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RP3044: Mainstreaming Low Carbon Retrofits in Social Housing

Summary of Existing Processes for Upgrading and
Maintenance of Social Housing Properties



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The authors confirm that this document has been reviewed by the project's steering committee. These reviewers provided constructive feedback, which was considered and addressed by the authors.

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Acronyms

AHO: Aboriginal Housing Office

CEFC: Clean Energy Finance Corporation

CHP: Community Housing Provider;

FACS: NSW Department of Family and Community Services;

LAHC: Land and Housing Corporation;

PAS: Property Assessment Survey

SHP: Social Housing Provider



1. Introduction

The need to improve the poor performance of the existing residential building stock in Australia is pressing, as the currently existing housing stock will still make up almost 60% of the housing stock in Australia in 2050. (The demolition rate of residential buildings has been estimated at $\approx 0.18\%$ p.a., and the rate of new stock addition at $\approx 2\%$ pa).

The recent ASBEC ‘Low Carbon, High Performance’ report highlighted the potential for a reduction of 100Mt in Australian Greenhouse Emissions through Existing Building Retrofits to be achieved by 2050 with a resultant \$9 billion in cost savings, with residential buildings accounting for about half of this amount. However, there has been little progress nationally in developing a Business Ecosystem to deliver this outcome.

The ASBEC report noted that *‘Despite the achievements of market leaders, broader progress in energy efficiency - particularly retrofitting of existing buildings - has been slow, with overall energy intensity improving by only 5 per cent in residential’* over the past decade. In particular, addressing the needs of low income households who *‘tend to live in more inefficient dwellings than other households, spend more of their household income on energy, and face stronger barriers to upgrading’* (ASBEC, 2016), has been identified as a key area for action.

The Department of Industry, Innovation and Science’s National Energy Productivity Plan (NEPP) , a key policy to meet Australian 2030 emissions reduction commitments, recognises that we need to “make choice easier” for consumers to realise improvements in residential building energy efficiency. Measure 4 in the NEPP also highlights the importance of supporting vulnerable consumers (e.g. community housing tenants) to reduce the barriers for their engagement with energy productivity measures. Service providers (which include Social Housing providers) are identified as important agents that can facilitate engagement of these consumers.

The social and community housing sector represents a significant opportunity for the development of a major, aggregated approach to low carbon retrofits in large portfolios of residential building stock. For example, in 2014, there were 150,358 houses in the Social Housing sector in New South Wales, this included both publicly managed properties (117,915) and those managed by community housing providers (32,443). Dwellings managed by CHPs may be state owned, e.g. by the NSW Land and Housing Corporation (LAHC) or by the NSW Aboriginal Housing Office (AHO), privately owned, or owned by the CHP. The management of these properties involves significant investment in maintenance and regular upgrades (\$284.9 million in 2015/16), to maintain dwelling quality in accordance with relevant regulation and maintenance standards.

Social Housing tenants are particularly vulnerable to energy price rises and extreme weather conditions. Their energy bills are typically a relatively higher proportion of household income, as they spend long hours in their homes [3]. Tenants of Social Housing properties are also more likely to be in fuel poverty (defined as having an expenditure on gas and electricity more than 10% of household income); 11.8% of Social Housing renters were found to be in fuel poverty, compared with 4.8% for the whole population [4]. Liu and Judd [5] reported that low income households were using compensatory measures to cope with energy bills, including: selective heating and cooling, rationing their use of appliances, finding alternative methods of staying comfortable (e.g. going to a shopping centre on hotter days), and skipping, or seeking assistance, on other essentials (e.g. food and medication) to allow them to pay bills.

The Social Housing sector in NSW is currently in a period of transition. Future Directions for Social Housing [6] sets out a 10-year transition plan for Social Housing in NSW, including

substantial construction of new housing, and transfer of management from state housing to CHPs. This represents a substantial change to the Social Housing sector, and presents an opportunity for CHPs to establish best practice systems as they adapt to the changing situation. Future Directions has a specific action item committing to provide ‘better maintenance and community amenity’, as well as a commitment to provide ‘improved physical environment in Social Housing areas’.

Importantly, the NSW Office of Environment and Heritage (OEH) are currently delivering a major upgrade program in the community housing sector; the ‘Home Energy Action’ program (HEA). This \$26.8 million program is targeted at low income, vulnerable householders, with the aim to improve access to high cost, high return, energy efficient appliances and building upgrades. The community housing stream is aiming to upgrade 2,500 homes in the sector, by providing 50% co-funding for a pre-defined range of upgrade measures.

