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Achieving energy efficiency in government buildings through mandatory policy and program enforcement

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Abstract Government buildings are responsible for a significant proportion of energy consumption worldwide, for example, in Australia, up to 41.5 PJ energy was consumed by government buildings in 2011–2012. While the newly constructed buildings may be energy efficient, the existing buildings, which account for more than 85% of the total building stock, were built prior to the time when energy rating systems was put in practice and are consequently energy inefficient to a large degree. Reducing the energy consumption in existing government buildings is essential, as it will not only reduce the costs and environmental impacts, but also show governments' strong commitment towards the reduction of greenhouse gas emission. Furthermore, successful building energy retrofit projects are the showcases to the general public, encouraging other sectors (e.g. commercial) to conduct building retrofits for energy savings. Recognising these benefits, several state governments in Australia have introduced building energy efficiency policies and programs. This paper reviewed the energy efficiency policies/programs in five States in Australia: Victoria, New South Wales, South Australia, Western Australia, and Queensland in terms of respective policies and targets, implementation methods and current progress. The lessons learned from these programs were also discussed. This research revealed that the key factors for a successful government building

energy retrofit program are 1) having a properly enforced energy efficiency mandate with clear energy saving targets, 2) establishing an expert facilitation team and 3) implementing suitable financing and procurement methods.

Keywords building energy retrofit, policy, energy efficiency, energy performance contract, energy auditing

1 Introduction

The construction industry is responsible for a significant proportion of energy consumption and greenhouse gas emissions. Amongst different types, government buildings are one of the biggest energy consumers. For example, the Australian government buildings used 41.5 PJ energy in 2011–2012 (Council of Australian Governments, 2012). This equals to the energy usage of more than 788,000 households with average 50 GJ/household annually (Office of the Chief Economist, 2016). In terms of costs, the Australian Government spends over \$1 billion on energy and water consumptions annually (Australian National Audit Office, 2009). Most of the buildings occupied by Australian government departments were constructed before the introduction of energy efficient building code or policies/programs and are energy inefficient. Therefore, in order to reduce the costs and the harmful GHG emissions, it is crucial to reduce the energy consumption through retrofitting these old and energy-inefficient government occupied building stock.

Several state governments in Australia have introduced energy efficiency policies/programs, which require the government departments/agencies to install energy efficient retrofit measures in their buildings following the retrofitting procedure outlined in those programs. Over the years, these programs have achieved a wide range of success in reducing energy consumptions and energy bills.

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However, while implementing these policies and programs, a wide range of barriers and challenges also arose. A review of these programs, barriers and challenges would be helpful to resolve these issues in the subsequent implementation stages of these programs. Moreover, such review is also useful for national and international governments when developing building retrofit policies/programs.

The aim of this paper is to analyse the building energy efficiency policies and programs of five state governments in Australia: Victoria, New South Wales, South Australia, Western Australia and Queensland. The analysis includes review of the relevant programs, current progress, associated barriers and challenges and the important lessons learned. The retrofit policies and programs from different states are compared for its strengths and weaknesses and for drawing key successful factors. By doing so the paper answers following research questions:

- 1) What are the lessons that can be drawn from these policies and programs?
- 2) What are the key factors for implementing a successful government building retrofitting policy/program?

2 Research method and process

Given the research aim and research questions stated in the previous section, this research has adopted a case study research method. Five states (Victoria, New South Wales, South Australia, Western Australia, and Queensland) are selected for case study identification and analysis. The first part of this research consists of review of each retrofit program including retrofit policies and targets, implementation methods and current progress. Then, lessons learned from these retrofitting programs are highlighted through comparative analysis. This method is suitable as the description helps to obtain a general view of the cases, and the comparison helps draw lessons and identify implementation strategies. Based on the lessons learned, recommendations have been made. The necessary data for the current research was collected from the state government websites, relevant government reports and through direct communication and interview with responsible government personnel.

3 Review of relevant government building retrofit policies and programs

3.1 Victoria: Greener Government Buildings

3.1.1 Relevant policies and targets

Greener Government Buildings (GGB) is a Victorian State

Government program in Australia designed to improve the energy and water efficiency of existing government buildings and infrastructure (Department of Treasury and Finance, 2016). The objective of this program is to facilitate retrofitting in government buildings including offices, hospitals, schools, universities, water infrastructures, sporting facilities, and traffic lights with some typical initiatives including lighting upgrades, HVAC (Heating, ventilation, and air conditioning), solar panels, and building management system. This program uses energy performance contract (EPC) method to procure and implement energy efficiency projects. The program was first introduced in 2009 by the Department of Treasury and Finance (DTF) and was awarded with Premier's Sustainability Award in 2011 for its contribution in reducing water and energy consumptions as well as greenhouse gas emissions. GGB is a mandatory policy for all Victorian government departments and agencies. According to this policy (GGB, 2011):

- All departments must implement projects according to the EPC process or equivalent, to meet the 2012 and 2018 GGB milestones.
- All EPC projects must have a blended simple payback period of seven years or less.
- Departments are responsible for coordinating the implementation of EPC projects across their properties and those of their portfolio agencies to meet GGB targets.

