Mandatory insulation requirements for rental properties

A review of the cost benefit analysis

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tailrisk economics
te maha hoki o nga pihikete

About Tailrisk Economics

Tailrisk Economics is a Wellington economics consultancy. It specialises in the economics of low probability, high impact events including financial crises and natural disasters. Tailrisk Economics also provides consulting services on:

- The economics of financial regulation
- Advanced capital adequacy modelling
- Stress testing for large and small financial institutions
- Regulatory compliance for financial institutions
- General economics.

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Introduction

In July 2015 the Minister of Housing, Nick Smith, announced a package of requirements for residential tenancies that included the retrofitting of ceiling and under floor insulation over the next four years.

The Minister explained, *"The Government is proceeding with the insulation and smoke alarm requirements because they are practical and deliver benefits far in excess of the costs. The insulation retrofitting is expected to cost $600 million, with benefits of $2.10 for each dollar of this cost. …. The health benefits of this will be reduced hospitalisations from circulatory and respiratory illnesses, reduced pharmaceutical costs, and fewer days off work and school."*

Officials estimated that the flow-on effect on rents for a property requiring ceiling and underfloor insulation and a new smoke alarm to be $3.20 per week.

The purpose of this report is to review the analysis that underpinned the favorable cost benefit results reported by the Minister. Where there are errors or weakness is the analysis we have made our own estimates of the benefits, recalculated the total benefit figure to generate a new benefit cost ratio.

Key findings

1. There were a number of weaknesses in the analysis underpinning the cost-benefit calculation. The most serious was a calculation error in the key supporting study. The annual benefit of insulation was accidentally converted into a present value twice, massively increasing measured benefits.

2. After correcting for this major error and taking a more realistic view of the benefit estimates in other studies, the net benefits of $630 million disappear. The $600 million insulation investment will probably generate benefits of closer to $170 million, for an economic loss of $430 million.

3. The benefits are 28 cents for each dollar spent on insulation not $2.10.

4. There is little robust evidence that the insulation requirements will materially improve health outcomes.

5. The economic loss will tend to fall on tenants who will face higher rents. This loss could be substantially reduced by dropping the underfloor insulation requirement.

Cost-benefit analysis evaluation

The Ministry of Business Innovation and Employment (MBIE) regulatory impact statement for the insulation proposals stated that the ratio of benefits to costs was $2.10 but did not provide appropriate detail on how that figure was calculated. We have assumed that the cost- benefit analysis was largely based on a Sapere Research Group paper commissioned by MBIE that analysed the effects of possible regulatory changes.

The authors of the Sapere paper drew on previous research.

1. Findings from the evaluation of the "Warm Up New Zealand Heat Smart Programme". This found:
   - An annual gain from a reduction in mortality of $439.95 per treated household.
   - A reduction in hospitalisation costs valued at $64.44 per treated household.
   - A reduction in pharmaceutical costs of $11.04 per year per treated household.

2. Findings from trials undertaken as part of the housing and health research at the University of Otago. Additional benefits, in the form of fewer days off school and reduced medical visits, were valued at $95.49 per household per year.

Review of the cited studies

Warm up New Zealand evaluation

The "Warm Up New Zealand Heat Smart Programme" evaluation was based on two related papers.
(a) "The impact of retrofitted insulation and new heaters on health service utilisation and costs, pharmaceutical costs and mortality" Barnard et. al (2011) and;
(b) "Cost-benefit analysis of the Warm-Up New Zealand: Heat Smart Programme" Grimes et al. (2012). This drew on the inputs from the Barnard study.

For our purposes only the first of these is relevant as the cost benefit assumptions appears to differ in some respects from the Ministry's analysis.

The Barnard paper reports on a study that compared health outcomes for the occupants of around 30,000 dwellings that were insulated under the Warm-Up New Zealand: Heat Smart Programme, with dwellings that were not treated to assess the following health and other benefits:

- Reduced mortality
- Lower hospitalisation costs
- Lower pharmaceutical costs
- Other health related costs.

Lower mortality benefits

To assess the impact of insulation on mortality the study used a sub-cohort of the study population, comprised of those aged 65+ who had been hospitalised before the date the house was insulated, and a control group living in houses that were not insulated. The reason for selecting the 65+/hospitalised group (rather than something closer to the population of people who had insulated their homes) was that the health status of treatment and control groups would be more similar.

Data was presented for three subgroups:

- All people hospitalised: It was found that there was a five percent reduction in the mortality rate where the houses were insulated, but that this result was not, statistically, significantly different to the mortality rate when no insulation was installed.

- People admitted for circulatory disease: This group had a lower death rate after their houses were insulated. The reduction in mortality (27 percent) was reported as statistically significant at the 95 percent confidence level.

- People admitted with respiratory diseases: The death rate was actually higher than for the control group but the difference was not statistically significant.

The estimate of lives saved was based solely on the number of lives saved in the second group.