In late 2016, the University of Wollongong Sustainable Buildings Research Centre (SBRC) commenced a project designed to assist Social Housing Providers (SHP) (including Community, Public and Aboriginal Housing Providers) to embed low carbon retrofits into their property maintenance and upgrading processes. The Mainstreaming Low Carbon Retrofits in Social Housing (RP3044) project had the overall aim to assist Social Housing Providers to cost-effectively upgrade their housing stock to improve the energy efficiency and thermal comfort. The project included three main activities: i) compiling the existing evidence base regarding direct benefits, co-benefits and risks of relevant upgrade options, ii) working with stakeholders to assemble the existing evidence into user friendly formats, and iii) conducting living laboratory monitoring and evaluation of a range of key technologies.

This interim report is focussed on clearly outlining the system in which Social Housing Providers currently operate, and the processes and practices employed to meet current maintenance requirements. This understanding was developed from a review of relevant literature, and a series of interviews with stakeholders in the Social Housing sector. The report presents information on the Social Housing sector, regulatory and other maintenance obligations, and options available for accessing external funding. Preliminary recommendations on the best ways to use the outcomes from the current project (RP3044) to influence the uptake of low carbon upgrades in this sector are also presented. The opportunities identified in this report will be considered by the RP3044 steering committee, as well as invited representatives from CHPs.

2. Organisational Structure of Social Housing in NSW

Social Housing is an umbrella term for a range of subsidised housing options, which provide accommodation for vulnerable community members who are unable to access suitable accommodation in the private rental market. Social Housing may be provided by government, not-for-profit or private organisations, and includes Public, Community and Aboriginal Housing, along with associated services.

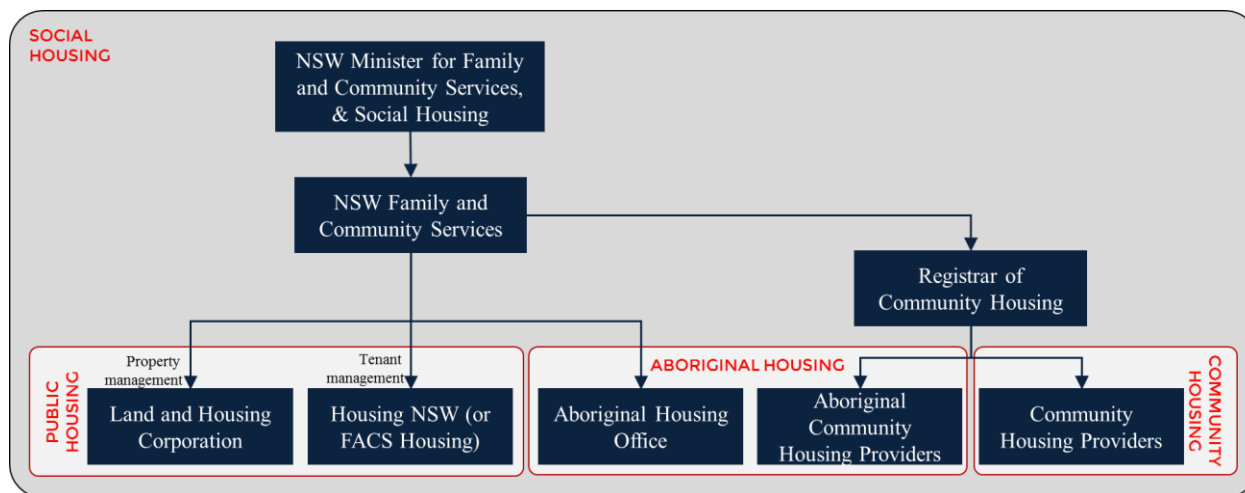


Figure 1. Social Housing organisational structure in NSW.

In NSW, the Social Housing sector is managed by the NSW Department of Family and Community Services (FACS). FACS oversees the management of:

- **Public Housing:** Public Housing is owned and managed by the government. In NSW, these properties are owned by the NSW Land and Housing Corporation (LAHC), and managed by FACS Housing. LAHC owned 131,936 properties in 2015/16, and managed an estimated 122,000 of these (the balance being leased). In 2015/16 108,637 households were living in these properties.
- **Community Housing:** Community Housing is managed by registered not-for-profit Community Housing Providers (CHP). There are approximately 19,000 of these properties in NSW, with 141 CHPs registered with NSW as their primary jurisdiction. Community Housing properties may be owned by LAHC (majority), a CHP, or by private owners, and are managed by a CHP subject to FACS regulations. CHPs are regulated by the NSW Registrar of Community Housing. Community Housing Providers are categorised as Tier 1, Tier 2 and Tier 3 based on the scale and scope of the provider's community housing activities (Tier 1 providers being the largest).
- **Aboriginal Housing:** Aboriginal housing is housing owned by the Aboriginal Housing Office (AHO), a FACS department. There are approximately 4,300 of these properties. Aboriginal Housing tenancies may be managed by the AHO, Housing NSW, or Aboriginal Community Housing Providers (ACHP).

