

# **Developing a Non-Energy Benefits Indicator Framework for Residential and Community Energy Efficiency Programs in New South Wales, Australia**

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## **Abstract**

The New South Wales (NSW) Government's Office of Environment and Heritage (OEH) gave Databuild an exciting task to develop a new, innovative indicator framework to measure and communicate the non-energy outcomes of their residential and community energy efficiency programs. Through the project, the NSW Government aimed to develop a set of high-level indicators that can be used to monitor and communicate transformational changes caused by their interventions. These indicators utilised a multiple benefits perspective and are in alignment with global initiatives. The purpose of the indicators are to: (1) enable high level monitoring of progress towards aggregate outcomes and broader goals across the programs, linked to OEH and NSW Government priorities; (2) recognise the multiple benefits possible from energy efficiency programs (e.g. including social health and other benefits); and (3) provide a basis for estimation of a broader range of economic impacts than are currently covered by OEH and NSW Government cost-benefit analysis frameworks.

## **Why is this topic important?**

The project is bringing together quantitative and qualitative measurement approaches from different disciplines (e.g. health, social research) and applying them to NSW Government programs to provide a broader understanding of program outcomes. This multi-disciplinary project needs to balance issues of methodological rigour, feasibility, communication and alignment with other programs for comparability. Physical health was selected as an example to demonstrate the approach used for all benefit areas. The NSW Government is leading the field in developing and applying a multiple benefits perspective to such programs. The challenges and learning experienced through the development of this project will be discussed.

## **Introduction**

Interest in the multiple benefits of energy efficiency has grown in recent years – in particular since the publication of the International Energy Agency's 2015 guide *Capturing the Multiple Benefits of Energy Efficiency*<sup>1</sup>. The Office of Environment and Heritage (OEH) is the NSW Government department responsible for working with the community to care for and protect NSW's environment and heritage. As part of its portfolio, the department designs energy efficiency and renewable energy policies<sup>2,3</sup>, and also delivers programs to achieve outcomes in support of the goals set out in the NSW Government's Energy Efficiency Action Plan (EEAP) and Renewable Energy Action Plan (REAP).

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1 International Energy Agency (2015) [Capturing The Multiple Benefits of Energy Efficiency](#).

2 NSW OEH (2013) [NSW Energy Efficiency Action Plan](#).

3 NSW OEH (2013) [NSW Renewable Energy Action Plan](#).

## Context

The NSW Government's EEAP aims to help reduce living costs and achieve greater energy efficiency in New South Wales. To meet the goals of the EEAP, OEH delivers a number of energy efficiency programs to support consumers who have a limited ability to change their consumption. These consumers include low-income households, small to medium-sized businesses and frontline government services. Examples of program elements include: energy efficiency advice for householders and businesses; grants for upgrading to lower energy-use appliances, machinery and lighting; retrofitting community housing to improve insulation; and engagement with rural communities to improve awareness of, and encourage action around, sustainability opportunities. Some projects have targeted thousands of householders or whole towns in rural Australia, while others are focused on smaller groups, e.g. Indigenous communities in remote locations. Specific examples of residential and community energy efficiency programs relevant to the Non-Energy Benefits Indicator Framework are as follows.

- 1) The \$26.8 million Home Energy Action Program provides high-return energy efficiency improvements to low-income households in NSW, in partnership with program partners across the social and environment sectors. Vulnerable families and households, including low-income renters, gain improved access to energy-saving appliances and home improvements.
- 2) The \$7 million Renewable Clean Energy Program supports the uptake of renewable energy in NSW regions by improving community acceptance through locally developed and community-supported activities.
- 3) The Collaborative Sustainable Housing Initiative works with housing industry representatives to facilitate the uptake of sustainable features in new and upgraded housing. It is currently building a shared measurement framework with stakeholders across the four themes of awareness, capacity, adoption and systematisation.
- 4) The \$1.25 million Stay Warm, Stay Comfortable Program aims to support around 2,000 households in regional NSW to transition from the use of firewood for home heating to more healthy and sustainable methods.
- 5) The Our Place program engages communities to undertake initiatives to improve the local environment and help people live more sustainably. The program aims to increase opportunities for people to look after their local environment and to be involved in their community.