The calculation of the value of the lives saved involved the following steps:

- Calculate the percentage of treated households that had an over 65 member who had been to hospital with a circulatory illness prior to treatment. This was 2.8 percent.

- Calculate the lives saved per year per 1000 households as follows:

  *0.028 (no. of individuals) * (112.7/1000) (control group mortality rate) *0.27 (27% reduction in mortality) = 0.852 deaths avoided*

- Calculate the value of the life saving per household assuming the value of a life year is $150,000.

This generates an average annual savings per household of $127.6.

There are a number of issues with the mortality impact results.

1. The wrong annual benefit figure was used in subsequent cost benefit analyses

Once the annual value of the mortality reduction was calculated, the present value for vulnerable occupants, assuming a life expectancy of five years was calculated. This figure was $440. Inexplicably, this present value figure was said to be the **annual value** of life saved in the cost benefit study when the annual figure had already been calculated as $127.92.

"If we estimate that a person who does not die as a result of receiving treatment lives for half as long as they would otherwise (conservatively five years) then we will end up with

*the following on-**going annual saving** per dwelling (discounted at 5%)"*

*$439.95 = $63.96 +sum (n=4, n=1) ($127.92)/((1+.05)^n)*0.85*

In the cost-benefit paper (Grimes et al. 2012) the present value figure of $440 per household was picked up as an annual value and used to calculate the present value of life saved was calculated over 30 years. The same error is made in the Sapere cost-benefit analysis. The effect of this error was to overstate the mortality reduction benefits by a factor of 3.44.

2. Renter demographics

The Sapere study implicitly assumes that the renters will have the same risk factors as the Barnard study. This is not correct. Data from the 2013 census show that the proportion of renters in the potentially vulnerable 65+ age group is 12 percent. The proportion in privately rented dwelling would be lower than this because a higher share of Housing Corporation tenants are elderly. As the percentage of older private renters is lower than the insulation study group this will mean that the average mortality benefit per household would be lower.

3. Wider impact on mortality ignored

The possibly more significant mortality result, that there was little impact on the death rates of all 65+ occupants, who had been previously hospitalised was ignored. It could have been concluded on this evidence that there was no mortality effect, or the number of lives saved to be used in the analysis was nine not the 18 derived from the circulatory illness data. By focusing on the illness subgroups there is a risk of picking up spurious relationships. There are a large number of illness categories and there is always a chance that at least one, by chance, will pass the 95 percent confidence level test.

4. Possible selection bias

The results could have been biased by other characteristics of the group that chose to install insulation and those that didn't. People inclined to insulate their houses may also be better inclined to look after themselves and have a better chance of subsequent survival. There is an attempt to control for this factor by matching the deprivation index characteristics of the treatment and control groups but for a number of reasons it will not be fully effective.

Correcting for the calculation error and applying a 50 percent reduction to the annual savings figure to adjust for points 2, 3 and 4 gives a benefit per household per year of **$63.96.**

Lower hospitalisation costs

The impact of hospitalisation costs was calculated by comparing the difference between each treatment groups' household monthly hospitalisation costs and the mean of its matched control group household monthly hospitalisation costs both before and after the insulation installation.

The results were odd. The total costs savings per household were $5.37 per month but the average monthly savings for circulatory, respiratory and asthma treatment costs were $5.62, $8.24 and $8.96 respectively. The circulatory and respiratory figures should have summed to around the $5.37 figure. This anomaly was noted but was put down as most likely being caused by variability or noise from hospitalisation types unlikely to be affected by improved insulation. It was concluded that the $5.37 figure was a conservative estimate of total savings.

We think that the odd results could possibly reflect issues with the hospitalisation cost data. There are two factors that could explain the lower hospitalisation costs. Treatment households could have a lower hospitalisation rate or the cost per treatment could be lower. It is not the first factor because that was independently tested. Treatment households actually had slightly higher hospitalisation rates.

The second explanation seems implausible but there no information on hospitalisation cost data (comparing the average cost for the treatment and control groups) that would allow a sense test of the results. There is no mention, as far as we could make out, in the document of any source for the cost of treatment data.

To illustrate the possibility of problems with the cost data we looked at the savings on asthma hospitalisations. At an average per month $8.96 per household for the entire insulation treatment group the annual savings come to $3.1 million. But the hospitalisation rate for asthma is only 1.8 per 1000 per year, so there were only 190 hospitalisations in the treatment group. Assuming that there was no difference in the hospitalisation rates between the treatment and control group, the $3.1 million savings must be explained by a difference in the average cost of treatment of $16,100. This looks to be highly implausible. The average cost of treatment in New Zealand hospitals is around $5,000.

As the study shows that insulation has no impact on hospitalisation rates, and the hospitalisation cost data appears to be problematic, we have not assigned any cost savings benefit for hospitalisations.

