification with its many renewable energy sources, dependable infrastructure, and friendly laws. Still, financial, technological, and behavioral restrictions delay the process. Houses, companies, and farms all must overcome these challenges if one is to profit from electricity. This part looks at important electrification prospects, summarizes the financial and environmental benefits, and points out the particular problems that governments, businesses, and local communities must solve to guarantee a seamless change.

2.3.1. Renewable Energy Capacity and Grid Readiness

By using mostly hydroelectric, geothermal, and wind energy sources, New Zealand produces 80% of its electricity from renewable sources (EECA, n.d.). This solid basis makes energy a low-emission, sensible option. Still, renewable energy sources are only part of the solution; the infrastructure has to be ready to meet the growing demand from extensive electrification.

Ara Ake (2024) points out that most of New Zealand's present decarbonizing efforts center on supply-side solutions meant to increase the capacity for renewable energy. Nevertheless guaranteeing a consistent power source requires a more comprehensive strategy

including demand control as well. Load management programs, time-of-use costs, consumer-level energy storage, and energy efficiency technologies help lower peak energy demand and minimize system overload. These instruments help to promote a better electrification process by minimizing wasteful energy use and increasing demand-side efficiency, therefore relieving the general burden on the system.

Reducing reliance on centralized power plants by employing distributed energy resources such as rooftop solar and battery storage technologies will provide system flexibility (Ellison et al., 2024). Utilizing smart grid technologies will enable New Zealand to increase electrification while keeping grid dependability and cost-effectiveness, hence enhancing the energy system. While electrification depends on new engagement from homes, companies, and the agricultural sector, strengthening the electrical infrastructure prepares the way for a successful path that addresses climate change.

2.3.2. Residential Sector: Cost Savings and Energy Security

Through electrification, homes throughout Aotearoa New Zealand may reduce costs and improve energy security. Especially when combined with rooftop solar and home battery storage, Griffith et al. (2024) contend that replacing electric alternatives with fossil-fuel-based appliances and cars will significantly lower national energy consumption. These savings result from better efficiency, decreased dependence on fossil fuels, and smart energy system application. Features like time-of-use pricing, which charges different rates depending on the time of day, help more evenly allocate power demand and lower peak load costs.

Though the long-term savings are great, high upfront costs discourage many homes from converting to heat pumps, induction stoves, and electric water heaters. Policymakers can help more families make the change and raise adoption rates by extending access to government incentives and funding choices. Long term, electrification guarantees more stable and safe household energy consumption and shields customers from erratic fossil fuel pricing. Smart

technology and local energy storage assist control demand and stop increasing residential electrification from taxing the grid.

Residential electrification goes beyond single homes. Widespread household adoption supports Aotearoa New Zealand's broader clean energy goals. Even so, the commercial and industrial sectors offer even greater potential for improving energy efficiency and reducing emissions.

2.3.3. Commercial and Industrial Sector: Efficiency and Competitiveness

The electrification change in New Zealand primarily depends on the proactive participation of companies and industrial activities. Reaching national decarbonizing targets relies deeply on including industrial energy consumers and industry leaders. Although New Zealand's pleasant weather lowers the desire for air conditioning and heating in many commercial buildings, especially in comparison with countries with high temperatures, industrial sectors such as manufacturing, transportation, and heavy industries nevertheless use large amounts of energy for heating. In particular, in the warmer northern areas where cooling demand is still rising, many buildings include internal heating systems that also function as air conditioning systems.

Turning from fossil fuels to electric substitutes improves global competitiveness, decreases prices, and boosts efficiency. According to the Energy Efficiency and Conservation Authority (EECA, n.d.), switching to electric alternatives for diesel-powered industrial boilers greatly reduces running expenditures and emissions. Still, electrification has difficulties including controlling peak power consumption, modernizing infrastructure, and guaranteeing grid stability. Furthermore affected by seismic dangers are rigorous construction regulations, which provide difficulties in including modern energy systems in commercial buildings.

While the current New Zealand government has indicated resistance to providing significant financial incentives for this shift, existing tax credits and energy efficiency rules help

electrification (Ara Ake, 2024). Businesses have to be proactive in creating electrification plans fit for both environmental objectives and financial reality without clear legislative direction. Beyond only saving money, electrifying industrial and commercial sectors is very important for national energy security enhancement and pollution reduction.