The GGB milestones were:

- Facilities accounting for at least 20% of the respective government department or agency's total energy consumption must be committed to an EPC by 2012.
- Facilities accounting for at least 90% of the respective government department or agency's total energy consumption must be committed to an EPC by 2018.

In 2014 efficient government building (EGB) program replaced the GGB program in Victoria. The key difference between these two programs was that under EGB no funding was available from DTF. Each department/agency was responsible for financing the retrofitting project either internally or through budget bid. In August 2016, the GGB program was reinstated with a \$33 million government fund and with an aim to reduce GHG emission by 25,000 tonnes/year and save up to \$100 million through reduced energy consumption. However, in this new GGB program, the criteria for payback period is reduced to 5 years and there is no particular target. Instead, a "quick win" program has been mandated under which all the government departments and agencies are required to identify and implement energy retrofit measures that have the payback period of less than one year in their building properties.

3.1.2 Implementation method and process

The main delivery method used in the program is EPC (see Fig. 1). Equivalent approach to EPC is also available

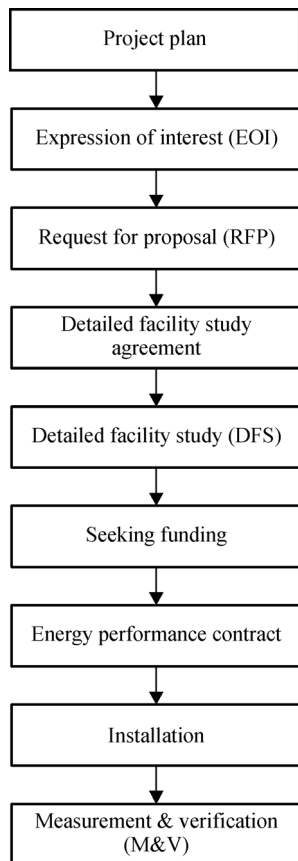


Fig. 1 EPC process in Victoria's Greener Government Buildings program (Department of Treasury and Finance, 2016)

where an agency's total energy consumption is too small to use EPC (usually less than 1GWh energy consumption per annum). In the EPC process, an energy service company (ESCO) performs auditing, identifies and installs retrofit measures and guarantees minimum energy savings. This method shifts many technical and financial risks from the government agency to the ESCO. A team of facilitators is available from DTF to provide guidance and support to the agencies for implementation of retrofitting projects under the GGB program.

As shown in Fig. 1, the retrofitting process starts with developing a project plan, which includes identifying a project manager, project scope, feasibility of an EPC, available funds, preferred timelines etc. After the approval of the project plan, a call for expression of interest is sent to a prequalified panel of ESCOs overseen by DTF. The pre-qualified ESCOs have already proven their capability of taking on similar projects from DTF. Based on the received express of interests from ESCOs, three ESCOs are selected by the agency to take part in a competitive auditing, identify retrofitting measures and propose retrofitting costs and savings during request for proposal (RFP) stage. The ESCO with the best RFP submission proposal is offered a detailed facility study agreement. The details

about the tendering process in RFP stage can be found in the GGB guideline (Department of Treasury and Finance, 2016). In detail facility stage (DFS), the ESCO carries out investment grade audit and develops a business case in collaboration with the government department/agency. The investment-grade audit is equivalent to a level 3 energy audit which offers the most detailed engineering and financial analysis (Cowan et al., 2004). For the DFS to be compliant, the ESCO need to achieve at least 80% of the proposed savings. At the end of DFS stage, the department/agency decides whether to 1) accept the DFS and implement the project, 2) not implement the project or 3) request ESCO to amend the proposal to make it compliant.

Once the DFS report is accepted, the government agencies are eligible to apply for funding to the Treasurer. However, this is an option, rather than a requirement of the GGB program. Departments and agencies may elect to access alternative funding sources. In applying to the treasurer for funding, the departments or agencies must commit to repaying the funds over a period consistent with the project's payback period (i.e., typically around five to seven years), using the project's cost savings to offset loan repayments. Once funding is approved, the EPC may be signed between the departments/agencies and the ESCOs. The EPC contract includes details of the agreed scope of works, commissioning procedure, maintenance schedules, project costs and performance guarantee, including measurement and verification (M&V) plan. The next stage is the installation of retrofitted measures, which can be carried out by the selected ESCO or by subcontractors engaged by ESCO. Finally, the M&V plan is developed which describes the responsibilities of the ESCO to measure and verify the project savings, and responsibilities of the customer to provide access to supporting data. The M&V plan may include the requirement for certain solutions to be measured and verified annually over the terms of the contract, however, it may also allow for other solutions (e.g. those less prone to changing in performance over time) to be verified over a shorter timeframe (e.g. a single verification several months after implementation). If savings in any year fail to meet the guaranteed savings (as stated in the EPC), the ESCO is required to reimburse the agency to the degree of the shortfall.

The VIC Government recognises that EPC is not suitable for all projects. In instances where the electricity consumption is less than 1 GWh, initiatives are already identified, or the savings risk is low and does not require a guarantee, the departments may procure work directly, foregoing the process of engaging more than one ESCOs and identifying measures through competitive auditing. But even in these instances, the project should meet the payback period criteria, carry out M&V to verify savings and same service provider should be engaged for initial auditing, installation, commission and M&V.

