

Clean Heat Programmes in Otago and Southland: aspects of the demographic composition of participants

Date June 2024

Contents

Scope	2
Background.....	2
Air quality perspective	2
Energy efficiency perspective	2
Public health perspective.....	2
Agencies and timelines	3
Otago Region	3
Southland Region.....	4
Energy Efficiency and Conservation Authority	5
Outcomes	5
Otago Region	5
Southland Region.....	9
Discussion	12
Programme efficiency in burner replacements.....	12
Equity perspective	13
Concluding remarks	14
References	15

Scope

This report is focused on the description of the heater and insulation retrofits achieved in Otago and Southland regions between 2017 and 2022, and an examination of the participants' distribution by socio-economic deprivation. Evaluating the impacts of the Clean Heat programmes on air quality and health are out of scope, due to a lack of data.

Background

Air quality perspective

In 2004 The Ministry for the Environment implemented the National Environmental Standards for Air Quality (NES). These established air quality measures (PM10 concentrations and exceedances per year) and standards regarding emissions and thermal efficiency of wood burners. Some places in central Otago and Southland have particularly bad winter air quality. These locations are identified as Air Zone 1 in Otago and the Invercargill and Gore airsheds in Southland. Household heating was identified as the primary source of particulate matter in the atmosphere and programmes to facilitate replacement of non-compliant burners in these target areas was initiated by both regional councils. All programmes were restricted to homeowners.

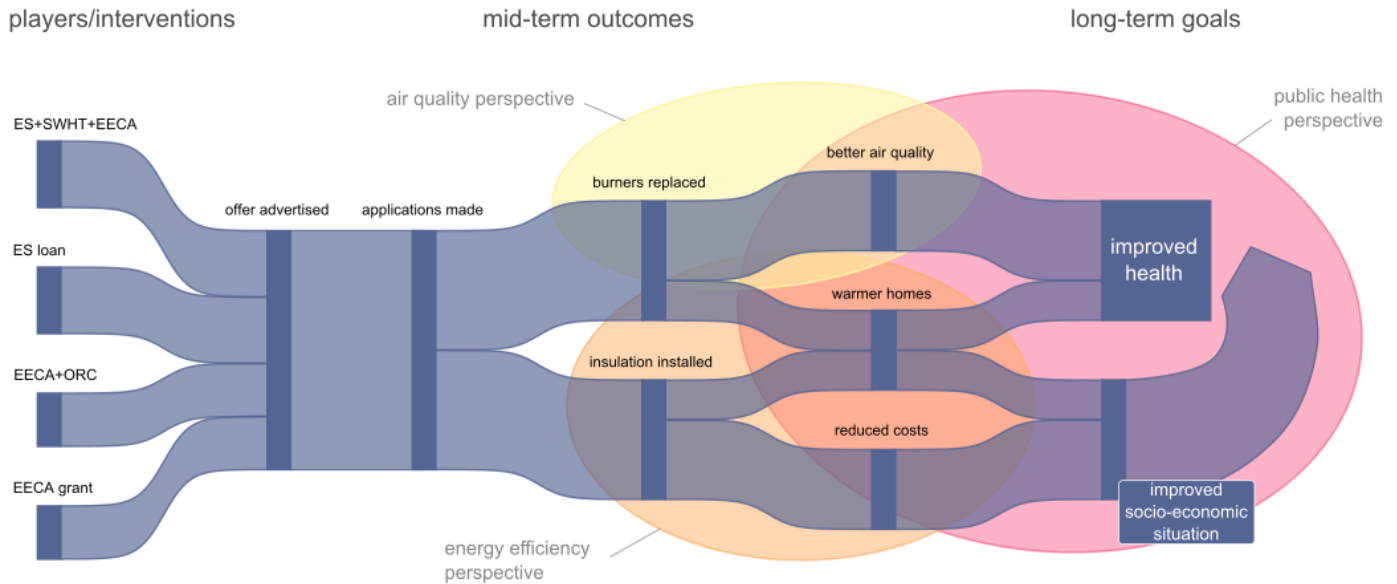
Energy efficiency perspective

The Energy Efficiency and Conservation Authority (EECA) is interested in minimising the government costs that stem from poor indoor heating. To this end, their primary focus is on assisting with insulating homes, with heater installation/replacements being a distant second. The housing stock in the Southern region is mostly older: the fraction of houses built before 2001 is ~ 66% in Otago and ~ 76% in Southland (estimated as % of total private dwellings between 2001 and 2018 census, [1]). As 2010 and 2015 studies by Building Research Association of New Zealand demonstrated [2,3], there is an undisputed need for improved insulation and heating in the many homes in Otago and Southland.

Public health perspective

The National Public Health Service is interested in evaluation of this programme because of the links between heating and insulation and health both directly (through related hospital admissions, missed days of school/work, etc.) and indirectly (through air quality). All factors in this situation act in synergy and improve outcomes for health, air quality and resource conservation.