To deliver their programs OEH works in partnership with other government departments and stakeholders (e.g. NSW Family and Community Services, Community Housing Associations). They leverage their influence and maximise positive outcomes relevant for both OEH and partner organisations.

In 2015 while still in the early stages of design and delivery of its new set of household and community programs, OEH commissioned this work to develop a set of indicators to capture the multiple benefits of energy efficiency from their programs. The purposes of the indicators are to:

- Enable high level monitoring of progress towards aggregate outcomes and broader goals across the programs, linked to OEH and NSW Government priorities

- Recognise the multiple benefits possible from energy efficiency programs (e.g. including social, health and other benefits) and develop methods for tracking these benefits
- Provide a basis for estimation of a broader range of economic impacts than are currently covered by OEH and the NSW Government's cost benefit analysis frameworks.

There was little evidence that could be found on developing a strategic framework to measure multiple benefits across a suite of Australian energy efficiency programs.

## Objectives

The specific objectives for the project were:

1. To define a set of key benefits in consultation with internal and external program partners, which are relevant to OEH programs and aligned with:
  - A 'multiple-benefits' perspective on energy efficiency, and
  - International indicators<sup>4</sup> where possible.
2. For each key benefit, to develop indicators and methods which OEH can implement, in order to:
  - Measure each indicator and how it changes over time, against baselines where possible
  - Measure the influence of OEH's interventions on each indicator
  - Measure how each indicator is progressing towards aggregate outcomes and broader goals across programs and linked to OEH, NSW Government and partner organisation priorities
  - Align indicators with international measures with a view to establishing a future process for benchmarking against international progress in these indicator areas<sup>5</sup>.
  - Measure economic impact, i.e. net public benefits and avoided negative externalities where possible.
3. 'Road test' indicators to ensure the final set of indicators are suitable for OEH programs.

## Method

The project had three phases:

1. Indicator scoping and method development – through desktop review, initial engagement with key stakeholders, and development of the methodology.
2. Further defining, honing and prioritising the key benefit areas and relevant indicators – through detailed program review, review of national and international evidence, discussions with OEH program leaders and in-depth testing with partners and experts. This included, operationalizing the indicators into practical data collection instruments (e.g. survey and interview questions) that OEH can use.
3. Review of indicators and 'road testing' with OEH programs, resulting in agreement on a 'minimum acceptable' measurement strategy and an implementation framework.

The project is nearing completion.

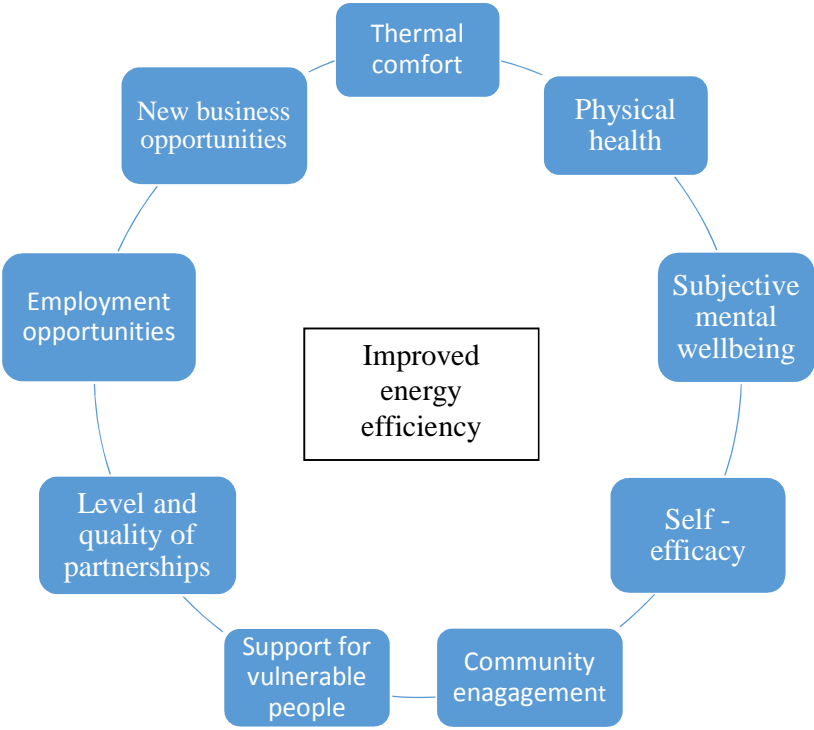
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<sup>4</sup> For example, the United Nations Sustainable Development Goals and the IEA multiple benefits framework.