3.1.3 Current progress

Since 2009, the Victorian Government has invested \$134 million on upgrading 389 buildings under GGB program. Over the 15 years, these projects are estimated to achieve cost savings of \$335 million, resulting in a positive net present value of \$107 million and the annual avoidance of 134,000 tons of greenhouse gas (GHG) emissions (a 5.1% saving on total government building emissions). (Victorian Government Purchasing Board, 2016). As of 2016, 22 projects are underway (Victorian Government Purchasing Board, 2016). Some of the prominent projects are Melbourne Cricket Ground, RMIT City Campus, Federation Square, Museums Victoria, and Metropolitan Fire Brigade.

3.2 New South Wales: Government Resource Efficiency Policy

3.2.1 Relevant policies and targets

In 2012–2013, the NSW Government consumed more than 1800 GWh of electricity, accounting for more than \$390 million. Also, the government building uses over 17 billion litres of water annually (OEH, 2014b). With the purpose to reduce NSW government agency operating costs by implementing resource efficiency measures, the Office of Environment and Heritage (OEH) announced the Government Resource Efficiency Policy (GREP) in 2014 (OEH, 2014b). The GREP includes measures, targets, and minimum standards to drive efficiency in energy and water use and waste reduction and improving indoor air quality. Compliance with GREP is mandatory for general government sector agencies on a whole-of-cluster basis. The NSW agencies are divided into ten clusters including education; family and community services; finance, services and innovation; health; industry, skills and regional development; justice; planning and environment; premier and cabinet; transport and infrastructure; and treasury (The NSW Treasury, 2015). The GREP requires agencies to:

- Incorporate resource efficiency considerations into all major decisions.
- Address the challenge of rising energy, water, clean air and waste management costs.
- Leverage their purchasing power when procuring resource-efficient technology and services.
- Publish annual statements of their performance against the policy.

There are 13 targets spreading across four areas, i.e., energy (E), water (W), waste (P), and clean air (A). Each target has different coverage and deadline. For the purpose of this research, only the energy and water efficiency targets are summarised in Table 1 (OEH, 2014b).

3.2.2 Implementation method and process

Similar to the GGB program, the GREP program also uses EPC to deliver energy efficiency project in NSW. A panel of pre-qualified energy service companies (ESCOs) is available from OEH, which the agencies can access to help identify energy-efficient projects and achieve project savings. A sustainable government team is also available from OEH to help the agencies to:

- Build the business case for their projects.
- Obtain approval to explore opportunities.
- Engage suppliers.
- Secure low-cost finance.
- Reduce the risks associated with implementation.
- Provide measurement and verification (M&V), and post-implementation support.
- Achieve the targets by minimising the use of agency's own staff.

There are several ways to finance the building retrofit projects in NSW that includes self-funding, commercial loan, energy efficiency loan, operating lease, capital lease, environmental upgrade agreement (EUA), on-bill financing, and energy services agreement. When selecting the best option, the Government agencies need to consider two important questions:

- 1) Which finance option best suits my preferences?

Table 1 The relevant energy and water efficiency target extracted from NSW's GREP

E	
Relevant energy targets	
E1	All clusters will undertake energy efficiency projects at sites representing 90% of their billed energy use by the end of 2023–2024 financial year, with an interim target of 55% for health and 40% for other clusters by the end of 2017–2018
E2	Large government owned and leased office buildings and data centres will achieve and maintain a NABERS Energy rating of at least 4.5 stars by June 2017
E3	All new electrical equipment purchased by government must be at least the market average star rating or should be recognised as high efficiency
E5	Small government sites will self-assess their suitability for solar leasing by July 2015
E7	Purchase a minimum of 6% Green Power
W	
Relevant water targets	
W1	All agencies should report on water use
W2	All new and refurbished government owned office buildings and leased office buildings with a net lettable area of over 2000 m ² will achieve a whole building NABERS water rating of 4 stars where cost-effective
W3	All new water-using appliances, shower heads, taps and toilets purchased by government agencies must be at least the average WELS star rating by product type

2) What are the expected financial outcomes with different finance option(s)?" (OEH, 2014a).

To be more specific, the factors affecting the decision-making are 1) the acceptable risk level; 2) impacts on the organisation's budget schedule (balance sheet); and 3) asset ownership and affordability for the capital expenditure. For the government clusters, the preferable financial mechanism can be the use of the Government Finance and Environmental Upgrades Agreement (EUA) (OEH, 2013). Moreover, the sustainable government team can also help the agencies to access crown finance from NSW treasury.

3.2.3 Current progress

In the five years prior to the introduction of GREP, the average annual uptake of the government finance facility to implement energy efficiency projects at government sites was only \$2.7 million. During the first year of GREP implementation, the government loan uptake reached to \$10.3 million, which is close to four times as much as that in previous five years. It is estimated that these retrofitting projects will result in \$1.5 million annual savings on government energy bills. These figures demonstrate that the GREP is driving energy efficiency activities across NSW government (GREP progress report, 2016). Most NSW Government clusters have taken energy efficiency actions complying with the GREP requirements in one way or another. Fifty-two energy efficiency projects were undertaken by agencies in 2014–2015. 74% of agencies reported under GREP policy have obtained or are planning to obtain a NABERS energy rating of at least 4.5 stars and NABERS water rating of at least 4 stars by June 2017.