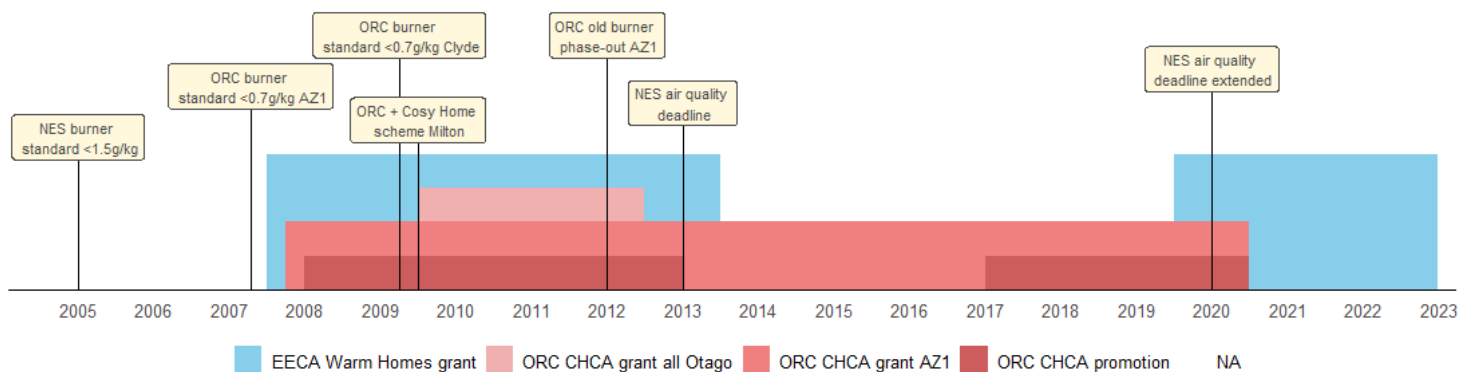
Over the years, different agencies had employed several approaches with varying success. The purpose of this report is to examine the degree of success of their efforts with the emphasis on equity. Based on the data, kindly provided by the various groups, it became possible to characterise the deprivation status of the applicants and the overall uptake of retrofit programmes.



Agencies and timelines

Otago Region

With the aim of meeting the NES, Otago Regional Council created an Air Plan which included both regulations (maximum emissions standards for newly installed wood burners, a mandate to replace all non-compliant wood-burners) and incentives (co-funded subsidy scheme to cover part of the replacement cost) in the target air zones. Originally four towns were involved: Alexandra, Arrowtown, Clyde and Cromwell. A year later Milton was added to the programme. Inclusion of Milton in particular was justified more by the relatively poor condition of the housing stock and less by air quality concerns. Since equal effort went into grants and promotions in target air zone towns and Milton, it is included as part of the target area in subsequent analysis.



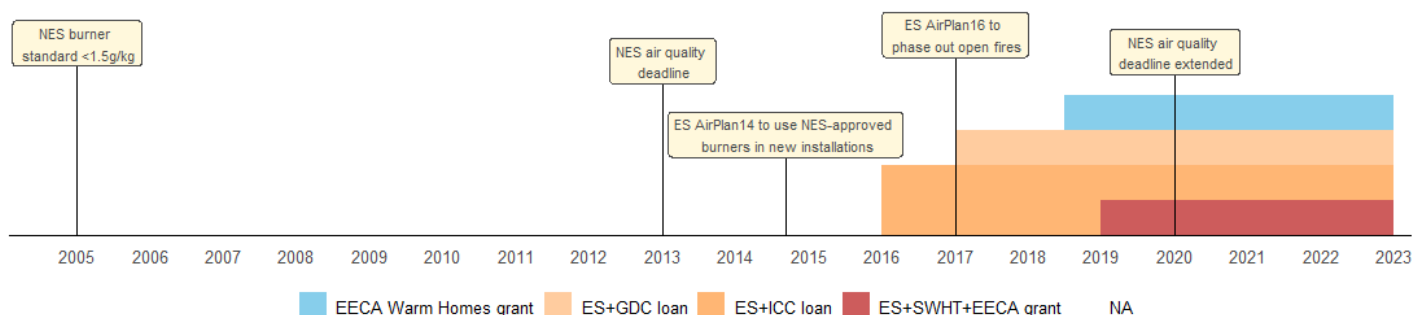
To assist homeowners (but not renters/landlords) with wood burner replacements, a subsidy scheme called Warm Homes Clean Heat project, funded in equal parts by ORC and EECA, was approved for Otago in late 2007 and applications began in 2008. To support a more equitable approach, applicants with Community Services cards (CSC) were given preference in the form of a larger subsidy sum (up to \$2,000 compared to \$1,500 for those without the card). The participants were expected to apply in response to advertising, i.e., the applicant pool was self-selected. As far as the author is aware no targeting or filtering was applied, (e.g., income, address, or deprivation score). Community Services cards were used as a way of distinguishing homeowners in greater need of support.

It needs to be emphasised that the primary purpose of the programme was to quickly improve air quality, not to assist areas or people in conditions of great socioeconomic deprivation. This explains why grants were provided even to the inhabitants of Arrowtown, which had no meshblocks scoring above 5 on NZDep2013 index, and an average New Zealand Index of Multiple Deprivation 2018 (IMD18) of 1, the lowest possible deprivation score.

In parallel with the ORC-based project, EECA has been working in the region, offering support with insulation and heater installations. There is no data on the EECA-only timeline in the Otago region, but based on the database published by EECA, the bulk of its activities were focused on insulation installations in wider Otago.

Southland Region

The same air quality rationale is underpinning the burner replacement programmes initiated by Environment Southland (ES). According to the 2014 ES Regional Air Plan, starting from September 6, 2014 a NES-approved burner has been required when installing a new burner or replacing an existing burner or fireplace within the Invercargill airshed. Non-approved burners/boilers were expected to be phased out from January 1, 2016 to January 1, 2029. Thus, in 2016 the first loan programme, co-funded by ES and Invercargill city council was initiated for the houses in the Invercargill airshed. In 2017 a similar programme, co-funded by ES and Gore district council, was initiated in Gore airshed.



The conditions of the loan were as follows: anybody who lives in the targeted airshed and is an ICC/GDC ratepayer can apply for help with replacing an open fire, old wood burner or multi-fuel burner. The loan amount is capped at \$5,000 over five years at a rate of 3.95%. The loan can be used to replace a current non-compliant heating source with a compliant

wood burner, pellet burner or approved heat pump and/or to upgrade insulation. Loan administration (and most of promotion) is done by local instead of the regional councils. The same principles of (1) self-selection of the applicants and (2) no targeting or filtering based on income or deprivation status were applied in Southland, as in Otago.