2.3.4. Agricultural Sector: Sustainable Energy Solutions

With about 6% of GDP and a sizable workforce, agriculture makes a considerable contribution to New Zealand's economy (Statistics New Zealand, 2024). For farm equipment, dairy processing, irrigation, and transportation requirements, the agricultural industry in New Zealand depends primarily on fossil fuel energy sources. One obvious way to lower emissions in this sector while preserving agricultural output is electrification.

The shift to electric substitutes is complicated in rural regions by the limited availability of dependable energy. Certain Māori villages among other isolated areas have varying access to power. Tracking fossil fuel-powered equipment use on farms, the Machine Count project (Ara Ake, 2024) looks for ideal locations for electrification. Identifying these locations enables the construction of sensible energy solutions that will cater to the demands of the industry.

Agricultural electrification will be supported by growing rural charging infrastructure, greater on-site renewable energy generation, and financial help for equipment modifications. Direct interaction with farmers via cooperatives, trade groups, and local networks helps to maintain electrification initiatives relevant and easily available. Data-driven suggestions will be crucial for policymakers to progress electrification, particularly because recent studies reveal the government has refrained from providing significant financial incentives for this shift (Ara Ake, 2024). Working together, farmers, technology suppliers, financial institutions, and lawmakers can create sensible energy solutions for the agricultural industry.

2.3.5. Economic and Policy Considerations

Reaching widespread electrification in Aotearoa New Zealand calls on the government to solve important problems concerning cost, infrastructure development, and fair access to power. While some laws seek to facilitate this change, lawmakers have to carefully consider present issues before choosing a sensible course of action.

Studies point to the most urgent issues: low public knowledge, large upfront expenses, and grid improvements. Reera et al. (2023) find that companies and consumers still see financial constraints as the main hurdle to embracing electrification. Emphasizing the need to invest in demand-response technology, energy storage solutions, and smart grids to keep the system dependable, Ara Ake (2024) and Griffith et al. (2024) also underline the importance of public education to raise consumer acceptability and knowledge of the long-term advantages of electrification.

2.4. Literature Review Summary

This literature review investigates the prospects, advantages, and difficulties of electrification across New Zealand's residential, commercial, industrial, and agricultural sectors. By substituting electricity for fossil fuels, especially in light of the nation's great renewable energy base, electrification presents an effective way to lower long-term energy prices, cut emissions, and enhance energy security.

Researchers highlight major financial and environmental benefits including household savings of over 1,000 NZD annually, less susceptibility to global fuel price volatility, and emissions reduction of up to 90%. Electrification boosts public health, enhances grid resilience, and helps to improve air quality as well.

Still, several obstacles impede advancement. High upfront costs, weak infrastructure, and low awareness still hamper adoption. Obstacles can come from technological limits on grid capacity, peak load demands, and old infrastructure. These issues hit the industrial and

agricultural sectors the hardest, as they require more substantial energy system changes. Policymakers, companies, communities, and homes must coordinate efforts if we are to promote electrification. New Zealand can create a cleaner, safer, and more electrified energy future by utilizing stronger financial incentives, well-defined policies, and targeted public education.

3. Methodology

This project intends to create a visual dashboard demonstrating important electrification statistics related to New Zealand. The goal of our project is to simply and effectively convey NZ's progress towards nationwide electrification, in a way that is accurate, motivational, and interesting. To achieve this goal, our key objectives include:

1. Investigate metrics that convey the benefits of electrification.
2. Research and develop a visual dashboard product to display nationwide progress in electrification.
3. Gather information concerning the effectiveness of the dashboard product as an informative resource for the New Zealand public.

Combining historical research, expert interviews, user testing, and public polls (see Figure 3.1) this study uses a mixed-methods approach. The success of the dashboard will be assessed by the project team depending on its capacity to assist customers in comprehending national electrification projects and its information display clarity. Although the team cannot promise certain results, they chose these approaches because they may help the project goals and provide valuable input within the given period.