As can be seen in Figure 2, a significant majority of Social Housing in NSW is currently both owned and managed by the NSW government. The majority of community housing is also owned by the NSW government, although 42% is owned either by the CHP or private sector.

		Asset ownership							
		Government		Community		Private sector			
		LAHC	AHO	CHPs	ACHPs	Private sector			
Asset management	Government	LAHC	110,524 (74%)	4,685 (3%)	-	-	2,706 (2%)	117,915 (78%)	78%
		AHO	-	-	-	-	-	-	
	Community	CHPS	15,825 (11%)	-	5,820 (4%)	-	5,840 (4%)	27,485 (18%)	22%
		ACHPs	-	-	-	4,958 (3%)	-	4,958 (3%)	
			126,349 (84%)	4,685 (3%)	5,820 (4%)	4,958 (3%)	8,546 (6%)	150,358 (100%)	
			87%		7%		6%		

Figure 2. Ownership and management of NSW Social Housing dwellings [1].

2.1. Future Directions for Social Housing in NSW

In 2009 the Commonwealth and State Governments agreed to support the development of the Community Housing sector, and to encourage the sector to own or manage up to 35% of Social Housing properties. This agreement included the provision of Commonwealth funding for the sector. In 2016, the NSW government released the *Future Directions for Social Housing* report [6], outlining a 10-year strategy for Social Housing in NSW. The report contained three strategic priorities (shown in Figure 3):

1. More Social Housing;
2. More opportunities, support and incentives to avoid and/or leave Social Housing; and
3. A better Social Housing experience.



Figure 3. NSW Government strategic priorities for Social Housing 2015 – 2025 as outlined in *Future Directions for Social Housing* [6].

The *Future Directions* report included a goal for greater private and non-government involvement in the Social Housing sector, including “financing, owning and managing a significantly expanded stock of social and affordable housing assets”. As well as pursuing private involvement in redevelopment of LAHC properties, FACS is currently in the process of transferring tenancy

management responsibility for a substantial number of public housing properties to non-government (i.e. community) housing providers. The 10-year goal is for CHPs to manage 35% of all Social Housing properties in NSW (i.e. an increase of properties managed by CHPs from approx. 19,000 to approx. 51,000). Management transfer will be conducted based on geographic location, with properties in the Shoalhaven, Mid North Coast, Hunter New England (excluding the Newcastle and Lake Macquarie local government areas) and Northern Sydney (excluding the Ivanhoe Estate) slated for transfer.

One of the key strategic priorities in the *Future Directions* plan is ‘a better experience in Social Housing’, including the provision of suitable, safe and quality housing. This priority has been further expanded by LAHC to include ‘a better Social Housing experience – (ensure thermal comfort does not cause energy poverty)’ [7]. Under the competitive tender process for CHPs wishing to participate in the management transfer of LAHC properties, CHPs will be required to “work toward achieving, measuring and reporting on how tenant outcomes have improved through the Social Housing Outcomes Framework” (currently under development, based on the Human Services Outcomes Framework [8]). The Human Services Outcome Framework includes two impact pathways related to the provision of good quality housing, one leading to improved health outcomes, and the other leading to feelings of safety via housing in safe environments.

As part of the asset transfer to Community Housing, the Community Housing provider must commit to the development of additional affordable and Social Housing properties, using asset values to access additional funding. In May 2012, 1200 new dwelling were planned in NSW. Whilst no specific target is provided, CHP environmental sustainability initiatives, practices and awards are listed as a consideration in assessing CHP performance in the Social Housing Management Transfer program [9].

3. Public Housing Asset Management and Maintenance: Energy Efficiency and Thermal Comfort

The management and maintenance of Social Housing properties in NSW is governed by a range national and state legislation and regulation, as well as FACS standards.