A review of the current progress shows that the Health cluster is responsible for the maximum energy consumption and over 50% of government emission (Audit Office of New South Wales, 2013). Nevertheless, it failed to achieve the energy reduction target; only 2% reduction in energy use since 2009. This is due to 1) the lack of clear energy efficient strategies and plans, 2) limited scope of energy efficiency measures, and 3) lack of funding options (Audit Office of New South Wales, 2013). With the first problem, the NSW Health has issued the Health Resource Efficiency Strategy 2016–2023 (HRES) in May 2016 to drive energy efficient activities in all its agencies and local hospitals. The further actions required are more technical supports and right incentives as well as managing projects' cost (Audit Office of New South Wales, 2013).

For other government clusters who have conducted building retrofits and monitored the performance, there are clear milestones for them to achieve in order to reach the final target. For instance, the education cluster needs to save \$23 million more to reach its 40% interim target; the industry, skills, and regional development cluster still has \$2.15 million more; and transport and infrastructure cluster needs to cut \$25 million more electricity cost.

3.3 South Australia: Government Building Energy Strategy

3.3.1 Relevant policies and targets

The Government Building Energy Strategy (GBE strategy) is a key strategic document of South Australian government to improve energy efficiency within government building. The GBE strategy updates and replaces the previous SA Government "Energy Efficiency Action Plan" which was endorsed by the Cabinet in 2002 (GBE strategy, 2013). The strategy was introduced in 2013 to realise three main objectives:

1) To achieve South Australia's Strategic Plan Target 61 (SASP T61).

2) To reduce energy costs to government, compared to business as usual.

3) To reduce greenhouse gas emissions associated with the operation of government buildings.

The 2011 update of SASP T61 states that energy consumption of government buildings should be improved by 30% by 2020 using 2000/01 level as baseline (milestone of 25% by 2014) (South Australia's Strategic Plan, 2011). The government building energy group (GBE group), which consists of at least one member from each portfolio agency, coordinates the implementation, reporting, and review of GBE strategy.

The GBE strategy is divided into several milestones throughout the lifecycle of the government buildings. Each milestone presents an opportunity to improve the energy performance and reduce energy costs of government buildings, e.g., targets for new buildings, new lease, and retrofitted buildings (GBE strategy, 2013). In this research, only the milestone for building retrofitting is considered and the action plans under this milestone are presented below:

- Develop and implement energy efficiency investment proposals through the budget bid process, using the Government Buildings Energy Efficiency Investment (GBEEI) programs.

- Mandate minimum energy efficiency standards for substantially refurbished acute healthcare facilities and primary and secondary education buildings.

- Ensure all major upgrades to government-owned office accommodation greater than 2000 m² floor area in the Adelaide CBD seek to achieve and maintain a minimum 4.0 star NABERS Energy rating (where economically viable).

The GBEEI program was developed based on the existing similar programs in Victoria GGB and NSW GREP. This program, under a mandate approved by the Cabinet on 23rd November 2015, requires that

1) by 30 June 2016, all agencies must have identified all energy efficiency upgrade opportunities with an average simple payback of seven years or less, at government-owned sites accounting for at least 30% of the agency's total energy consumption; and

2) by 30 June 2017, all agencies must have identified all

energy efficiency upgrade opportunities with an average simple payback of seven years or less, at government-owned sites accounting for 100% of the agency's total energy consumption (Department of State Development, 2016).

3.3.2 Implementation method and process

The GBEEI program under GBE strategy recognised EPC as the cost-effective energy efficiency investment in SA Government buildings. The retrofitting process under the GBEEI program is presented in Fig. 2. (Department of State Development, 2016). Funding is available from the Department of Treasury and Finance (DTF) to implement the identified energy efficiency opportunities that fulfill the above-mentioned payback requirement subject to the final approval of the Treasurer.

Similar to the GGB and GREP program, a central facilitation service is available from the Department of State Development (DSD) to help the agencies throughout the retrofitting process in their buildings. The Central Facilitation Service includes representatives from DTF and the Department of Planning, Transport, and Infrastructure to support the agencies. In addition, a list of qualified ESCOs with required competencies in delivering energy performance contracting projects is also available from the website of DSD. The facilitation service team is responsible for maintaining the list of qualified ESCOs. The pre-qualified ESCOs have demonstrated required competencies, previous experience in delivering EPC projects, and/or attained Energy Efficiency Certification Scheme accreditation.

The process of delivering energy efficiency project using EPC is similar to the process in GGB in Victoria and therefore, is not repeated here. However, the templates, checklists, and requirements are adjusted according to the need of South Australia.

3.3.3 Current progress

According to the annual energy efficiency report (AEER) of 2014–2015, the energy efficiency of South Australian government-owned and leased buildings improved by 22.1% compared to the 2000–2001 baseline (Department of State Development, 2015). Although the improvement is less than the 2013–2014 improvement of 23.8%, it is on track to meet the 2020 milestone of 30%. The decrease in efficiency in 2014–2015 compared to the 2013–2014 may be attributable in part to the weather patterns for the year. The months of August 2014 and April through to June 2015 recorded lower than average temperatures, while November 2014 through to March 2015 were above average. In 2014–2015, 80% of the office floor space leased by the government in CBD buildings had been reported to have NABERS energy rating of 4 or more stars (Department of State Development, 2015).