<sup>5</sup> Noting previously discussed constraints that the ability we have to do this will be limited by the fact that the UN Sustainable Development Goals (SDGs) are only in draft form at the moment.

## Indicators to be measured

The nine key benefit areas were chosen from 35 potential benefits, on the basis of their priority for OEH programs and key program delivery partners at this time (Figure 1). Key benefits were also selected based on the results of a literature review conducted on similar programs, the indicators they used and data collection methods. We recognise that there are many other important private and public benefits beyond OEH that will need to be addressed in future projects.



**Figure 1:** Key benefit areas to be measured

Table 1 (below) provides a description of each of the key benefit areas included within this project.

**Table 1:** Description of each key benefit, suggested indicators and evaluation instruments for data collection

<b>Key benefit area</b>	<b>Description</b>	<b>Indicators</b>	<b>Evaluation instrument</b>
Thermal comfort	Improvements in the thermal performance of buildings not only improves energy efficiency, but also results in a more comfortable and liveable indoor environment, particularly during hot or cold spells.	Internal temperature; % participants who perceive improved thermal comfort	Physical and in-program measures; Participant survey
Physical Health	The indoor environment may impact the physical health of occupants, particularly elderly people, children and people with medical conditions who are vulnerable to excessive heat and cold. Drafts, damp and mould also contribute to negative physical health.	% participants who report improved physical health	Participant survey
Subjective mental wellbeing	Refers to general happiness and positive outlook that is central to self-fulfilment; closely connected to the clinical concept of mental health as well as to physical health.	% participants who report improved mental wellbeing	Participant survey
Self-efficacy	The ability of individuals to control the use of energy in the home; empowerment that arises through understanding how energy works, through the use of knowledge, technology or seeking the right assistance; confidence to take action and control one's life which is closely linked to wellbeing and to resilience.	% participants who report increased capacity to control energy use; % participants who contribute and take action in their community as a result of program	Participant survey
Community engagement	The extent to which people are connected to their local community or area, through formal or informal links, and the extent to which they participate in or feel connected to the life of their community.	Number of grants, participants, community groups formed and community projects meeting objectives; time community groups have existed; % participants reporting social connections	Physical and in-program measures; Participant survey; Interviews with program partners, stakeholders and community organisations

Support for vulnerable people	The extent to which support options are available to people who need them the most will influence their ability to access support and address problems	Number of referrals; referral type offered; action taken by participants to pursue options; satisfaction with support	Physical and in program measures; Participant survey
Level and quality of partnership	The effectiveness of partnerships that different program stakeholders have formed in order to achieve common goals	Type of partnership arrangement; level of effectiveness (rubric)	Physical and in program measures Interviews with program partners and stakeholders
Employment opportunities	The extent to which programs create additional jobs, either locally or elsewhere in NSW, through demand for additional goods and services	Number of jobs created	Physical and in-program measures; Interviews with community organisations and local businesses
New business opportunities	The extent to which programs create additional business opportunities through demand for additional energy efficiency and renewable energy	Number of businesses that expanded into new areas of work	Interviews with local businesses