The Social Housing system is underpinned by the *Housing Act 2001 (NSW)*. The NSW Housing Act has a number of objectives; the key objective relevant to the maintenance of properties is: *(d) to ensure that public housing and community housing reflects the housing standards of the general community and is designed to cater for the ongoing needs of consumers,*

As with all properties for rent in NSW, housing providers must ensure they meet the requirements of the *NSW Residential Tenancies Act 2010* (Residential Tenancies Act). The Residential Tenancy Act includes requirements that the premises must be:

- In a reasonable state of cleanliness and fit for habitation by the tenant. Fit for habitation is understood to mean *‘that the premises might be used and dwelt in not only with safety, but with reasonable comfort, by the class of persons by whom and for the sort of purpose for which, they were to be occupied’*[10].;
- Compliant with statutory obligations relating to the health or safety of the premises (i.e. provision of smoke alarms, appropriate pool fencing, window and balcony safety, and reasonable security), and;
- Provided and maintained in a reasonable state of repair.

How far the provision of ‘fit for habitations’ relates to a landlord’s obligation regarding the energy efficiency and thermal comfort of a premises is not clearly defined. There is not currently any requirement for minimum standards of energy efficiency. A NSW Fair Trading review [11] of the Residential Tenancy Act noted: “given that a tenant is paying for the water and energy they use, landlords must ensure fittings in the property are efficient and do not result in additional costs for the tenant.”

In cases where structural defects or poor maintenance cause internal conditions which may no longer be considered fit for habitation (e.g. mould caused by a leaking roof), the landlord is liable for rectification and compensation costs. It is not always clear whether repairs are required due to tenants not meeting their obligations to keep the premises clean, or there is a structural or maintenance issue that must be addressed by the landlord. The Tenants’ Union of NSW report that mould or pest infestations are a common example of the blurred lines between a tenants obligations to clean and a landlords obligations to maintain a property [12].

FACS interprets the Residential Tenancies Act as an obligation to provide housing that is ‘clean, safe and habitable’ [12]. LAHC use a set of Asset Standards to meet this requirement, namely Design Standards, Asset Performance Standards, Basic Provision Standards and Property Assessment Surveys. These standards are discussed in the following sections.

3.1. Design Standards

LAHC design standards apply to both new buildings and the renovations of existing housing. The fundamental principles outlined in the current LAHC design standards [13] are;

- i) Compliance with National Construction Code (NCC);
- ii) Whole of life cost effectiveness balanced with innovation;

- iii) Functionality;
- iv) Energy and water sustainability (stated as meeting BASIX requirements and achieving a 6 star NatHERS rating), and;
- v) Aesthetics and a sense of home.

Section B of the design standards outlines performance standards and deemed-to-satisfy solutions for the supply of housing consistent with the design principles. There are several clauses with relevance to the energy and thermal performance of premises, including:

- Dwelling performance requirement, B4.2 states that: *Dwellings must provide cooking, bathing, sleeping, eating and entertaining spaces; have year round thermal comfort, incorporate passive solar design techniques; reduce the need for artificial lighting and ventilation; have sufficient furniture and circulation space; and provide privacy*
- Building envelope and external elements performance requirement B9.2 states: *The building fabric must control light, heat, cold, noise and air, withstand imposed loads and provide a comfortable internal environment for the occupants.*
- Energy and water sustainability performance requirement B10.1 states: *LAHC requires systems that reduce energy and water costs for LAHC and tenants.*
- Energy and water sustainability performance requirement B10.2 states: *a) Meet BASIX requirements without the benefit of the star and water ratings of washing machines, dishwashers, fridges, clothes washers, clothes dryers or air conditioning.* A number of climate based specific design responses are provided to meet this target.
- Energy and water sustainability performance requirement B10.2 states: *b. Achieve a 6 star NatHERS rating for 75% of dwellings, 5 Star for remainder.* The deemed-to-satisfy responses to achieve this include: minimising premises with southerly aspects, installation of wall and ceiling insulation, external shading as outline in Section J of the NCC, ceiling fans in living areas, and draught sealing to all doors.

As noted, the LAHC design standards apply to both new builds and major refurbishments. According to the design standards, refurbishments are defined as works required to address more than just maintenance issues, and are intended to ‘*extend the useful life of the building, improve the amenity of the grounds and facilities and integrate with tenant directed service provision*’. There is a requirement that major refurbishments deliver ‘*higher dwelling yields and lower project cost*’ than a knock-down rebuild. There are no specific additional requirements relating to refurbishments, other than the requirement that the components, landscaping and services are equal to new construction.

