

Policy for low carbon (energy efficiency) retrofit/renovation of residential buildings

Rapid review

Objectives of this rapid review

Countries around the world have recently taken significant steps to improve the energy efficiency of new buildings. Their measures have addressed energy efficiency through a variety of means, from technological improvements to enacting various regulatory requirements and establishing policy initiatives. However, a large percentage of the existing residential building stock constructed prior to the appearance of these policy measures are appreciably less efficient than most newly constructed residences. Moreover, they will continue to use significant amounts of energy long into the future.

Existing residential buildings present large opportunities for energy performance improvements that reduce greenhouse gas emissions (GHG), but the barriers are numerous and complex. Australian buildings make a significant contribution to GHGs with a net Energy Star Rating of only 1.5-2 stars (compared to the state code specifying 6 stars for new dwellings). Numerous stakeholders with competing interests and at multiple levels of authority make for a complex policy space.

Our main objective was to rapidly locate and synthesize knowledge from scholarly peer reviewed literature employing systematic review and meta-analytic approaches to answer the question: **What policies work, or could potentially work, to achieve low carbon outcomes from retrofit/renovation of residential buildings, to what extent do they work, and how is that measured?**

Key findings of this rapid systematic review

This rapid review identified two results extracted from the eight studies (published between 2013 and 2018) that fulfilled our inclusion criteria. Firstly, our

analysis identified five common themes across the included studies which provide tentative information for what would be needed to make low carbon residential retrofit/renovation policy work. Secondly, we make an overall observation that the included studies did not provide sufficient evidence or establish conclusive results about the effectiveness of specific low carbon policies compared to other policies. Below, we highlight some selected findings in support for these two results.



Common themes across the studies

Qualitative summary of findings across all the included studies identified five common themes for consideration for low carbon policy for residential retrofit/renovation.

1- Tailor policy to decision-makers dispositions and perspectives.

Tailor policies to decision maker dispositions and perspectives in their choices over green technologies. Decision makers refer to individuals and households, but also those who advise homeowners, such as the construction industry and tradespersons. It seems that variables other than cost and economic performance may play a larger role in decision making than expected (e.g., their health, comfort,

having control). However, there is a lack of deep understanding on what these dispositions / characteristics and perspectives exactly are or how to consider them.

Further primary research is needed to measure and understand more deeply the variables that affect the outcomes of policies, for instance, decision makers' dispositions, the external contextual factors, the taken for granted 'common knowledge', and so on.

Homeowners' decisions to renovate are shaped by an alliance of economic and non-economic goals. Therefore, existing incentives, typically targeting the economic viability of measures, have brought little success.

(Friege and Chappin 2014)

2- Funding or subsidies should target up-front costs. But subsidies for operations may encourage free-riding.

Funding or subsidies should target up-front costs since incentive schemes that reduce uncertainty may help to overcome barriers. These include clear project schedules and investment return, simple comparison between different choices, better communication, etc. These can however favour free riders, those who would have been willing to renovate without the funding. Further, funding for durable technologies (e.g., solar panels and vehicles) is more needed than not-durable categories of technology (e.g., renewable electricity).

The results of this review highlight the need for further secondary (systematic review) and primary research and trials on evaluation and comparison of the outcomes of the implementation of financial incentives. And they should be matching policies where it is possible to account for the complexity of independent variables affecting outcomes.

Financial incentives remain a key element for the promotion of energy-relevant investment decisions. Not surprisingly, funding amount and energy prices are positively associated with energy-relevant investment decisions.

(Kastner et al. 2015)

3- No one-size fits all. Tailor for contextual factors.

No one size fits all, so tailor policies to account for contextual factors such as the location, thus climatic conditions, energy prices and many other more variables. The social-cultural contexts of local area are also vital for successful implementation of policies. These include but not limit to: householders' knowledge of and attitudes toward energy efficient renovation and relevant technology, people's livelihoods and expenditure on energy, preferred channels of communication, etc. With so many factors, there is lack of evidence what would work the best, and what works in one place does not necessarily work in another.

The ranking of cost-optimal energy efficiency measures is strongly dependent on climate zone, due to the close relation between temperature and energy consumption.

(D'Alpaos and Bragolusi 2018)

4- Implement earlier rather than later (also earlier in the building life-cycle).

The earlier the policies are implemented, the better. For reasons such as: acceptance, urgency of the issues, having time to do more for cases where doing little will not be sufficient (e.g., upgrading the building shell is not sufficient for leaky houses so more will be needed) or where unforeseen consequences reduce positive outcomes and thus more will be needed (the rebound effect).

Meanwhile, early implementation should also be considered in the building life cycle. For example, policy targeting at operational cost earlier in the building life cycle may help improve the return of investment.

Controlling for contextual features, it arises that regions in which environmental policy has been earlier implemented show a higher attitude to green technologies, thus providing a higher economic support.

(Bigerna et al. 2017)

5- Take a comprehensive systems approach to policy design and implementation.

Take a comprehensive systems approach to retrofit/refurbishment policy design and implementation. Using a mix of policy measures is linked to the previous point. This applies not only to using a wider selection of retrofit/renovation options simultaneously but focusing also on sectors across the board and adopting other measures (e.g., using and re-using low carbon embodied materials, measures relevant to a low carbon circular economy). It also involves integrating social-cultural factors in policy programs to foster better education and communication.

Mathematically, comprehensive refurbishments should have resulted in more pronounced improvements in energy performance than thermal retrofits and upgrades.

(Willand et al. 2015)

Overall observation

None of the included studies evaluated or compared the effectiveness of specific *policies or policy packages* to others. Rather, they examined residential buildings energy efficiency retrofit/renovation studies from a number of different perspectives and in the process either identified policies as explanatory variables or as (directly or indirect) factors that impact on the outcomes of residential energy efficiency retrofit/renovation interventions. The studies provide a variety of conclusions that suggest there is not sufficient evidence or conclusive results to decide about the effectiveness of any particular policy.

One reason is that the studies found that actual results of energy improvements are often reported at opposite ends of a spectrum (i.e., similar studies report opposite results) which indicates that:

- 1) Unidentified and unexamined factors are involved that means similar programs produce different outcomes. Many of the included studies call for the establishment of consistent sets of variables to be used by studies in determine building energy efficiency;

- 2) Diverse interventions are needed to achieve sufficient results, but studies do not all implement or make the same sets of interventions, and thus in comparison there are biasing and blurring of results between studies, and;
- 3) Differences between studies, the quality of studies and uncertainty over the input variables can affect outcomes and the calculation of outcomes. For instance, many studies do not measure energy use before and after the intervention.

Another reason has to do with unforeseen or unexamined processes that produce different actual outcomes from expected outcomes (e.g., rebound effects).

Conclusion

This rapid review identified five common themes for policy makers to consider to support low carbon residential retrofits/renovations. In addition, an overall observation highlights the need for empirical analysis of energy outcomes from any implemented policy.



Studies reviewed

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Full report

Graham, P, Bok, B, Jinlong, L, Zwagerman, M, Burton, C (2019) Policy for low carbon (energy efficiency) retrofit/renovation of residential buildings: Rapid review (report). CRC LCL, Sydney, Australia.



Disclaimer

This research is funded by the CRC for Low Carbon Living Ltd supported by the Cooperative Research Centres program, an Australian Government initiative.

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