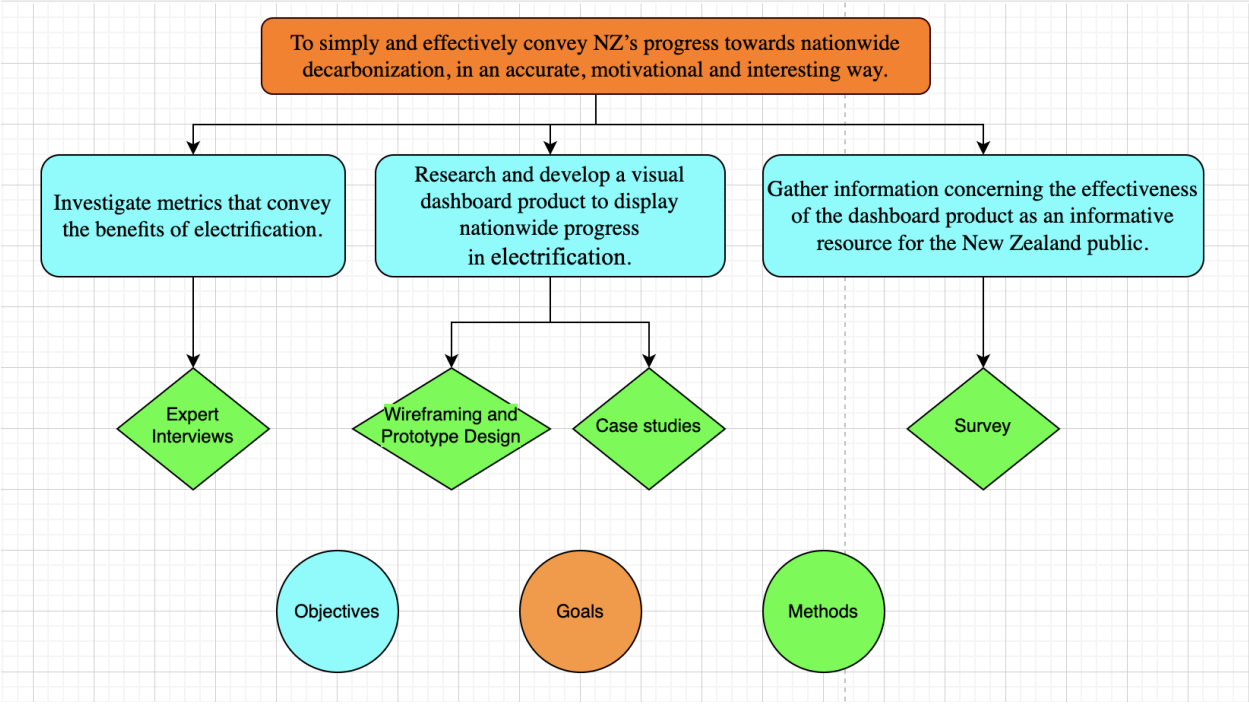

Figure 3.1: Methods flow chart

3.1. Objective 1: Investigate metrics that convey the benefits of electrification

To identify key metrics that enhance the accessibility of this information, we will begin by consulting with our sponsor. First, examining the sponsors' established metrics to gauge the benefits of electrification will guide the research, ensuring future findings build upon proven industry insights. Additionally, expert interviews will evaluate and validate the sponsors' initial metrics and confirm their alignment with broader expert perspectives on electrification.

3.1.1. Expert Interviews

Expert interviews serve three main functions: exploring the research topic and generating hypotheses, gathering data for a mixed-method design, and producing qualitative and quantitative data (Soest, 2023). To explore perceptions of the electrification transition, the project team will employ snowball sampling and collaborate with Ara Ake and Rewiring Aotearoa by interviewing their colleagues and additional experts they recommend.