3.2. Asset Performance Standard

The LAHC Asset Performance Standard [14] sets out in detail how the performance of existing public housing premises are assessed to determine whether the property, or its constituent components, are in acceptable condition, and if maintenance (repair or replacement of components) is required. The Asset Performance Standard details performance requirements for 50 individual components, based on three measures:

- **Safety** - A failure that could cause a risk of injury. Components that have a safety-related failure will need to be made safe and repaired in a shorter timeframe (Steps will need to be taken to ensure that no one is exposed to the risk whilst rectification works are undertaken).

- **Function** - A component is not performing as designed, but is secure, complete and has no missing subcomponents.
- **Appearance** - Appearance failures have no impact on the function of the component. However, they affect the level of dwelling amenity

A dwelling is assessed as well-maintained, maintained or below maintained standard, based on an approximation of 97% compliance with the component requirements, with *'minimal tolerance for safety failures and only a small tolerance for function failures.'* A 'maintained' dwelling is considered to meet the requirements of the Residential Tenancies Act. LAHC has previously identified that at 2010-11 between 30 and 40 per cent of its properties are not at the "well-maintained" standard [2]. Components assessed under the standard with relevance to the energy efficiency and thermal performance of a property include:

- Air conditioner: including a requirement that the system meets the specific health needs of climates for climate moderation/air filtration.
- Ceiling: it is noted that *'water stains or mould on the ceiling, whilst unattractive, may not be affecting the ceiling performing its prime purpose'*
- Exhaust fans: the standard recommends exhaust fans be vented directly to the outside (rather than to another room or ceiling space), and that any exhaust fan vented to the outside should be *'either self-closing or sealed'*.
- Carpet: Whilst the rationale is to prevent injury in the event of a fall, it is noted that rubber underlay should be provided under carpet on concrete floors.
- Heaters: the noted purpose is to provide space heating safely and efficiently.
- Walls: there is a note related to wall affected by mould noting that it should be assessed whether the mould is a cosmetic issue, or is *'beginning to affect the integrity of the wall lining and if it poses a health hazard'*. The example given shows a significant mould growth, but shows this as failing only the appearance test (i.e. no safety issue is noted).

The asset performance standard states that, beyond meeting the fundamental and immediate need of providing safe, habitable and clean housing, *'part of the vision for Social Housing is dwellings ... providing a safe and comfortable environment, functioning efficiently, ameliorating climatic extremes, operating on a sustainable basis and attractive as a home.'*

The Asset Performance Standard also includes the Basic Provision Standards which outline the minimum required provisions for Social Housing premises. Of relevance to energy efficiency and thermal comfort are the requirements that all properties must have screen doors and window locks (for security, but with implications for natural ventilation), and that carpet must be provided in cold climate towns.

3.3. Property Assessment Survey

The performance of LAHC properties are assessed against the Asset Performance Standard using the Property Assessment Survey (PAS). The PAS is a visual condition assessment of Social Housing properties. The majority of LAHC properties were assessed using the PAS between 2012 and 2014, and 10% of properties are now surveyed annually [15]. The PAS is carried out using pre-developed survey templates for four dwelling categories; cottages (also used for semi-detached, etc...), units, building and structure, and grounds and common areas. The results of the PAS are used to schedule planned or preventative maintenance, as well as to inform property upgrade

programs. The PAS data is categorised as general data (property type, location, date of survey), component conditions assessments, and property quality standards. Property quality standards includes information such as:

- Asset amenity data (aspect, view, property care etc)
- Distance to facility or services
- Dwelling modifications
- Safety and structural integrity issues
- Environmental attributes (hot water and ceiling insulation etc)
- Tenancy risk indicators (overcrowding, grills/bars installed etc)

The PAS includes assessment of many items relevant to the energy and thermal performance of a dwelling, listed in Table 1.