In 2019 Awarua Synergy, the local service provider, partnered with EECA in taking up insulation and heater installations in the Southland region. Southern Warm Homes Trust (SWHT) and Environment Southland joined the grant programme as co-funders (contributing 10% and 5% of the cost respectively).

Energy Efficiency and Conservation Authority

EECA has a different approach to the matter, with the focus on providing warmer homes. There is a strong focus on insulation, but heater replacements are also supported. EECA support of heater replacements ran until 2014, when it was stopped, and after July 2018, when it was restarted.

EECA specifically targets low-income households (either as CSC-holders or by a deprivation score of the area). Their support scheme is a grant of up to \$3,000 towards heater installation and/or insulation and the application process is very straightforward, which is particularly good for their purpose of involving the targeted demographics. There are no air quality-based areas of interest for EECA in either Otago or Southland. Note that currently EECA-only grants do not support replacements of non-compliant wood burners, only the new installations in the homes which previously lacked any fixed heaters.

Outcomes

Otago Region

In the course of the ORC-EECA co-funded programme, a total of 3,169 unique applications were submitted, 1116 were for insulation only, the rest included a heater replacement. In total, 2,380 applications were successful and resulted in an installation. Of the 789 unsuccessful applications, this report identified 149 applicants who succeeded on their next attempt, usually one or more years later.

For context, the EECA-only scheme in Otago registered 16,616 retrofit applications. Ten percent of applications overlapped between ORC-supported cases (1,606) and were excluded from subsequent analysis to ensure the same installation would not be counted twice. Nevertheless, more overlaps, duplicates and errors are possible in the data. Unfortunately, the time frame of EECA-only retrofits is unknown, as well as the outcome of the applications.

The numbers of successful applications implemented in the Otago region, grouped by funding scheme and application type, are as follows:

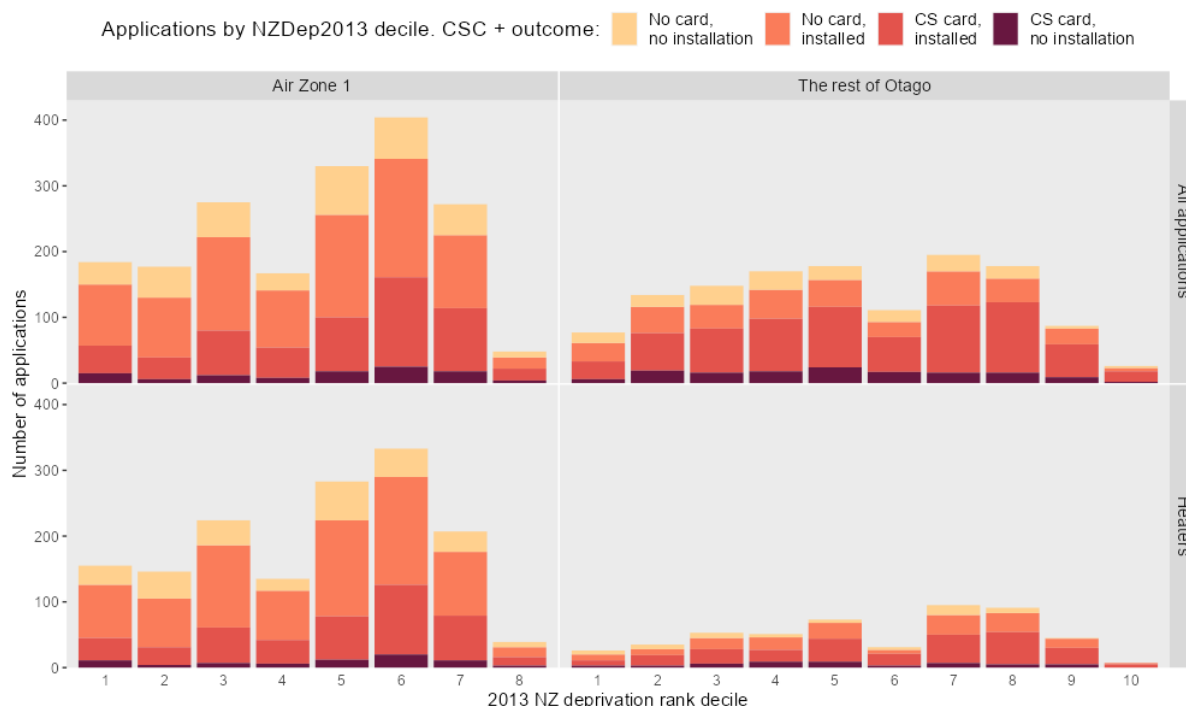
Funding source / Installation type	Air Zone 1 + Milton	The rest of Otago	Regional totals
ORC+EECA / Heater	1,183	398	1,581
ORC+EECA / Insulation	217	582	799
EECA only / Heater	93	1,346	1,439
EECA only / Insulation	586	13,217	13,803

The following alluvial graph illustrates the same information in the flow form. Blue corresponds to applications that involved heater replacement. The bulk of EECA-sponsored installations were for insulation only and occurred around Otago. The percentage of heater replacements did not differ much between targeted area of interest (14%, 93 replacements) and the rest of the region (9%, 1,346). By contrast replacements co-funded by ORC were mostly done in the target area (59%) and mostly involved heaters (84% in the target area, 66% in total).



ORC-supported applications originated mostly from the areas of interest, but the rest of the region is widely represented too, although typically with just one or two applications per town or settlement.

Not all applications were successful: for some the quote was drawn but expired, others were cancelled or left unfinished. To estimate the equity aspect of applications and their outcomes, two metrics were used: (1) the presence or absence of community services card (CSC) and (2) the meshblock-level NZDep2013 score [4] of the application address. Figures below depict only ORC-supported applications.



