

Net Zero Carbon Housing - A submission to the Climate Change Strategy for South Australia

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Key questions posed:

- What are the major opportunities to substantially reduce our emissions?
- How can South Australia be the innovator in climate change action?

Given the context of the considerable carbon emission impact due to the residential building sector, this submission will focus on the opportunity to establish a zero carbon housing policy for all new homes. The submission is based on evidence generated at the Lochiel Park Green Village in South Australia, and the wealth of research conducted on similar low carbon case study estates around the world. In particular, this submission will discuss the value proposition for low carbon housing to both government and households. The economic impacts discussed in this submission are drawn from reports developed by the University of South Australia and published by the CRC for Low Carbon Living:

- Value Proposition: Low Carbon Housing Policy (Berry & Davidson 2015a)
- Value Proposition: Householder Experience (Berry & Davidson 2015b)

The value proposition for low carbon living is defined as the articulation of the measurable value an organisation or individual will receive from the experience; where the end value equates to the perceived benefits minus perceived costs. This means that the value of low carbon living is unique to the perspective of the investor, and the set of benefits and costs included in the economic equation relate only to those likely to be perceived by the investor.

State Government as the investor (policy maker)

For this section the investor is defined as the Government responsible for the policy requiring homes to be specifically designed for low carbon living. The value proposition is communicated quantitatively as a net present value (NPV) calculation, covering all monetised costs and benefits associated with the effective life of the experience – in this case the effective life of the low carbon housing policy. A key limitation is that not all costs and benefits can be accurately monetised and included where there is insufficient evidence to allocate a dollar value to that experience. Therefore, as the research identifies many benefits that cannot be monetised, the results should be seen as relatively conservative and, in general, underestimate the economic benefits to the South Australian community.

Our research finds clear evidence there are multiple benefits associated with a low carbon living housing policy of mandating net zero carbon performance for new homes. The Government investor would expect to achieve multiple policy outcomes across areas as diverse as health, productivity, employment, energy, climate change, as well as the public budget. From a macro-economic perspective, although many impacts were not able to be monetised with sufficient confidence, the Government investor will experience a net increase in local employment, downward pressure on energy prices, and increased economic activity within a more efficient economy better able to respond to world energy price increases.

Our research concludes that the value proposition of low carbon living is overwhelmingly positive to the South Australian Government with a conservative NPV of \$1.31 billion for a 10 year policy action, and a benefit/cost ratio of 2.42. The empirical evidence demonstrates that low carbon living will provide many benefits including improved energy efficiency, energy network infrastructure savings, improved human health and wellbeing, carbon emission reductions, and benefits from increased social capital. The benefits far outweigh the costs associated with creating low carbon housing.

Net economic impacts

Given the caveat that some experiences are difficult to monetise with a degree of confidence, applying the assumptions and values described earlier in the report, the NPV calculation is overwhelmingly positive.

Table 1: Economic results for proposed net zero carbon house standard

Benefit	\$2,226m
Cost	\$919m
Net Present Value	\$1,307m
Benefit/Cost Ratio	2.42

Table 1 shows the present value of all monetised benefits and costs associated with low carbon living, based on a discount rate of 7%, for the 10 year effective life of the proposed policy. The benefit/cost ratio and NPV demonstrates that the Government investor will receive a substantial net benefit from regulating low carbon housing, even without considering the likely significant macro-economic benefits.

Whilst the majority of the economic benefit is due to improved energy efficiency and the transition to renewable energy generation, strong flows of benefits also stem from energy network savings (reduce in peak demand). Smaller but valuable flows relate to the health and wellbeing impacts of improved thermal comfort, although these benefits are likely to be significantly underestimated.

The NPV result is sensitive to the discount rate applied, but remains strongly positive with a benefit/cost ratio of 1.95 at a relatively high discount rate of 10%, and achieves a benefit/cost ratio of 3.49 at a 3% discount rate. Sensitivity analysis shows that without the various indirect benefits the benefit/cost ratio at the 7% discount rate is 1.96 demonstrating that the direct energy benefits are substantially greater than the net costs of the proposed standard. If the non-energy (i.e. health and productivity) benefits were equivalent to the value of the thermal comfort related energy savings as suggested in the literature, the net value increases to \$1.52 billion with the benefit/cost ratio increasing to 2.65.