Before conducting interviews, the study team will explain confidentiality procedures to participants and secure informed consent (see Appendix A). Two team members will conduct the interviews in person or via conference call, with one member asking questions and the other taking notes. With consent, the interviewers will record and transcribe each interview, and we expect each session to last approximately 45–60 minutes. The project team will structure the interviews around prepared questions while leaving room to explore additional topics and ask follow-up questions. Our team designed the questions so experts can share their insights on electrification and propose beneficial metrics (see Appendix B). The team will then analyze the transcripts thematically to highlight recurring themes. This approach will start with metrics our sponsors have established as indicators of electrification progress and then assess whether these align with broader expert perspectives via questions B.8 to B.13

3.2. Research and develop a visual dashboard product to display nationwide progress in electrification.

This objective focuses on exploring and developing a dashboard that effectively informs the public about New Zealand's electrification progress. To find best practices in data visualization, user accessibility, and general efficacy, the project team will start by reviewing a wide spectrum of currently available dashboards, including those concentrated on sustainability, environmental monitoring, energy usage, and public policy communication. Utilizing a case study approach, the team will use pertinent design principles and engage in controlled prototyping to produce a dashboard that meets the goals of the project sponsor and offers information in an understandable, easily accessible manner.

3.2.1. Case Study Analysis of Existing Dashboards

Examining a variety of current websites and dashboards that provide energy, environmental, or sustainability-related data initially helps this goal. The project team intends to investigate how various platforms present difficult facts to public audiences using this case study.

The team will approach the review without bias and let the results guide further design choices instead of presuming which strategies are most effective.

The team will examine a range of websites, potentially including government portals, charity platforms, or worldwide energy data sources, to complete this study. These sites could cover subjects including energy usage, emissions, progress toward electrification, or generation of renewable energy. The team will look at broad traits such as layout, accessibility, usability, and clarity with which every platform provides data to a wide audience.

Finding consistent strengths or flaws across several websites will help the team get useful knowledge that supports the creation of a user-friendly dashboard. One of multiple sources in the dashboard design process, this case study will also include expert interviews and user testing comments.

3.2.2. Wireframing and Prototype Design

Following the analysis of the case study and expert interview results, the project team will start the design process by building wireframes to direct the dashboard structure and layout. By use of wireframing, the team will be able to investigate numerous options for displaying information on electrification-related issues, including both performance indicators and past patterns. The team will be open to several design techniques and avoid presuming that any one way, such as gauges or real-time measurements, would sufficiently meet all communication requirements. Early testing findings and stakeholder comments will guide final design decisions.

Working with the sponsor, the team intends to select a wireframing tool; based on team experience, Canva is the most probable choice. Project time limits mean the team expects to review wireframes once with the sponsor before moving into the prototype stage.

The team will give top priority to fit with current abilities and take the platform learning curve into account while choosing web development tools and a hosting environment. Instead of concentrating just on perfect functioning, the team will evaluate which technologies might help

the dashboard evolve within a constrained period. Options may include simpler website-building tools fit for the team's capacity, AWS, Java-based frameworks, or others.

The team will provide a maintenance and upgrade guide to guarantee long-term usage as well. This application will enable the sponsor to install the dashboard on their selected platform and handle necessary future upgrades. After the project ends, the guide will encourage ongoing usage and improvement in line with the technological situation of the sponsor.

This adaptable and pragmatic approach will help to produce a prototype that, even as the project develops depending on technical restrictions and expert comments, stays instructive, accessible, and practical to build.

3.3. Gather information concerning the effectiveness of the dashboard product as a motivational instrument for the New Zealand public.

Evaluating how a public-facing dashboard informs users requires measuring factors such as usability, clarity, and perceived value—aligning with our pre- and post-survey questions. By aiming to simply and effectively convey New Zealand's decarbonization progress at the time of data collection in decarbonization, this objective helps determine whether the tool truly resonates with Wellington individuals regarding electrification.

3.3.1. User Surveys

We plan to independently recruit participants who are willing to review the dashboard and provide feedback on its usability, clarity, and informational value. Participants will complete pre- and post-surveys (see Appendix D and E), each containing targeted questions to assess the impact the dashboard has on them. By comparing responses before and after participants interact with the dashboard, we can gauge whether specific information elements (e.g., cost metrics, and emissions data) influence shifts in users' understanding and perceptions of electrification. This pre/post structure does not guarantee a direct causal effect on motivation, but it helps us measure

any observed changes in user attitudes, aligning with the factors highlighted in Electric Homes (Ellison, Thorn, Pawson, & Griffith, 2024b).