Towns in the target air zone (i.e., Alexandra, Arrowtown, Clyde and Cromwell) have no areas with a deprivation score above 8. About 1/3 of all applications made in that area came from CS card holders (628 out of 1,859), and of those, 83% resulted in successful installation. A similar pattern held for a subset of applications which included the heater (i.e., not for insulation-only): 1/3 of such applications were made by card-holders (479 out of 1,524) and 85% of those resulted in a heater replacement. The percentage of successful installations for applicants without a CS card was lower: 60 to 70% in the target air zone and across Otago. Since the reasons for an unsuccessful installation were primarily the expiry of a quote and a cancellation of the application, rather than rejections per se, the higher rate of success for cardholders probably reflected their greater motivation to obtain financial assistance.

In accordance with a complex timeline of the project, there was a considerable year-to-year variability in the number of applications and resulting installations across Otago. The figure below illustrates the number of successful heater replacements in the corresponding year.

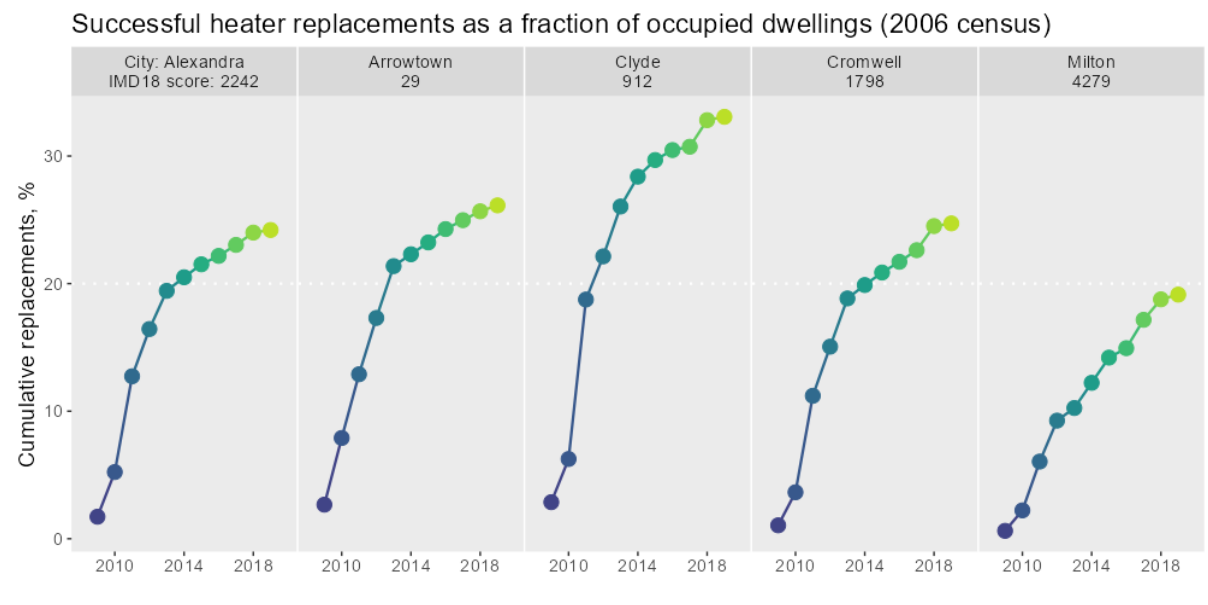
88 (6%)	181 (11%)	382 (24%)	345 (22%)	265 (17%)	69 (4%)	64 (4%)	44 (3%)	55 (3%)	73 (5%)	15 (1%)
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019

The greatest number of replacements occurred in the years 2010 (11%), 2011 (24%), 2012 (22%) and 2013 (17% of the total number). In the following years replacements had slowed dramatically, most likely in response to a pause in the EECA-funded heater replacement support.

The number of privately occupied dwellings in each town may serve as an approximate measure of the total pool of non-compliant wood burners that had to be replaced and thus allow a transition from raw replacement counts to a more meaningful metric. NESAQ wood-

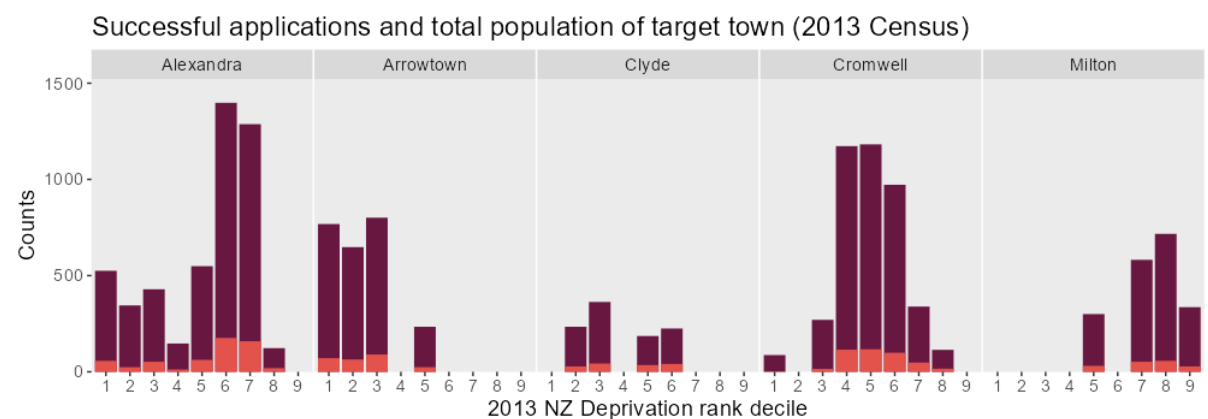
burner emission and energy-efficiency standards were issued in 2005. Thus, at the highest level of approximation, all burners predating that standard may be assumed non-compliant, and all burners installed later – to be compliant. While this is an oversimplification, since not all dwellings have a fixed heater [3], it provides a starting point and a uniform metric to use for comparisons across different areas. Dwelling counts of the 2006 census are closest in time to the introduction of the NESAQ standard and are used for this purpose throughout this report.