Although the nine key benefits were explored individually, there are clear links between them that need to be considered when individual indicators are examined and when conclusions are made regarding the overall benefits of a program. For example, educational programs that improve householders' knowledge about energy efficiency may empower them to take action (i.e. self-efficacy) which in turn improves the comfort of the home and potentially their physical health and mental wellbeing. Alternatively, a program that focuses on improving community engagement around renewable energy may have additional benefits regarding individual wellbeing, but also on jobs growth.

## Methodological considerations

OEH wish to both observe changes in these multiple benefit indicators over time whilst their programs are running, and also to measure success – i.e. *how and the extent to which OEH has influenced observed changes*. As such, in measuring the key benefits there are methodological decisions that need to be taken. This is to ensure that specific methods are appropriately based on the type of programs being delivered, the timing of delivery, the target audience and how success can be measured<sup>6</sup>. Furthermore, the amount of resources required needs to be considered. The following methods were considered.

1. Comparison group methods - where data are observed/collected from program participants and from similar groups who have not participated, comparing differences between them. These quasi-experimental methods are robust when successfully applied, but can be resource intensive, and may not be possible to implement in some circumstance (e.g. where suitable comparison groups cannot be identified).
2. Pre-post methods – where baseline data are observed/collected prior to implementation of a program, then data collection is repeated following implementation to assess differences over time as a consequence of the program. Such methods can be less resource intensive, but also less robust in identifying the relative contribution of the intervention versus other factors<sup>7</sup>. Limitations arise if a program has already begun (i.e. not possible to collect baseline data) or if baseline data collection is impractical.
3. Post only methods – where data are observed/collected after a program intervention only, without baseline or comparison group data available. Such methods are the least robust for assessing the relative contribution of an intervention versus other factors. However, post-only methods are often the most practical (and least resource intensive) in field settings where baseline data and comparison groups are impractical.

In developing the recommended approach, OEH requested that we consider and recommend methods which will provide useful and reasonably robust data on which policy and program decisions can be made, and that are as cost effective to apply as possible. Table 1 lists the indicators and suggested evaluation instruments.

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<sup>6</sup> Considering that it will be possible to attribute some benefits directly to the programs, while it may not be possible to directly attribute other benefits.

<sup>7</sup> Robustness can be improved through statistical analysis, e.g. correcting for weather variations or for occupant characteristics.

## Developing indicators for measuring health outcomes

For the purposes of this paper, we have focused on just one of the indicator areas included within the project - physical health. We have picked physical health because it is of key interest in the context of multiple benefits in households and relevant to many energy efficiency/ fuel poverty programs. It also represents some of the key issues we experienced in developing measures across all benefit areas.

Improvement in thermal performance of buildings/homes is thought to have a direct impact on the physical health of occupants. There is considerable evidence that shows that particular elderly people, children and people with existing medical conditions (e.g. respiratory, heart or kidney disease) are vulnerable to periods of hot or cold indoor temperatures<sup>8</sup>. Cold drafts, damp, mould and heat stress all contribute to negative physical health among occupants and can be addressed by energy efficiency measures.

Improved health as an outcome is also important for several OEH programs and partners (e.g. NSW Family and Community Services and Community Housing Associations). It is also aligned with several Sustainable Development Goals<sup>9</sup>. Table 2 provides an example set of costs and benefits associated with energy efficiency measures in residential housing.

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8 Williamson et al (2009) [An Investigation of Potential Health Benefits from Increasing Energy Efficiency Stringency Requirements](#).

9 Including Good Health and Wellbeing (indicator 3), Affordable and Clean Energy (indicator 7) and Sustainable Cities and Communities (indicator 11).