3.4 Western Australia: Energy Smart Government

3.4.1 Relevant policies and targets

The Energy Smart Government (ESG) program is Western Australian government initiative to focus on energy efficiency within government buildings. The program was established in 2002 to reduce the costs of energy consumption in government buildings and to be an example for driving change in the general community and business (Western Australian Auditor, 2010). The first phase of the ESG program was finished in 2007 and second phase started one year after. The requirements of the ESG program were communicated to agencies through a Premier's Circular. In the first phase, the ESG policy requires the government agencies with 25 or more full-time employees to reduce energy consumption by 12% over five year period from 2002–2007 (Western Australian Auditor, 2010). In the second phase that started from 2008, the absolute consumption reduction target for all government agencies was replaced by agencies determining their own energy intensity targets (Department of Premier and Cabinet, 2008). At this stage, no information is available about the current status of the second phase of ESG program.

3.4.2 Implementation method and process

During the first phase of the ESG program, the Sustainable Energy Development Office (SEDO), a division of the Office of Energy was given the responsibility to manage the ESG program. In the second phase, the duty of SEDO was transferred to Public Utilities Office, Department of Finance (Colin Murphy, 2010). Unlike the GGB, GREP and GBE programs there is no guideline provided to the departments/agencies for implementing the ESG program in their buildings. The agencies that participated in the ESG program have developed their own energy efficiency retrofitting plan and implemented it using their own resources with financial assistance from SEDO. For instance, the Polytechnic West (a Western Australian government agency) appointed a Sustainability officer who was responsible for conducting building energy efficiency retrofits (Stivey, 2011). The upfront cost for this project was provided by SEDO.

For the second stage, each participating agencies needed to develop their energy management plan (EMP), signed by the agencies' chief executive and submitted to SEDO for approval (Department of Premier and Cabinet, 2008). There were problems associated with this process such as 1) some agencies (about 17) did not develop appropriate EMPs and most of the documents were unusable; and 2) the SEDO was transferred to Public Utilities Office under Department of Finance in 2012 which created administrative issues (Colin Murphy, 2010).

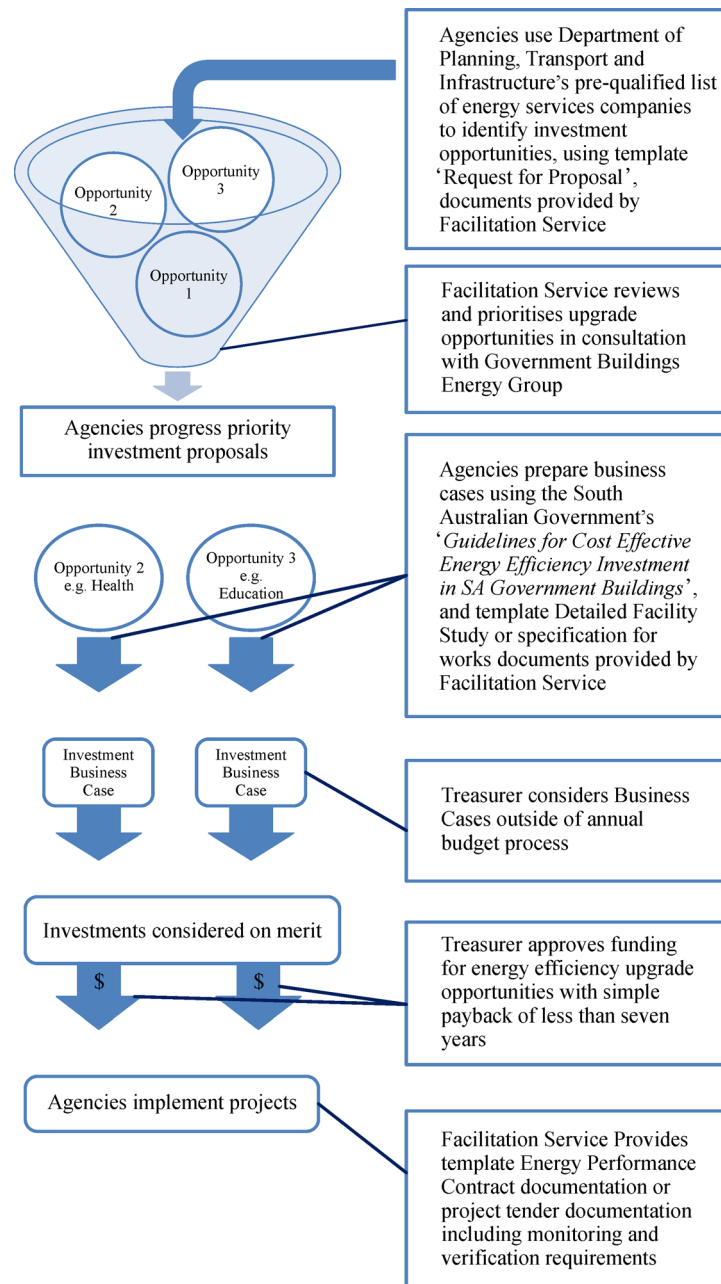


Fig. 2 Process and roles in South Australia Government Building Energy Efficiency Investment program (Department of State Development, 2016)