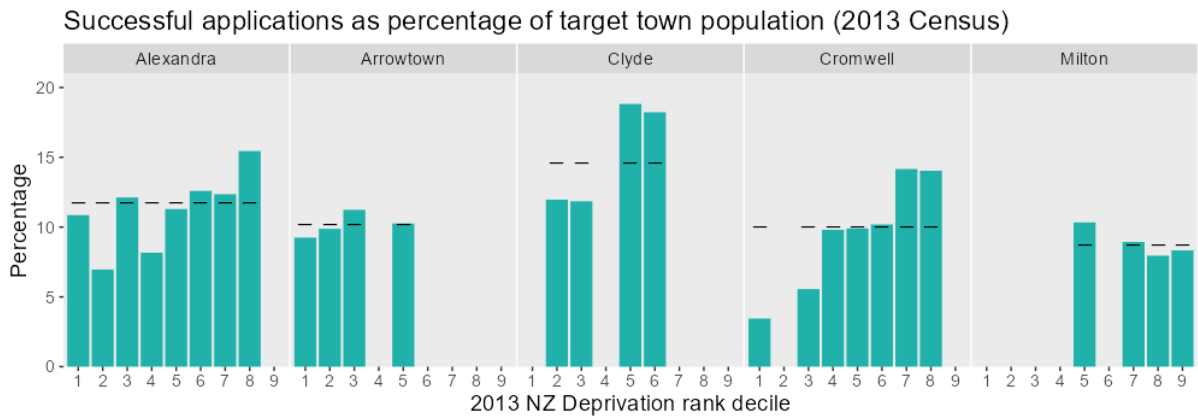
The figure below illustrates successful wood-burner replacements, expressed as percentage of private occupied dwellings in each of the towns in the target area (towns of the air zone + Milton).



The X axis represents years (also coloured), and the curves are cumulative. In towns of the air zone the total cumulative replacements levels were at 25-30%, with Milton not far behind, reaching just below 20%.

From an equity perspective, Arrowtown scores relatively low on the deprivation scale, whereas other airzone towns have a more varied composition. The distribution of successful subsidy applications closely reflects the overall demographic composition in each of the target towns, with areas of higher deprivation represented either equally or slightly better than areas of low deprivation.





Black horizontal dashes represent the average percentage of applications from the whole town population, irrespective of the deprivation status [data from 5], and serve as an expected value for the subsequent comparisons by deprivation. None of the Kolmogorov-Smirnov tests of the observed vs expected application percentages, performed for each town, returned p-values below 0.05, therefore the differences were not statistically significant. However, Cromwell came closest to significance with $p = 0.07$.

Financial contribution of the ORC ranged from 90,000 to 634,000 NZD per financial year, with a yearly average of 225,000 NZD.

Southland Region

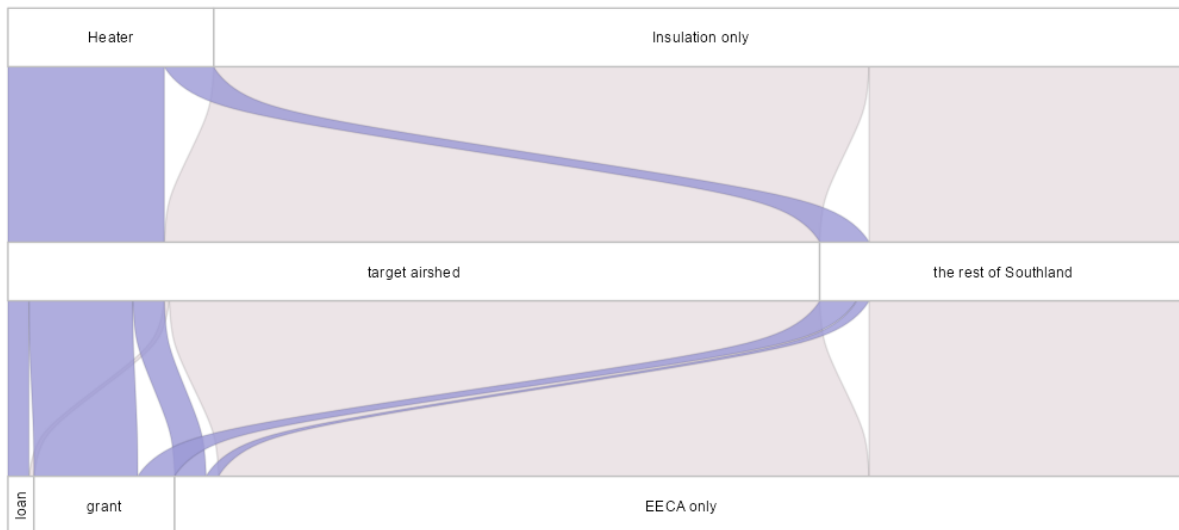
Since 2016 a total of 1,224 successful applications were submitted to ES-sponsored programmes, 1,034 were for ES-SWHT-EECA support, the rest (190) were for ES-ICC/GDC loan.

EECA-only scheme in Southland registered 8,410 retrofit applications. Almost all applications sent to the ES-SWHT-EECA project (1,014) were also present in the EECA dataset, and thus were excluded from subsequent analysis to ensure the same installation was not counted twice. Nevertheless, more overlaps, duplicates and errors are possible in the data. Unfortunately, the time frame of EECA-only retrofits is unknown, as well as the outcome of the applications.