The annual flow of costs and benefits (see Figure 2) shows that the present value of the additional construction costs is initially higher than the present value benefits from energy savings, electricity generation and other factors. By year 5 the annual benefits from the accumulation of new homes become larger than the additional costs associated with the low carbon housing standard. After the 10 year policy period new homes cease to be added and the remaining costs relate to the replacement of water heaters, DC/AC inverters and photovoltaic panels at the end of their respective economic life.

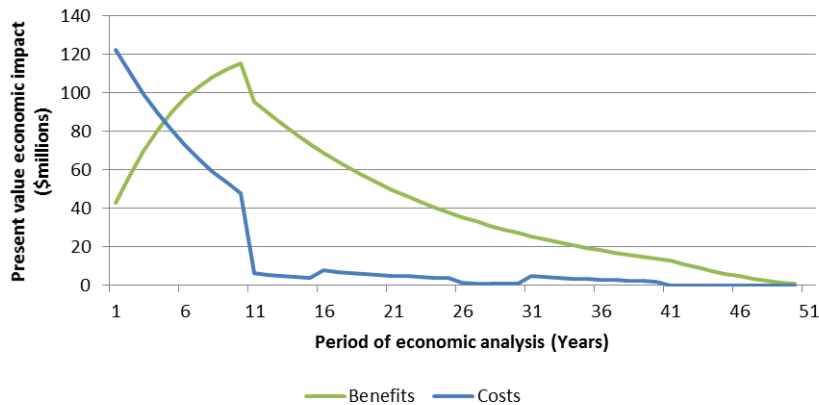


Figure 2: Flow of economic costs and benefits for proposed standard

Figure 2 graphically presents the relative monetised economic flows after taking into account inflation, energy price escalation, discount rates and industry learning rates. In the graph the initial increased construction cost is followed by periodic product replacement costs, whilst the continuous benefit stream is experienced by society for the life of all buildings constructed under the low carbon housing policy. The policy measured here is implemented for just 10 years, but as the impact of each home extends to their 40 year effective life, some benefits are received by the Government investor 50 years after the policy introduction.

Macro-economic impacts

The change to a net zero carbon housing policy provides additional economy-wide investment and cost reduction effects. The macro-economic benefits of low carbon living are likely to facilitate increased economic activity (as measured by gross domestic product [GDP]), higher local employment, advantageous price impacts and favourable trade balances (International Energy Agency 2014).

The international evidence from econometric research into energy efficiency policies, including low carbon housing policies, has pointed to considerable positive impacts on employment and GDP (Braungardt et al. 2015), decreases in inflation, growth in GDP (Barker et al. 2006), and falls in energy prices (Allan et al. 2006).

The lack of local macro-economic evidence and modelling, and evidence specific to a net zero carbon home policy, means that for the purpose of this analysis no additional economic cost or benefit has been allocated to macro-economic impacts. Given international experience, it should be noted that the benefits, which are likely to be significant, increase the value proposition of the policy to government. Further macro-economic research will be necessary to determine the scope and value of the likely benefits.

The additional economic activity related to higher value building materials and the additional renewable energy systems will have flow-on effects such as increased taxation revenue, and similarly the increase in disposable incomes due to lower operational energy costs will have a net positive effect on government tax revenues. Due to the complexity of tax revenue redistribution between Federal and State levels of government in Australia, the calculation of the value of additional tax revenues was beyond the scope of the project.

Although the report is unable to calculate with sufficient confidence the full macro-economic impact of a transition to net zero carbon homes, there is sufficient evidence to suggest that the Government will achieve and value a net increase in local employment, downward pressure on energy prices, and increased economic activity within a more efficient economy better able to respond to world energy price increases.

Householder as the investor

Housing affordability is a key concern of government and households, and the history of building energy regulatory reform has demonstrated that it is imperative that changes to building regulations should be accompanied by sufficient evidence that investors benefit from the proposed change. This submission is based on the report Value Proposition: Householder Experience (Berry & Davidson 2015b) which examines the economics of net zero carbon homes in a manner consistent with the requirements of the Australian Government's Office of Best Practice Regulation.

Low carbon living is associated with changes to typical house designs; to the type, size and use of energy technologies; and potentially changes to maintenance schedules and regulatory compliance processes. For the purpose of this submission low carbon living is based on the expected performance of a net zero carbon home defined as: an energy efficient building that generates sufficient low carbon energy on-site over the course of a year to supply all expected on-site energy services for the building users (Berry, Davidson & Saman 2014). Lochiel Park Green Village homes provide suitable local examples of near net zero carbon homes.