3.4.3 Current progress

At the end of first phase of ESG program, the actual reduction in energy consumption was only 0.1% whereas the target was to reduce 12% over five years (2002 to 2007). Although one-third of the agencies succeeded in meeting their target, these reductions were offset by a lack of progress among larger energy consuming agencies. In many agencies, energy saving opportunities were identified using facilitation grant but were not implemented despite the availability of capital advance funds. Those agencies indicated that they were not prepared to take the

risk of energy efficient upgrades because they were not convinced that the recommendations were achievable within the allocated budget or estimated payback periods. In the first phase of ESG program, the government committed \$16 million in capital advance funding for energy efficiency upgrade, however, nearly \$12 million of the allocated fund left unused. SEDO was not strategic enough to manage the program. They had financial incentives to distribute but did not use them adequately to leverage success (Western Australian Auditor, 2010). The second phase of the ESG program did not incorporate the lessons learned from the first phase; failed to address

the shortcomings of the program adequately. Therefore, it is unlikely that the second phase would be successful in realising existing energy saving opportunities or identifying new ones (Western Australian Auditor, 2010).

3.5 Queensland: Strategic Energy Efficiency Policy

3.5.1 Relevant policies and targets

In April 2007, the Queensland Government introduced Strategic Energy Efficiency Policy for Queensland Government Buildings. This program was introduced as part of the “Climate Smart 2050-Queensland climate change strategy” initiative where the Queensland government committed to playing its part in meeting a national GHG emission reduction target of 60% by 2050. This Strategic Energy Efficiency Policy demonstrates leadership by addressing energy efficiency in all government buildings. The following mandatory minimum targets and timeframes for reducing energy consumption were established for all government buildings:

- 5% reduction by 2010.
- 20% reduction by 2015.

Energy consumption figures for 2005–2006 was used as comparative baseline to achieve the target.

3.5.2 Implementation method and process

Individual departments are directly responsible for implementing energy efficiency measures in their buildings in accordance with the Policy and Strategy. All departments are required to develop and implement an Energy Management Plan (EMP) for their building portfolio. The EMP includes activities regarding prioritising buildings for energy efficiency, undertaking energy audits of targeted buildings; identifying energy saving opportunities and installing retrofit measures, implementing educational and training programs for staff regarding energy efficiency etc.

The QLD Department of Housing and Public Works is responsible for overseeing the implementation of this Policy. They provide technical advice, operational guidelines, and practical support to the departments in implementing this policy in their buildings. They also assist departments in the preparation of business cases to support funding requests to Queensland Treasury Corporation. All of the management and control activities that are undertaken by the Department of Housing and Public Works on behalf of the departments is funded from the Government Energy Management Strategy (GEMS) program.

A Program Coordination Group, which includes representatives from Department of Housing and Public Works, Department of Mines and Energy, Queensland Treasury and Environment Protection Agency, is available to review and advise on the effectiveness of the policy. The group also review the formulation of funding submissions for

whole-of-Government programs and, as required, review and advise on specific departmental programs.

3.5.3 Current progress

The progress achieved towards energy efficiency under this policy is currently unknown. No information is available in the government website regarding the outcome of this strategic policy. It was understood from direct communication with the government officials from Department of Housing and Public Works that this policy was scrapped shortly after it was introduced due to the change of government.

4 Lessons learned

Each State experienced some successes and challenges or barriers while implementing the energy efficiency policies and programs according to the characteristics, policies, templates, procurement procedure, funding provider, etc. There are some important lessons to be learned. These lessons will be helpful for the governments in revising the existing policies and programs or developing new energy efficiency policies or programs. Figure 3 summarizes the important lessons learned through analysing the energy efficiency policies and programs of the five States.

4.1 Mandating targets

Victoria state government’s 2009 GGB program had a mandate of implementing energy performance contract (EPC) in government departments/agency within certain time (section 3.1.1). During 2009–2012, the program resulted in annual direct cost savings in utilities and maintenance bills of \$32.17 million. The net present value of the first 19 projects was \$125 million in 2012 (Greener Government Building Performance Report 2009–2012). In NSW, the average annual investment in energy efficiency projects at government sites increased fourfold from \$2.7 million to \$10.3 million within first year of implementing of the mandatory GREP program. These demonstrate the importance of mandating a target in building retrofitting program. Following the footsteps of VIC and NSW, the SA government introduced a mandate in November 2015 which requires the government agencies to identify energy efficiency upgrade opportunities in their sites within certain time as mentioned in section 3.3.1.