4. Conclusion

This document proposes both a methodological and practical framework for working with Ara Ake and Rewiring Aotearoa to develop a visual dashboard aimed at advancing public interest in electrification. Incorporating insights from case study analyses and expert interviews, the project team will develop a prototype that emphasizes potential factors, such as, cost savings and emissions reductions that may help users better understand and, potentially, adopt electric solutions. The dashboard development itself will involve a progression from initial wireframes through iterative feedback, culminating in an accessible prototype for our sponsors. Additionally, our plan to run pre- and post-use surveys, to assess how effectively our dashboard informs and motivates participants. In this way, we will balance technical accuracy with practical usability, laying the groundwork for a resource that can evolve alongside New Zealand's progress toward electrification.

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Appendix A: Expert Interview Consent Form

We are students from Worcester Polytechnic Institute (WPI), an engineering university in Worcester, Massachusetts, in the U.S.A. We are working with Ara Ake and Rewiring Aotearoa to research New Zealand's electrification progress. Our team plans to develop a product to inform and motivate individuals to explore the benefits and reasons for switching to electric appliances. Your taking part in this study is voluntary, and you may withdraw from the project at any time. You may choose to not answer any question, and we will skip it. **This interview should take 45 to 60 minutes.** We will keep data confidential, store it securely, and use it solely for research purposes. If you wish to remain anonymous, we will remove or anonymize personal identifiers (if used) in any published materials. There are no anticipated risks beyond a normal conversation, and the benefits include a contribution to public awareness of electrification.

If you have any questions or concerns about this research, please contact the project advisor Professor Robert Kinicki (rek@wpi.edu). If you have questions about your rights as a research participant, contact the WPI IRB Office at irb@wpi.edu.

1. Do we have you're consent to do this interview?
2. May we record the interview via audio?
3. May we use your name, or do you wish to remain anonymous?

Appendix B: Expert Interview Questions

Demographics

1. What gender do you identify with?
2. What is your highest level of education?
3. What is your job title?
4. What company/university do you work at?
5. How would you rate your level of expertise in Electrification in NZ?

State of Household Electrification

6. How would you describe NZ's state of electrification adoption today?
7. What are the biggest challenges to tracking progress in decarbonizing NZ households?

Key Metrics and Visualization

8. Which quantitative metrics do you use to judge progress in electrification and decarbonization? Why are these metrics meaningful?
9. What appliances will have the most impact if converted to electric power sources?
10. What percent of the NZ population heat their house?
11. What metrics would you use to judge the impact (Cost savings, power consumption, power type) of electrifying:
    a. Space heaters/cooling
    b. Water heaters
    c. Cooking stoves
    d. Grills
12. What metrics do you believe best convey the benefits of electrification in motivational ways?

13. Are there any existing visual solutions or other online presence that fare well in communicating progress against electrification or climate targets? Why do you believe these are effective for communicating with the public?
14. Are there any other experts you believe would have expertise that would help with our project?

Appendix C: Survey Consent Form

We are students from Worcester Polytechnic Institute (WPI), an engineering university in Worcester, Massachusetts, in the U.S.A. We are working with Ara Ake and Rewiring Aotearoa to research New Zealand's electrification progress. Our team plans to develop a product to inform and motivate individuals to explore the benefits and reasons for switching to electric appliances. Your taking part in this study is voluntary, and you may withdraw at any time. You may choose not to answer any question, and we will skip over it. **This survey should take approximately 10 to 15 minutes.** Data will be kept confidential, stored securely, and used solely for research purposes. Your personal information will remain completely anonymous. There are no anticipated risks beyond a normal conversation, and the benefits include contributing to public awareness of electrification.

If you have any questions or concerns about this research, please contact the project advisor Professor Robert Kinicki (rek@wpi.edu). If you have questions about your rights as a research participant, contact the WPI IRB Office at irb@wpi.edu.