**Table 2: Example of health costs and benefits of energy efficiency measures in residential housing; from Williamson et al (2009)<sup>10</sup>**

<b>Health Costs</b>	<b>Health Benefits</b>
Private Costs	Private Benefits
<ul style="list-style-type: none"> <li>• Direct healthcare costs                             <ul style="list-style-type: none"> <li>○ Medical/healthcare co-payments</li> <li>○ Medication</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Reduced risk of disease and death arising from thermal conditions in homes</li> <li>• Potential increased quality and length of life</li> <li>• Reduced acute healthcare costs (including medication, ambulance, hospital, rehabilitation etc.) due to disease attributable to thermal conditions in homes</li> <li>• Potentially reduced chronic healthcare costs (including medication, ambulance hospital, rehabilitation etc.) due to disease, including mental disorders and psycho-somatic health issues, attributable to thermal conditions in homes</li> <li>• Potential reduction in healthcare costs for persons affected by mould-related air pollutants<sup>11</sup></li> <li>• Reduced costs from external noise-related health effects, including learning deficits, cardiovascular effects and annoyance<sup>12</sup></li> </ul>
<ul style="list-style-type: none"> <li>• Indirect healthcare costs                             <ul style="list-style-type: none"> <li>○ Attendance/transport costs</li> <li>○ Lost productivity and foregone income</li> </ul> </li> </ul>	
Supplier Costs	Societal Benefits
<ul style="list-style-type: none"> <li>• Direct and indirect healthcare costs, relating to injured manufacturing and building workers, including workers compensation costs</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced morbidity and mortality during weather extremes (impacting on available hospital beds, ambulances etc.)</li> <li>• Potential reduction in morbidity associated with mould-related air-pollutants</li> </ul>
Government Costs	
<ul style="list-style-type: none"> <li>• Provision of healthcare services and payment subsidies</li> </ul>	

### Literature review summary

A total of 21 studies were identified as relevant to the measurement of health in relation to energy efficiency. Seven studies were specifically relevant (Table 3) because they directly informed approaches to measure health and were applied in a similar context to NSW and the programs OEH deliver.

10 Williamson T, et al (2009) [An Investigation of Potential Health Benefits from Increasing Energy Efficiency Stringency Requirements](#).

11 (From Williamson et al (2009)) “In the Frankfurt study, Braubach et al (2008) measure exhaled nitric oxide, as a marker for respiratory allergic reaction, for 117 occupants of intervention and control homes. No significant differences were found, but this was a small sample size.”

12 (From Williamson et al (2009)) “A variety of studies have explored external noise-related health effects, e.g. Stansfeld et al., Aircraft and road traffic noise and children’s cognition and health: a cross-national study. *Lancet* 2005; 365: 1942.”

**Table 3: Key studies measuring health**

**Australian studies**

1. *Williamson T, et al (2009) An Investigation of Potential Health Benefits from Increasing Energy Efficiency Stringency Requirements.*
2. *NSW Health (2010) Closing the gap: 10 Years of Housing for Health in NSW, An evaluation of a healthy housing intervention.*
3. *NSW OEH (2014) Home Power Savers Program non-energy benefits evaluation report.*
4. *Australian Bureau of Statistics (2011-13) Australian Health Survey.*

**International studies**

5. *Braubach, M., et al. (2008), Preliminary results of the World Health Organisation (WHO) Frankfurt housing intervention project.*
6. *Maidment, C.D., et al. (2014), The impact of household energy efficiency measures on health: A meta-analysis, Energy Policy, Vol. 65, Elsevier Ltd., Amsterdam, pp. 583–593.*
7. *Warm up New Zealand (2011) The impact of retrofitted insulation and new heaters on health services utilisation and costs, pharmaceutical costs and mortality.*

## **Proposed methods**

In these studies health outcomes were measured in two main ways:

- 1) Social research methods such as self-report survey questions to determine the percent of program participants who report improved physical health since intervention – Where appropriate, existing peer-reviewed surveys were used to assess householders' general health, as well as specific health problems related to poor thermal conditions in homes (e.g. respiratory conditions). For example, Brauback et al (2008) examined the health benefits of housing improvements in a pre-post study comparing intervention householders with non-intervention householders. They used self-report survey questions to cover general health, chronic and acute conditions, and number of sick days occurring in the previous 3 months.
- 2) Observable independent outcome data such as that collected from hospital records – The NSW Housing for Health program undertook major renovations of poor quality housing occupied by Aboriginal Australians. The study examined hospital separation data to determine whether improvements in the housing stock translated into shorter hospital stays in intervention areas. Since intervention areas were isolated, hospital data could easily be compared to other hospitals in areas where the intervention had not occurred. Studies outside Australia have obtained address-level health outcomes data and matched this to those who received the intervention and those who had not (e.g. Warm up New Zealand). Observable outcomes data was easier to quantify regarding economic benefits, through cost benefit analysis.

## Methodological issues and limitations

Several issues and limitations need to be considered in any approach to measure health indicators. Firstly, health indicators are significantly influenced by other factors, such as existing chronic conditions, age and socio economic status. These need to be accounted for in order to improve accuracy regarding attribution of program impacts. Careful multivariate analyses incorporating known factors can assist in determining the contribution and impact of a program. Secondly, results of social research methods can be limited by participant bias depending on how, when and in what context questions are asked. Careful consideration must be given to data collection methods. Thirdly, when considering observable outcomes data such as patient records, OEH would need to rely on external sources, such as NSW Health, for access and support. Since access to data for specific hospitals may not be made available (from NSW Health), another way of assessing health outcomes is to compare aggregated hospital utilisation in the areas where an intervention has taken place with state-wide or even country-wide trends. Whilst this may be technically possible, a key consideration is whether the population size and geographic location of the households impacted by OEH programs would be large enough in any one catchment area to be able to detect observable changes in admission records. Furthermore, socio-demographic and climactic factors may not be comparable. Finally, timing of the intervention and data collection needs to be considered carefully in order to ensure there is potential to capture changes in health conditions. A 3-month period following an intervention is expected to allow sufficient time to collect self-reports of acute conditions, as well as any exacerbation of chronic conditions reasonably expected to occur. Hospitalisations are less frequent and may require a larger time frame (or larger sample size) to establish reasonable comparisons. Timing of the collection of all data, whether thermal comfort, health or other indicators, should be carefully calibrated to ensure linkages between factors can be appropriately assessed in analysis.

## Preliminary findings and lessons learned

The project is in the early stages of implementation, however preliminary findings and lessons learned are summarised in Table 4.

**Table 4:** Preliminary findings and lessons learned

Preliminary finding	Lesson
Ambiguity of the term “multiple benefits”	The term multiple benefits (also referred to as non-energy benefits, social benefits and social indicators) was interpreted in varying ways by stakeholders. Time should be taken to: agree on terms; explain the meaning of multiple benefits; explain how they are used and why.
Some stakeholders did not see a connection between multiple benefits and their work	Some stakeholders, both internal and external, misunderstood the concept of the research, having not heard of or utilised a multiple benefits framework. Sufficient background information and context should be given to participants, with direct links to their specific programs outlined. The most effective recruitment and participation occurred where participants had previously considered, or been exposed to a multiple benefits framework, and could see the value of taking a more holistic approach.