The numbers of successful applications implemented in the Southland region, grouped by funding scheme and application type, are as follows:

Funding source / Installation type	Invercargill/Gore Airshed	The rest of Southland	Regional totals
ES+ grant / Heater	759	269	1028
ES+ grant / Insulation	Unknown	Unknown	Unknown
ES+ loan / Heater	154	NA	154
ES+ loan / Insulation	36	NA	36
EECA only / Heater	230	92	322
EECA only / Insulation	4,751	2,323	7,074

The alluvial graph below illustrates the same information in the flow form. Blue corresponds to applications that involved a heater replacement. The bulk of installations in the region were for insulation only. Based on available data, the percentage of heater replacements was somewhat higher in the targeted airshed (19%, 1,143 replacements) compared to the rest of the region (13%, 361). Replacements funded by council loans were only done in the target area and mostly included heaters (81%).



In Southland, too, not all applications were successful. However, the reasons for lack of installation and sometimes even the number of unsuccessful applications are unknown, as well as the Community Services status of the applicants and in some cases their addresses. To estimate the equity aspect of applications, only one metric, i.e., the index of multiple deprivation (IMD18, [6]) decile of the area (datazone) where application originated from, was available. Locations in the target air zone (i.e., Invercargill and Gore) are socioeconomically diverse, with neighbourhoods scoring from 1 to 10 on deprivation scale.

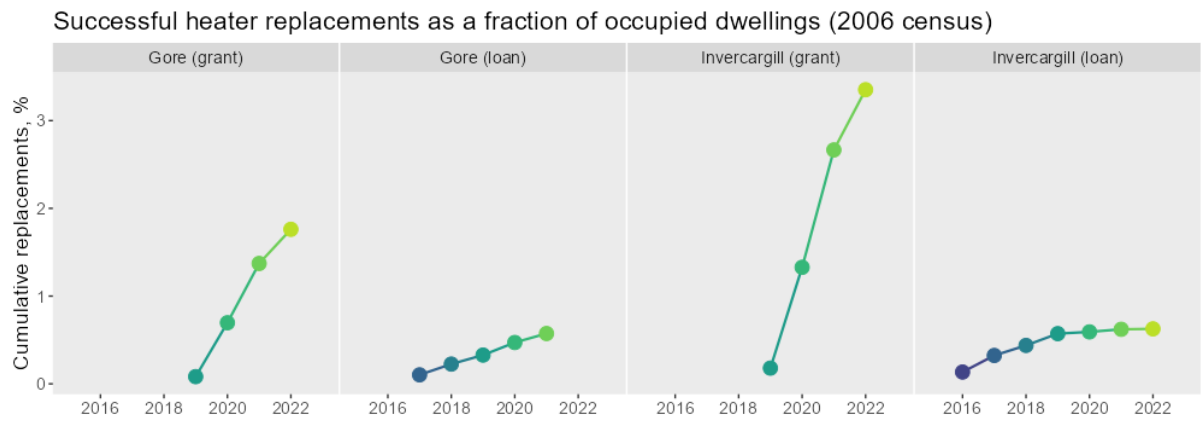
In accordance with a complex timeline of the project, there was a considerable year-to-year variation in the number of heater replacements across Southland:

				60 (6%)	328 (32%)	423 (41%)	223 (22%)	grant
	27 (18%)	43 (28%)	29 (19%)	32 (21%)	11 (7%)	11 (7%)	1 (1%)	loan
	2016	2017	2018	2019	2020	2021	2022	

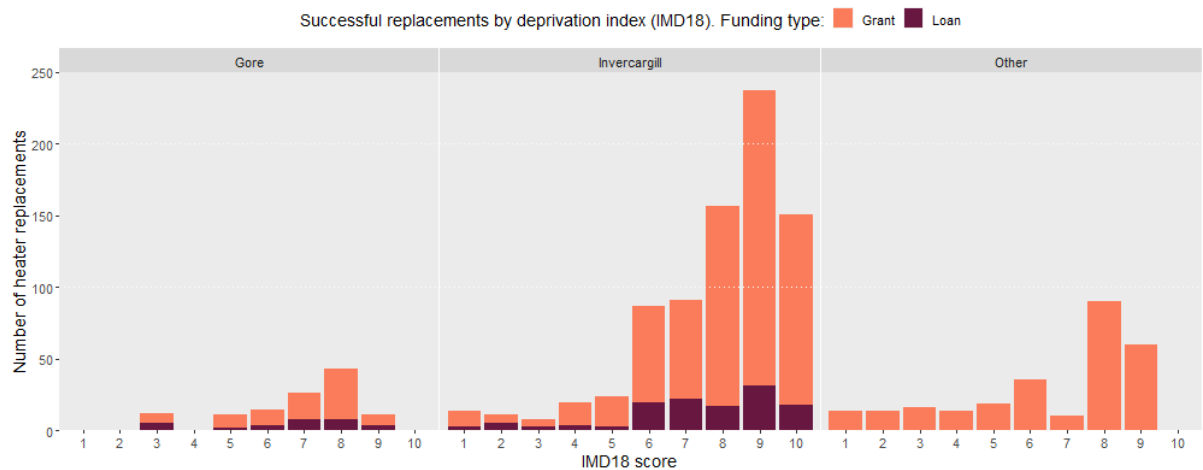
The greatest number of replacements supported by the ES+SWHT+EECA scheme occurred in the years 2020 and 2021, despite complications due to COVID-19, and data for 2022 is incomplete (up to September). The majority of loan-supported replacements occurred between 2016 and 2019. Although currently the loan is unavailable due to change in legislation, the loan-supported replacements slowed down before that, in 2020.