4.2 Setting input and output targets

The energy efficiency target in Victorian GGB program is an input type target that requires the government

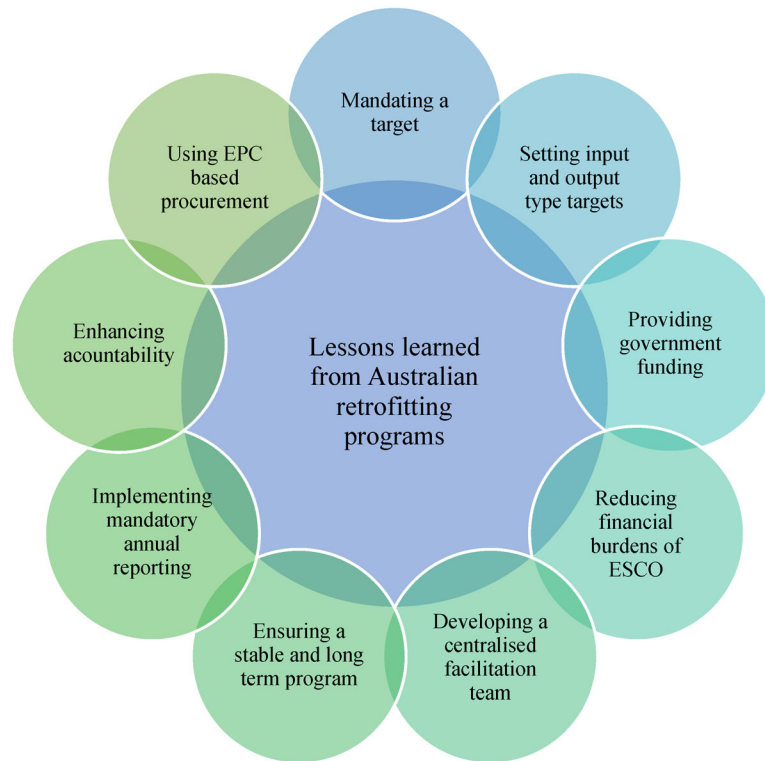


Fig. 3 Lessons learned from different Australian states' building energy retrofitting programs

departments or agencies to identify and implement energy efficiency upgrade within certain timeframes. On the other hand, NSW's GREP program has both input (implement energy efficiency upgrade within certain time) and output (at least 10% savings, minimum NABERS energy and water rating) type targets. The output target in GREP resulted in a drive for achieving the minimum target rating amongst the departments/agencies as discussed in section 3.2.3. The output type target in GBE strategy of SA also resulted in having NABERS energy rating of 4 or more stars in 80% of the office floor space leased by the government in Adelaide CBD. The overall output type target of reducing 30% energy consumption from government sector by 2020 also helps the SA government to realise the improvement in energy efficiency compared to the base level and the level of energy reduction required to reach as the 2020 target.

4.3 Providing government funding

When the Victorian's GGB program was changed to EGB program, no government funding was available for implementing projects. As a result, there was a significant drop in government building retrofitting activities. Even worse, a number of planned energy efficiency retrofits in Austin Health, Monash Health, Northern Health, West Gippsland Health Services, Latrobe Regional Hospital, Peninsula Health, and Western Health, Alfred Health, Barwon Health and St Vincent's Hospital in Victoria were ditched due to the changes in the program. Also, retrofits to

schools and hospitals around Victoria, including in Frankston, Monash, Footscray and Geelong were put on indefinite hold (Tina Perinotto, 2014). This incident demonstrates the need for having a suitable government funding arrangement for energy efficiency project.

4.4 Reducing financial burden of ESCOs

In the Victorian 2009 GGB program (GGB, 2011), three ESCOs would carry out initial auditing of the sites and submit a proposal outlining the savings and costs that their companies can offer. The ESCOs have to bear the expense of auditing themselves. While one of them will win the tender and be assigned the project, the other two companies will not only fail to attain the contract but also will not be reimbursed for their initial investment into the auditing and the drafting of the proposal. This was identified as a major barrier in the GGB program because most ESCOs ended up decided not to take the risks and ultimately backed out of the program (Zhang et al., 2015). Even the winning ESCO is only compensated at the end of the investment grade auditing and project development stage, and such compensation could get further delayed due to the inefficiencies by several parties that are involved in the program (Zhang et al., 2015). In the 2016 GGB guidelines, the financial burden of the ESCOs has been minimized through introducing new regulations which allow them to invoice for 50% of the investment grade auditing fee before starting this stage (GGB, 2016).

4.5 Developing a centralised facilitation team

The facilitation teams in VIC, NSW and SA played a significant role in implementing the energy efficiency projects in different government departments and agencies. The team is available to assist departments and agencies with facilitation services for the scoping, procurement, implementation and management of EPC. It was observed that assisting the government agencies in different aspects of a project may reduce the time taken at different stages, and allow for better project outcomes.

4.6 Ensuring a stable and long term building energy retrofit program

A stable and long term building energy retrofit program that does not change significantly with time is a precondition for achieving positive outcomes from a building retrofitting program. When the Victorian GGB program was changed to EGB program in 2014, a number building energy efficiency projects did not go ahead and the ESCOs that were involved in preliminary auditing for those projects ended up incurring major investment loss (Tina Perinotto, 2014). This sort of incidents could negatively influence the ESCOs to get involved in government building retrofitting activities. Also, the government building retrofitting strategy in Queensland was introduced in 2007 but was terminated shortly after that due to the change in government.