Data collection limitations within programs	The programs included in this project were at different stages of the program cycle. Methods need to be flexible enough to accommodate retrospective data collection. Resources are often limited, drawing on existing data where possible increases the cost effectiveness of evaluations and bolsters the case for new data sources where existing data is not present.
Collaboration is vital	Interviews with external program partners offered multiple perspectives that enhanced understanding about the barriers and enablers to data collection in different settings. This understanding was instrumental in enabling the framework to be useful across different programs, populations and contexts, and in assessing common outcomes. The level of collaboration required to enable a multiple benefit project should not be underestimated. An understanding of the interdependence of all partners is required for success with each partner clearly understanding their role.
Disconnect between some internal stakeholders and their program partners	Some program partners were able to see the usefulness of a multiple benefit framework beyond expectations. Some partners were already thinking about measuring the broader benefits of their work (i.e. outside of energy efficiency), but this didn't necessarily get discussed within their partnerships with OEH. Where interdisciplinary cross-sector collaboration is required it is vital that assumptions are made overt and agreed.
Establishing baseline data	Establishing a baseline across many programs is difficult. Consultation and collaboration with program leaders is crucial to select optimum baseline measures that would be transferrable across programs. Using program logic frameworks for individual programs and developing an overall program logic for collective programs is useful in identifying key indicators for baseline measurement.
Methodological limitations and global relevance	It was challenging to develop measures based on existing approaches. Many approaches in the international literature were not applicable to NSW OEH programs due to the differences in local concerns and climatic conditions. This highlights the importance of ensuring that approaches are relevant and feasible in the context of current programs.
Quantifying the public benefits of programs	There was concern that the current multiple benefits framework did not include 'public' benefits. Such public benefits were beyond the scope of this project, as was inclusion of the many other private benefits that could have been examined. The current project represents a 'first step' in a longer-term program of pursuing a comprehensive multiple benefits framework. This highlights the importance of continuing to build the evidence base in this area.
Attribution/contribution	Attributing benefits, such as those included in this framework, to specific programs will be an on-going challenge. The question of how much a program contributes to change in any benefit measure must be consistently present in any evaluation activities. More work needs to be done to fully understand the complex interactions that take place.
Barriers to	Although program leaders broadly agreed with the concept of a multiple

implementation	benefits framework, it has been challenging to implement. Refining tools and metrics will assist greatly, but engaging in a wider story of social and economic development took participants outside ‘business as usual’ practices. They did not necessarily have the mandate to work in such a way. The role of leadership in creating a holding environment for this work is critical. Working with program leaders on incorporating indicators in their evaluation plans, gaining and incorporating feedback from external partners on the framework, and working with all involved to understand their role, has assisted greatly with the implementation to date.
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## Conclusion

In developing the recommended approach, OEH requested that we consider and put forward methods which will provide useful and reasonably robust data on which policy and program decisions can be made, and that are as cost effective to apply as possible. Whilst this sounds simple, implementing a multiple benefits approach is inherently uncomfortable. It forces a view of the whole and cuts across silos. This is a challenging context where innovative ideas and a high degree of motivation are needed.

As multiple benefit endeavours push beyond the intellectual exercise and are operationalized into practical tools for evaluating individual programs (as well as broad state-wide and national policies), it is vital that relationships are developed with policy makers, investors and stakeholders to understand their decision-making processes. This will ensure that multiple-benefit considerations can be achieved productively.

Beyond the technical aspects discussed in this paper, implementation has prompted an exploration of an adaptive challenge in implementing this framework. From the choice of measures, to interviewing stakeholders it has become clear that there is a critical role in creating an emotional connection with the work. This emotional connection, added to the creation of an evidence base, can enable those involved to commit to taking a systems view, however challenging that may be, in order to work more effectively with entrenched social, economic and environmental challenges.

It is extremely difficult for any one sector to make progress alone. Logically, if we are thinking about energy efficiency as a co-benefit to other activities, we might also seek to find ways to identify the energy savings arising in non-energy fields where multiple benefits are occurring. This prompts a consideration of all stakeholders early and often, and an engagement framework that embeds them in the process. The collaboration required to enable a multiple benefit project should not be underestimated. It is critical for success to enhance the capacity of those involved to design, implement and measure policies and programs that capture the multiple benefits they seek.

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