Although the earliest heater replacement project started in 2016, the number of private occupied dwellings as counted by 2006 census in each location serves as an approximate

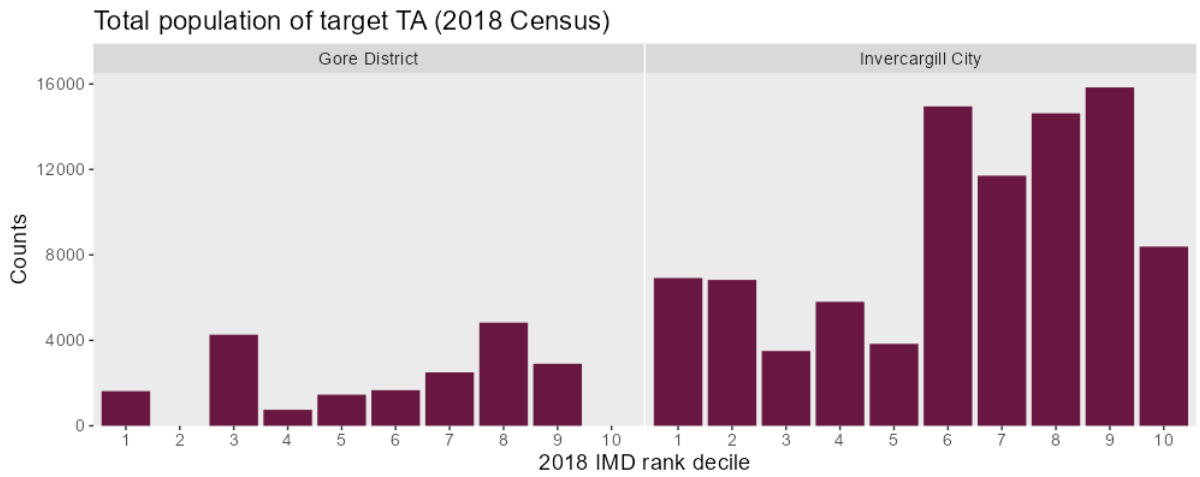
measure of the total pool of non-compliant wood burners that had to be replaced. The same reasoning applies here as in the case of Otago. The figure below illustrates successful wood-burner replacements, expressed as percentage of private occupied dwellings in Invercargill and Gore. The X axis represents years (also coloured), and the curves are cumulative.



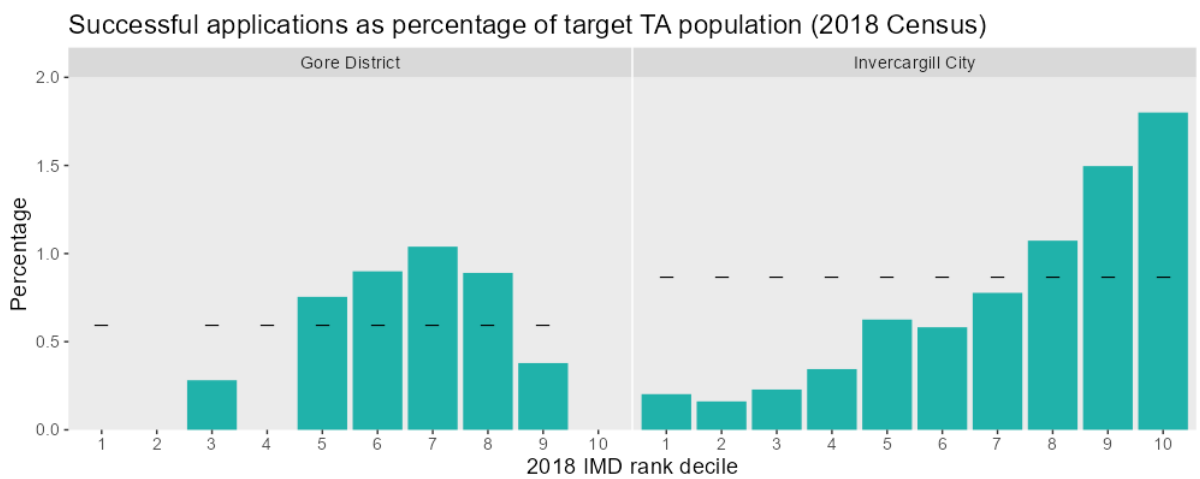
The total cumulative replacements funded by the loan were below 1%, by ES+SWHT+EECA grant just under 2% for Gore, and over 3% for Invercargill. From an equity perspective, both loans and grant-funded applications came predominantly from the areas scoring high on deprivation scale.



This broadly reflects the overall demographic composition of both target areas (applications not plotted as they are not visible at this scale):



Notably, however, the successful applications expressed as percentage of population in the corresponding IMD18 datazones show that areas of high deprivation are over-represented.



Black horizontal dashes represent average percentage of applications from the TA population [data from 1], irrespective of the deprivation status, and serve as an expected value for the subsequent comparisons. A Kolmogorov-Smirnov test of the observed vs expected application percentages returned a statistically significant difference for Invercargill (p-value of 0.003), but not for Gore.

Discussion

Programme efficiency in burner replacements

In Otago the targeted area of interest comprises only 8% of the population (17,200) and occupied dwellings (5,454) of the entire region (225,200 and 75,234 respectively). The outcome of the programme shows that the relevant towns were successfully targeted, and

heater replacements in particular were very successful, covering 22% of occupied dwellings in the area of interest.

In Southland the demographic situation is very different, with 68% of the population and occupied dwellings concentrated in the targeted airsheds (66,600 of 97,500 and 24,889 of 34,802 respectively). Under the ES and ICC/GDC loan scheme, only 154 heaters, i.e., 0.6% of occupied dwellings (as of 2006 census) were replaced. Grants funded exclusively by EECA, taken together with grants co-funded by ES, Southern Warm Homes Trust and EECA performed much better, but still they made only a 4% dent in the number of occupied dwellings.