4.7 Implementing mandatory annual reporting

According to GREP of NSW, each government agency should provide a report annually including their annual energy consumption, water consumption and number of energy efficiency projects undertaken in that year and estimated annual savings. This mandatory annual reporting scheme would have the potential to influence the retrofitting decision making in different government departments/agencies. Direct conversation with government officials in Queensland revealed that this sort of mandatory annual reporting creates peer pressure on the government departments/agencies to perform better.

4.8 Enhancing accountability of relevant departments

Lack of accountability may be one of the many reasons for not achieving the desired outcome from WA's ESG program. At the end of this program, two-third of the government agencies did not achieve the retrofitting targets. Many agencies identified energy savings opportunities but did not implement them. There was no accountability or financial penalty imposed on the agencies for not achieving the targets (Colin Murphy, 2010). The SA's GBE strategy (GBE strategy, 2013) states that the major limitation of their previous "2002 Energy Efficiency

Action Plan" was that agencies were not held accountable. There is a need for a mechanism to ensure that the departments are committed to improve energy efficiency through making them accountable for its actions.

4.9 Using EPC based procurement methods and risk transfer

In WA's ESG program many agencies did not implement the energy efficiency retrofit despite the presence of energy saving opportunities and government funds because of the risks associated with this type of projects (Colin Murphy, 2010). In the EPC-based procurement methods the technical and financial risks in achieving energy savings are shifted from the government department/agency to the ESCO. This type of performance-based contract procurement system could have driven those agencies in WA, who did not implement energy efficiency retrofit due to associated risks, to implement it.

5 Key successful factors for a building retrofitting policy/program

From the review of different government building retrofitting policies and programs and discussions on lessons learned from those programs, it was realised that the followings are the key factors for developing and implementing a successful building energy retrofitting program:

5.1 Having a properly enforced mandate with clear retrofitting targets

Mandating an energy efficiency target was found to be one of the most important success factors for achieving energy efficiency in government buildings. The retrofitting program should have a clear retrofitting target and should have an appropriate mandate to ensure its implementation within desired time frame. The target should include both input type and output type. The input type target is helpful to accelerate the retrofitting rate whereas the output type target ensures that a certain level of energy savings is achieved within the program period. The mandate should also include any mechanism to hold the departments/agencies accountable if they fail to achieve the target.

5.2 Establishing expert facilitation team

The government personnel in most cases may lack the expertise to engage and manage energy efficiency projects. The expert facilitation team will help the department/agency throughout the retrofitting process from project planning to implementation. This team reduces the time required to implement projects and minimize the use of agency resources by helping assemble the right team and providing education and dedicated assistance to reduce

agency workload. The facilitation team manages the compliant reports template, environment management plans template, standardised contract forms, guidelines for EPC procurement, etc.

5.3 Implementing suitable procurement and financing method

Sections 4.3 and 4.9 showed the importance of having a good financing and procurement method. Although having a government funding source is desired, it should not necessarily come from the government only. Whatever the source of financing is; it should be easily accessible by the government departments and agencies. It was reported that vast majority of government departments in Victoria are prevented from borrowing money from general market and must borrow it from public account (Tina Perinotto, 2014). A suitable procurement method can help the government agency to effectively implement the energy efficiency retrofitting and achieve the desired savings with minimum risks.

6 Conclusions

In this paper, the government building energy efficiency policies and programs of five different states in Australia were analysed in terms of program targets, implementation methods and current progress. It was then followed by a discussion of important lessons learned from the programs. The review showed that Victoria's EPC based GGB program is successful in retrofitting their government building stock. The NSW's GREP program is also found to be making significant progress. The NSW government investments in building energy retrofitting projects increased four times within first year of implementing the mandatory GREP policy compared to that of previous years. These programs are successful largely because of having a mandate to achieve the target and use of EPC based procurement method. The availability of government fund in the form of a loan is also observed to be an important success factor for the VIC's GGB program. Following the success of VIC and NSW, the SA government also adopted EPC based building retrofitting program to fund deep retrofit project (over \$1 million) for government buildings. Although the WA's ESG program had an energy savings target and available government fund, the program failed to achieve the desired energy savings target largely because of the absence of suitable procurement program. Also, there was no mechanism to hold the individual departments/ agencies accountable if the retrofitting target was not achieved. The lack of a stable and long term building retrofitting program resulted in the failure of QLD's strategic energy efficiency policy. It also resulted in termination of the GGB program in 2014, which

scrapped a number of planned retrofitting activities at that time and incurred huge loss to the ESCOs.

In conclusion, the key successful factors for government building retrofitting programs are: 1) properly enforcing a mandate with clear retrofit targets, 2) establishing an expert facilitation team and 3) implementing suitable procurement and financing methods. The government should not only introduce mandates and targets but also use appropriate mechanisms to enforce them and achieve the desired outcomes. An expert facilitation team from the state government is part and parcel of a successful building energy retrofit program. The team will help the departments/agencies to plan, manage and implement the retrofit project by following retrofit guidelines as the government personnel may lack the expertise in managing energy efficiency projects. An easily accessible financing source is required to cover the upfront costs of the retrofitting project. Finally, a suitable procurement method such as EPC, is required to minimise the associated risks and effectively implement building energy efficiency upgrade to achieve the desired savings.

The main contributions of this paper are discussions of important lessons learned from the previous program and identification of key factors for a successful building energy retrofitting program, both are useful for future practical references.

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