Pharmaceutical cost savings

The analysis shows an average annual savings of $11 per year per household. We do not have an issue with this result.

Other benefits imputed from other studies

The source of these benefits is a study reported in Chapman et al. "Effect of insulating existing houses on health inequality: cluster randomised study in the community" *BMJ* 2007:334:460.

The study examined the effect of insulation (provided free) on the wellbeing of low-income households who had symptoms or a history of respiratory disease. The insulated house group was compared with a matched control group.

The results were reported as follows:
"*Insulation was associated with a small increase in bedroom temperatures during the winter (0.5°C) and decreased relative humidity (−2.3%), despite energy consumption in insulated houses being 81% of that in uninsulated houses. These changes were associated with reduced odds in the insulated homes of fair or poor self-rated health, self reports of wheezing in the past three months, self reports of children taking a day off school and self reports of adults taking a day off work. Visits to general practitioners were less often reported by occupants of insulated homes. Hospital admissions for respiratory conditions were also reduced but this reduction was not statistically significant".*

The key results that were fed into the cost-benefit analysis were:

Impact type	**Impact per household**	**Value per household**
Days off work	-0.167 days	$58.9
Days off school 12-18 yrs.	-1.98 days	$32.3
Days off school 6-11 yrs.	-0.765	$20.0
Medical visits	+0.05	- $16.2

Total		$ 95.5

The benefits do not seem very credible when matched against the reported small change in average temperature and may have been generated by reporting bias. Notably, when there was an independent check on one of the reported impacts the improved outcome did not hold up. Participants reported fewer doctors' visits after houses were insulated but doctor's records showed that visits actually increased.

The outcomes were self-reported by the participants who may have been inclined to give the researchers positive news, or the trial itself, rather than the insulation, may have changed outcomes. Households that had received free insulation may have been less inclined to take a 'sickie' knowing they should report it, and more inclined to make older children go to school.

Some of the other trial results illustrate the reporting bias effect. For example 398 of 550 respondents reported feeling cold most or all of the time prior to insulation, but only 95 afterwards, when the average temperature had increased by only 0.6 degrees. Objectively the change in average temperature should not have generated such a marked response, so occupants were either experiencing a placebo effect, or they were putting a positive slant on their reporting.

For doctors visits, the study uses the actual rather than the self reported change, but this still leaves doubts about the robustness of the other self-reported results.

From a policy perspective one of the more important outcomes of the study is that insulation will have a limited impact in raising the temperature in houses occupied by the poor. As heating becomes more effective heating is reduced to save money that is better spent elesewhere.

The other issue with use of the results is that that the characteristics of the trial group (poorer and sicker) is likely to overstate the impact for the general population. This issue was acknowledged in the report and the imputed benefits for the treatment population were halved to $47.75. However, this adjustment was not applied in the cost-benefit analysis and by the later Sapere cost-benefit study.

We have reinstated the adjustment and have made a further 50 percent adjustment for possible bias in the trial results.

Our estimate of the imputed benefits is **$23.87** per household

Heating savings

The Aspere report puts the value of energy savings at around $31.82 for houses fitted with both ceiling and underfloor insulation. The figure looks low, so for this exercise we have assumed, somewhat arbitrarily, a figure $63.64 that is double the Aspere estimate.

Summary of our benefit assessments

Benefit type	$ per household per year
Lower mortality	63.96
Hospitalisation costs	Nil
Pharmaceutical costs	11.02
Other benefits	23.87
Energy savings	63.64
	162.51

Cost-benefit analysis based on amended benefits

In this section we amend the MBIE cost-benefit analysis to capture our estimate of the insulation benefits. The steps are as follows.

Ceiling and underfloor insulation

We have assumed that the aggregate benefits of $162.51 per dwelling per year have arisen from just the installation of ceiling insulation. In reality some would have also have been due to underfloor insulation as well so our figures probably overstate the ceiling only benefits.

There is an important difference between the efficacy of ceiling and underfloor insulation that needs to be taken into account. We have assumed that ceiling insulation is 2.5 more effective that underfloor insulation based on MBIE's ('Your Guide to Smarter Insulation') assessment of the relative sources of heat loss in a home.

On that basis underfloor insulation will deliver annual benefits per dwelling of $162.51/2.5= $65.

Expected average savings per dwelling
The Sapere report identified 139,000 rental properties that did not have underfloor insulation and 40,000 that did not have ceiling insulation (in both cases were insulation is possible). On these numbers the weighted average saving per property is $86.90.

Total benefits and the benefit-cost ratio
The aggregate benefits are calculated by taking the total cost of insulation of $600 million (reported by the Minister) and multiplying by the benefit/cost ratio of 2.1 to get total benefits of $1230 million. This estimate was based on per household annual benefits of $643 per annum. If we substitute our estimate of $86.90 we get a total benefit figure of $170 million.

The benefit-to-cost ratio is 0.28 and the net loss is $430 million.