Presumably, it is much easier for ORC to focus its financial resources on a small area of interest (8% of occupied dwellings), whereas Environment Southland has a larger target to cover (68% of occupied dwellings, 8 times larger in relative terms). Estimated as a fraction of regional totals rather than the targeted areas, the ORC funding scheme provided replacements to 2.1% of the region's dwellings compared with the ES + SWHT + EECA grant scheme, which retrofitted just under 4% of the region's occupied dwellings, a fraction twice as large as Otago's. However, in terms of financial contribution, ORC subsidised 50% of the costs, whereas ES contributed only 5% to the grant scheme.

Overall, Otago Regional Council achieved a high rate of success in targeting the area of interest and effecting burner replacements there, likely through a combination of regulations and incentives, promotion, partnership with EECA and a very significant financial contribution. Interestingly, EECA datasets from both regions clearly demonstrate the organisation's priority in installing insulation rather than heaters: region-wide numbers of installed insulation as a percentage of occupied dwellings (2006 census) reach 18% in Otago and 20% in Southland.

Equity perspective

At the outset of the heater replacement programmes, the importance of equity relative to other priorities differed for different agencies. The Otago Regional Council scheme in the targeted air zone, as well as the Southland Regional Council loan scheme, are focused on air quality. In the case of the Otago Regional Council scheme, additional provision was made, in the form of a larger subsidy, to the holders of community services cards. The other agencies, namely EECA overall and SWHT and Awarua Synergy in Southland, were focused on assisting those in greatest need. Southland Regional Council approached their priorities flexibly, splitting their support into mostly air quality-driven and mostly deprivation-driven replacement programmes.

The outcomes of these programmes reflect these priorities. Within Otago, the applications from the targeted air zone had a modal NZDep2013 decile of 6 (IMD18 decile of 1), whereas in the rest of the region the modal NZDep2013 and IMD18 decile was 7/8 (both covered by ORC+EECA programme). In the targeted towns the percentage of applications relative to the town population varied between 9 and 15%, with distribution between meshblocks with different NZDep2013 scores broadly reflecting their population size. A slight trend among applications for overrepresentation of areas with higher deprivation may be consistent with a relatively poorer condition of the housing there.

In Southland, the modal IMD18 decile for both loan and grant applications equalled 9. In Invercargill in particular, the areas of higher deprivation were overrepresented among successful heater retrofits. Even though this positive trend may stem from poor condition of the housing stock in the more deprived areas, it also reflected the accessibility of the Southland granting programmes.

Concluding remarks

The scope of this report was limited to an analysis of uptake by socio-economic deprivation due to a lack of available data. NPHS, Southern would welcome involvement in the early planning phase of any future related programmes, so that data requirements for a potentially broader evaluation scope can be discussed (e.g., equity of access by ethnicity and health status; and health and air quality outcomes).

Given the relatively poor state of the existing housing stock and the great role housing plays in determining health, an ongoing effort is required to bring the living conditions of all the citizens up to a healthy standard. From this, as well as an energy conservation point of view, all assistance rendered for heater replacements and insulation is of great value.

There is one significant, albeit unavoidable, limitation in the scope of all programmes discussed above, i.e., that they are only available to homeowners. There is an undisputed need for improved insulation and heating in the owner-occupied homes in Otago and Southland. However, studies by Building Research Association of New Zealand demonstrated that more rental properties suffer from poor conditions, including inadequate or missing insulation and heating, relative to owner-occupied homes [2,7].

In terms of programme organisation, the ORC experience showed that a complex approach of regulations and incentives, targeting, and significant financial contribution can provide quick and dramatic change in the number of accomplished retrofits.

The use of the Community Services card as a threshold for greater support in the Otago granting scheme, appears to be an easy-to-implement, equity-enhancing step, potentially beneficial for the future programmes in both Otago and Southland. In both regions, however, the primary method for participants to join was through self-selection. For future programmes involving retrofits, alternative approaches are possible, e.g., specific households may be detected and either invited to apply or directly assisted with insulation and heater installations.

References

1. Stats NZ (2020). 2018 Census Dwelling total New Zealand by Statistical Area 1. Stats NZ, Wellington, NZ. <https://datafinder.stats.govt.nz/layer/104628-2018-census-dwelling-total-new-zealand-by-statistical-area-1/>
2. Buckett, N., Jones, M. & Marston, N. (2012). BRANZ House Condition Survey 2010: Condition comparison by tenure. BRANZ Study Report SR264. BRANZ Ltd. <https://www.branz.co.nz/pubs/research-reports/sr264/>
3. White, V. & Jones, M. (2017). Warm, dry, healthy? Insights from the 2015 House Condition Survey on insulation, ventilation, heating and mould in New Zealand houses. BRANZ Study Report SR372. BRANZ Ltd. <https://www.branz.co.nz/pubs/research-reports/sr372/>
4. Atkinson, J., Salmond, C., & Crampton, P. (2014). NZDep2013 index of deprivation. *Wellington: Department of Public Health, University of Otago.*
5. Stats NZ (2018). Population by meshblock (2013 Census). Stats NZ, Wellington, NZ. <https://datafinder.stats.govt.nz/layer/8437-population-by-meshblock-2013-census/>
6. Exeter, D. J., Zhao, J., Crengle, S., Lee, A., & Browne, M. (2017). The New Zealand Indices of Multiple Deprivation (IMD): A new suite of indicators for social and health research in Aotearoa, New Zealand. *PloS one*, 12(8), e0181260.
7. White, V., Jones, M., Cowan V. & Chun, S. (2017). BRANZ 2015 House Condition Survey: Comparison of house condition by tenure. BRANZ Study Report SR370. BRANZ Ltd. <https://www.branz.co.nz/pubs/research-reports/sr370/>