Table 1. Energy and thermal performance characteristics assessed by the PAS

Insulation	Age of ceiling insulation;
Cooling	Type of fixed cooling system (AC ducted, in-wall unit cooling system, RCAC, evaporative cooling)
	Type of portable cooling system (portable fans, portable AC);
	Do any of the rooms have ceiling fans;
Heating	Type of fixed heating system (electric, gas flued, in wall unit heating, RCAC, wood fire efficiency, wood fire open);
	Type of portable gas heater (unflued gas, radiant, fan, oil filled column, convection)
	Is there a gas bayonet installed?
Airtightness	Do any of the rooms have unblocked wall vents;
	Fixed draught excluder installed;
	Gaps at base of doors;
	Gaps around windows (NA, large, small)
Hot water system	Hot water system type (electric storage, electric instantaneous, electric roof model, heat pump, solar- electric boost, gas storage, gas instantaneous, gas roof model, solar gas-boosted)
	Are HW pipes insulated?
	Where is the HWS located?
Other	Internal door needed for zoning?
	Window shutters or shading (for each direction)
	Number of solar PVpanels?
	North roof size and solar access (NA, North <10m ² , North 11-19m ² , North > 20m ²)
	Is a skylight required to increase natural light to living area;
	Are common area and/or carpark lights on in daylight hours? If yes, are they on unnecessarily?
	Type of common area lighting control system
	Carpark ventilation system installed?

3.4. LAHC Maintenance Contracting Options

The condition of a component as assessed by a Property Assessment Survey in accordance with the Asset Performance Standard may determine a maintenance response is necessary, or a housing provider may receive a maintenance request from a tenant. LAHC program maintenance delivery should promote value for money and achieve dwellings that are functional, safe, comfortable, sustainable and attractive [15]. LAHC has a number of maintenance contract options for dealing with different maintenance issues, shown in Figure 4:

- Responsive maintenance - urgent and priority repairs that are necessary to return a building or building component to a safe and functional level. Includes routine repairs that cause tenants discomfort and could become a risk to health and safety if not undertaken. The priority of works is determined by the LAHC criticality matrix, which is not currently publicly available [15]. The criticality matrix considers the type of damage, whether it presents a safety risk, whether it forms part of an essential service within the premises, and whether it is already scheduled for repair via planned maintenance. Works classed as urgent (generally safety issues) require a response within 4 hours, Priority 1 works with 24 hours, Priority 2 within 48 hours, and Priority 3 within 72 hours [16].
- Planned maintenance - scheduled upgrades completed at a known frequency, and that are necessary to ensure that properties are continually managed at or above the Maintained Standard. Planned maintenance includes upgrades and/or component replacements. Planned general repairs have a target response of within 20 days [16] of a maintenance request. Sub-categories of planned works include vacant restoration works, and servicing works such as lawns, grounds and cleaning, building essential services, lift maintenance, fire safety monitoring and security. Requirements for planned maintenance will generally be raised during the PAS.
- Capital and upgrade works. Capital and upgrade works are based on strategic property decisions, which are made with reference to land value, property condition, and property amenity. For example, a poorly maintained property in rural NSW would be more likely to receive capital funding for refurbishment than a similar property in Sydney, where the land value would make demolition and redevelopment a better economic option. The need for capital and upgrade works may be identified by a PAS, but scoping work will generally also be required to prepare a request for tender.