The scope of experiences and impacts examined in this section is limited to the private benefits and associated costs of low carbon living from the perspective of the householder investor, and therefore explicitly excludes societal benefits and associated costs such as impacts to energy networks due to reductions in peak energy demand or lower health costs associated with improved thermal comfort reducing the need for hospital visits. The scope is also limited to those householder experiences related to living in a low carbon impact home and precinct, rather than other lifestyle experiences associated with food production, waste management, transport and other activities that occur mainly outside the dwelling or estate. The scope is limited to carbon emission impacts rather than broader environmental sustainability issues, and therefore water related impacts are limited to the energy used to meet hot water demand. The key parameters, assumptions and values incorporated within the NPV calculation are documented in the associated report (Berry & Davidson 2015b).

Table 2 shows the present value of the private benefits and costs associated with low carbon living, based on a discount (mortgage interest) rate of 5%, and if the home was constructed in the first year of the proposed policy.

Table 2: Private economic impacts from Year 1 construction

Benefit	\$41,355
Cost	\$16,420
Net Present Value	\$24,935
Benefit/Cost Ratio	2.52

Our research shows that the value proposition of low carbon living for detached homes is overwhelmingly positive with the householder investor experiencing a NPV benefit of \$24,935 for homes constructed in Year 1 of the policy. The flow of costs and benefits throughout the building's effective life demonstrates that from the householder perspective the additional construction costs are covered within the first 8 years of low carbon living.

Rapid industry learning

The regulatory environment, and in particular the use of performance-based codes and standards, is a key driver of innovation, leading to change in industry skills and knowledge, product and supply chain development, and increased production volumes. This market transformation has a material influence on the end cost of housing. From one perspective regulation may drive some costs higher in the immediate term due to additional construction and technology requirements, but simultaneously regulation creates the transformation that drives the cost of housing lower over the medium and longer term.

If construction was completed in the 10th year of industry's experience of providing low carbon homes, including a 10 year period of building product learning, the benefit/cost ratio increases to 3.54 (see Table 3).

Table 3: Private economic impacts from Year 10 construction

Benefit	\$52,040
Cost	\$14,709
Net Present Value	\$37,331
Benefit/Cost Ratio	3.54

Whilst the benefit stream is predominantly impacted by inflation over the 10 years since the policy was adopted, the additional construction cost even after inflation has decreased, reflecting the benefits associated with policy stimulated increased building system production volumes, improved industrial processes, and the development of skills and knowledge for the various building industry professions.

Householder experience

The experience of the householder investor documented in this report demonstrates that low carbon living provides many benefits including lower energy bills, increased levels of thermal comfort, improved health and wellbeing, intrinsic positive feelings associated with climate change action, and benefits from increased social capital. Where those experiences can be monetised with reasonable confidence, the net private impact is overwhelmingly positive to householder investors.

Whether the home is created in the first or the last year of a 10 year policy induced industry learning process, low carbon living provides the householder a net economic benefit by around the 8th year of the assumed 40 year life for the building. The additional construction costs and subsequent technology replacement costs are quickly overtaken by a steady stream of economic benefits and positive experiences enjoyed by householders.

The published report notes important limitations to the data, particularly those benefits associated with intrinsic experiences, and therefore the results should be considered conservative with substantial non-monetised benefits likely to improve the overall impact.

And whilst this value proposition analysis is focussed on the householder experience of net zero carbon detached homes, many of the experiences are likely to be similar in townhouses and apartments built to a similar energy performance standard. Further value proposition research is planned to examine a wide range of householder experiences associated with higher density low carbon living.

Conclusion

This submission has sought to address two key questions:

- What are the major opportunities to substantially reduce our emissions?
- How can South Australia be the innovator in climate change action?

The evidence collected by the University of South Australia over many years demonstrates the significant and cost effective opportunity to substantially reduce emissions associated with new housing. Given the substantial and rapid learning process experienced by industry due to regulatory change, the South Australian housing industry is likely to develop a competitive advantage in innovation over those in other regulatory environments. The development of new skills, tools, products and systems will provide South Australian industry with a competitive advantage to deliver improved housing product to other domestic jurisdictions and international markets.

In summary, our research shows that the value proposition of low carbon living is overwhelmingly positive for both the householder investor and government.

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