1. May we record the interview via audio?
2. Sign name.

Appendix D: User Feedback Survey

Demographics (Pre Dashboard Testing)

1. Are you 18 or over?
    - Yes
    - No (stop the survey and politely thank the person anyway)
2. Are you currently a resident of New Zealand?
    - Yes
    - No (stop the survey and politely thank the person anyway)
3. What is your age range?
    - 18–24
    - 25–34
    - 35–44
    - 45–54
    - 55–64
    - 65+
4. What is your gender?
    - Male
    - Female
    - Non-binary / Other (Please specify): _____
5. What is your highest level of education?
    - No formal education
    - High school diploma or equivalent
    - Some college or technical training
    - Bachelor’s degree

- Master's degree or higher

6. What is your current employment status?
    - Employed full-time
    - Employed part-time
    - Self-employed
    - Unemployed
    - Student
    - Retired
7. What type of residence do you live in?
    - Apartment / Flat
    - Detached house
    - Townhouse / Semi-detached house
    - Rural / Farm property
    - Other (Please specify): _____
8. How many people live in your household?

    (Open-ended response)
9. What is/are your primary energy source(s) for home heating? (Select all that apply)
    - Electricity
    - Natural gas
    - Solar energy
    - Wood or biomass
    - Other (Please specify): _____
10. What type(s) of renewable energy sources, if any, do you currently use at home? (Select all that apply)

- Solar Panels
- Wind Energy
- Micro-hydro
- Battery Storage
- Geothermal
- Other (please specify): _____
- None

11. How informed are you about the potential cost savings that household electrification can bring?
    - Extremely informed
    - Very informed
    - Moderately informed
    - Slightly informed
    - Not at all informed
12. How informed are you about the potential reductions in local and national carbon emissions that electrification could achieve?
    - Extremely informed
    - Very informed
    - Moderately informed
    - Slightly informed
    - Not at all informed
13. As of now, how motivated are you to explore or adopt electrified solutions?
    - Extremely motivating
    - Very motivating
    - Moderately motivating

- Slightly motivating
- Not at all motivating

Appendix E: User Feedback Survey (Post Dashboard Testing)

General Experience

1. How would you rate your overall experience with the dashboard?
    - Excellent
    - Good
    - Neutral
    - Poor
    - Very Poor
2. How easy was it to navigate the dashboard?
    - Very easy
    - Somewhat easy
    - Neutral
    - Somewhat difficult
    - Very difficult
3. After reviewing our dashboard, how informed are you about the potential cost savings that household electrification can bring?
    - Extremely informed
    - Very informed
    - Moderately informed
    - Slightly informed
    - Not at all informed
4. After having looked through our dashboard, how informed are you about the potential reductions in local and national carbon emissions that electrification could achieve?

- Extremely informed
- Very informed
- Moderately informed
- Slightly informed
- Not at all informed

5. How likely are you to replace your appliances to take advantage of these benefits?
    - Extremely likely
    - Very likely
    - Moderately likely
    - Slightly likely
    - Not at all likely
6. What, if anything, was missing from the dashboard?

   (Open-ended response)

Design & Usability

7. How visually appealing is the dashboard?
    - Very appealing
    - Somewhat appealing
    - Neutral
    - Not very appealing
    - Not appealing at all
8. How would you rate the clarity of the data visualizations (graphs, charts, maps)?
    - Very clear and easy to understand
    - Somewhat clear
    - Neutral

- Somewhat confusing
- Very confusing

Content & Information

9. How informed are you about New Zealand's decarbonization efforts?
    - Extremely informed
    - Very informed
    - Moderately informed
    - Slightly informed
    - Not at all informed
10. As of now, how motivated are you to explore or adopt electrified solutions?
    - Extremely motivating
    - Very motivating
    - Moderately motivating
    - Slightly motivating
    - Not at all motivating
11. List, if any, the key metrics and/or data points missing that you expected to see.

    (Open-ended response)
12. Did you find the interactive features (filters, comparisons, custom views)

    helpful?
    - Yes, very helpful
    - Somewhat helpful
    - Neutral
    - Not very helpful
    - Not helpful at all
    - No opinion

13. What features would you like to see improved or added to the dashboard?

    (Open-ended response)

Final Thoughts

14. Do you have any additional feedback or suggestions?

Thank you very much for taking the time to evaluate our dashboard and provide us with your valuable opinion.