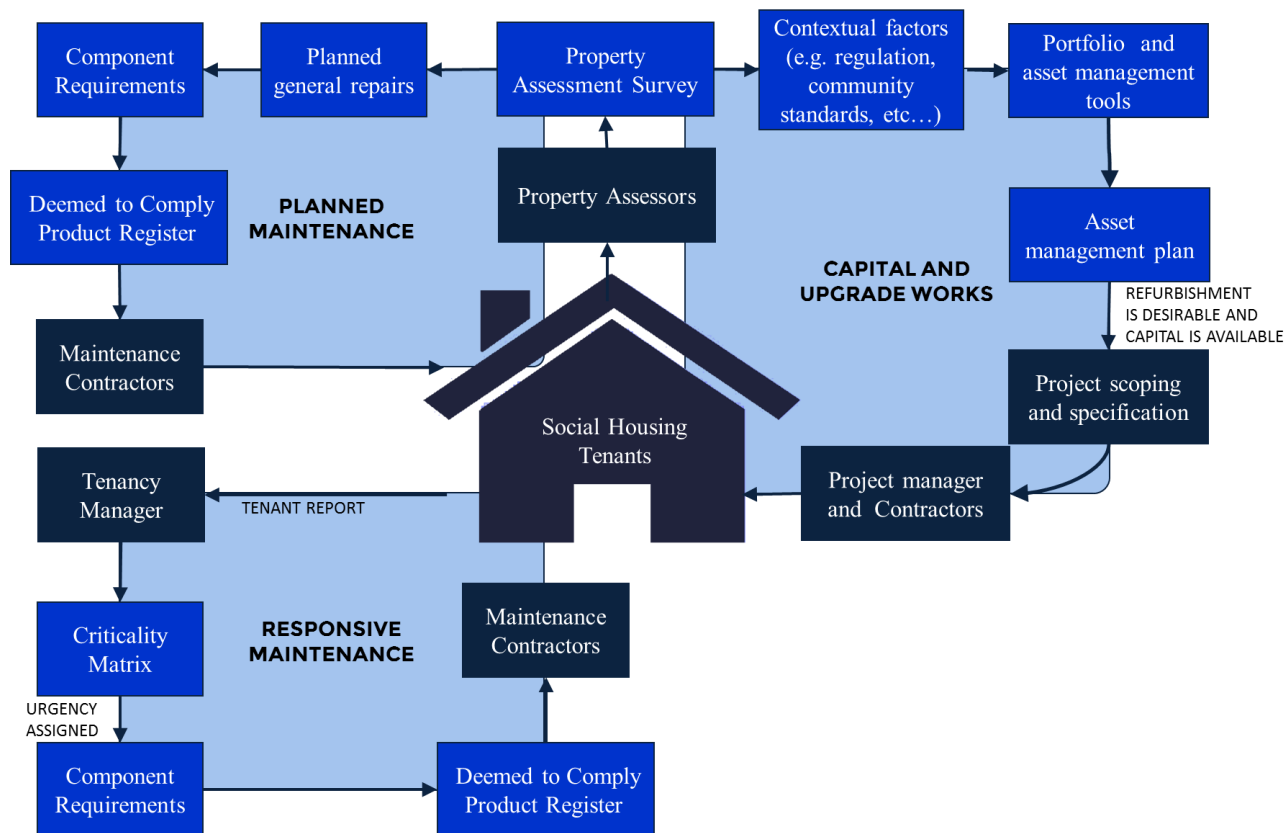


Figure 4. LAHC maintenance contracting options

3.5. Component Requirements and Deemed to Comply Product Register

LAHC provide detailed requirements for individual components to be installed in their properties, for both new dwellings and asset maintenance works. For each individual component, the LAHC component requirements [17] outlines the ‘business interest’ the item needs to fulfil, the specific criteria for judging acceptability of any particular product, and any specific warranty requirements. On the basis of the component requirements, LAHC maintains a Deemed to Comply Product Register; a non-exhaustive, non-exclusive lists of specific products (as well as manufacturers and suppliers) that have been assessed as meeting the LAHC requirements for use in its buildings. Suppliers and/or manufacturers can apply to have their products added to the register. To be added to the register the supplier must address the following environmental related questions:

- Is the product or component manufactured to maximise the environmental outcomes as listed in eco – specifier?
- Is the product/component 100% recyclable and has the company an implementation plan to fully recycle the product?
- Is the product safe to install and is it benign when installed in the dwelling?

The component requirements document specifies that LAHC ‘is seeking both value for money and the promotion of better performing products at affordable prices’. It also notes that ‘life cycle costs are as important as the purchase price and this places a different emphasis when judging the suitability of products to that of the general residential market.’ The performance criteria for all components is based on, amongst other things: i) proven performance; ii) proven quality and/or

endorsement from reputable organisation(s) in the industry; iii) best value for money; and iv) low maintenance.

There are numerous components with specific performance requirements (beyond meeting relevant Australian standards) relevant to energy efficiency and comfort. The major items include:

- Windows
 - Glazing: Achieve required WERS star rating for aggregate solar heat gain for building type and climate.
 - Awnings: Provides effective shading; Achieve required window star rating for aggregate solar heat gain.
- Roof
 - Roof and Eave Ventilation: Either under eave vents (minimum size 400 x 200 mm), or ridgeline roof ventilators.
 - Skylights: Certification of greater than 95% specular reflectance from shaft; Min. 250mm internal diameter; Achieve a WERS rating better than 5 star for heat and cooling transfer.
 - Ceiling insulation: Thermal insulation to a property shall meet BASIX requirements.
- Lighting: Energy efficient lamps to be used
 - LED lights: All luminaire models must have previously been used by an Accredited Certificate Provider to successfully create Energy Savings Certificates under the NSW Energy Savings Scheme.
 - External Lighting: Energy efficient Tri-phosphor globes and tubes.
- Water Heaters (required volume varies by number of bedrooms and technology)
 - Solar HWS: High energy efficiency – generate more than 25 renewable energy credits.
 - Gas HWS: Minimum 5 star energy rating.
 - Electric Water Heaters: no efficiency requirements.
- Heating
 - Gas Space Heaters: Min. 4.3 efficiency stars and 6.0 emissions star rating; heaters with flues.
 - Wood Space Heaters: Min. appliance efficiency rating of 60%
- Rangehood: Exhaust to outside
- Dryers: Min. 2 star Energy Rating
- Washing Machines: 4 Star WELS rating; 4 Star Energy rating (3 star for common laundries).

3.6. Maintenance Budgeting

The breakdown of expenditure between recurrent (e.g. responsive and planned maintenance), and capital and upgrade works for the period from 2003 to 2013 is given in Figure 5 from the Audit Office of NSW, 2013 [2].

It can be seen Figure 5 in that capital and upgrade spending is heavily affected by the availability of external funding sources (in the example above Nation building economic stimulus funding in 2008-11, and State [Housing] Acceleration Funding in 2009-10).

The same report concluded that:

With constraints on rental and grant funding and existing assets requiring increasing maintenance expenditure, LAHC advised that to continue to operate within its means, it has implemented measures such as selling properties and delaying some capital and maintenance expenditure. This will impact the condition and level of stock, and is not financially sustainable long-term.

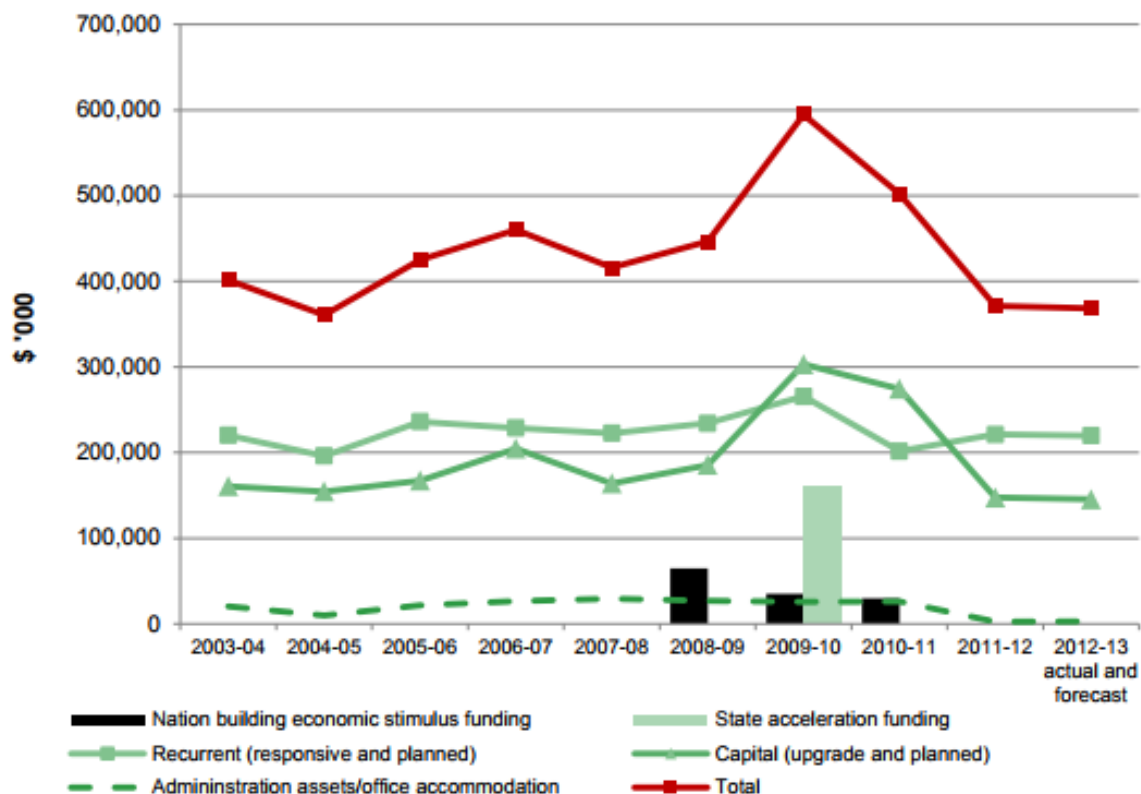


Figure 5. Total annual maintenance expenditure for the LAHC housing stock portfolio, 2003-04 to 2012-13 [2].

The proportion of properties constructed in each decade in the Social Housing property portfolio is given in Figure 6. FACS considers the useful life of a residential building to be 50 years [18], meaning that 25-30% of Social Housing properties are close to exceeding their useful life, and close to 60% of properties were constructed more than 30 years ago.

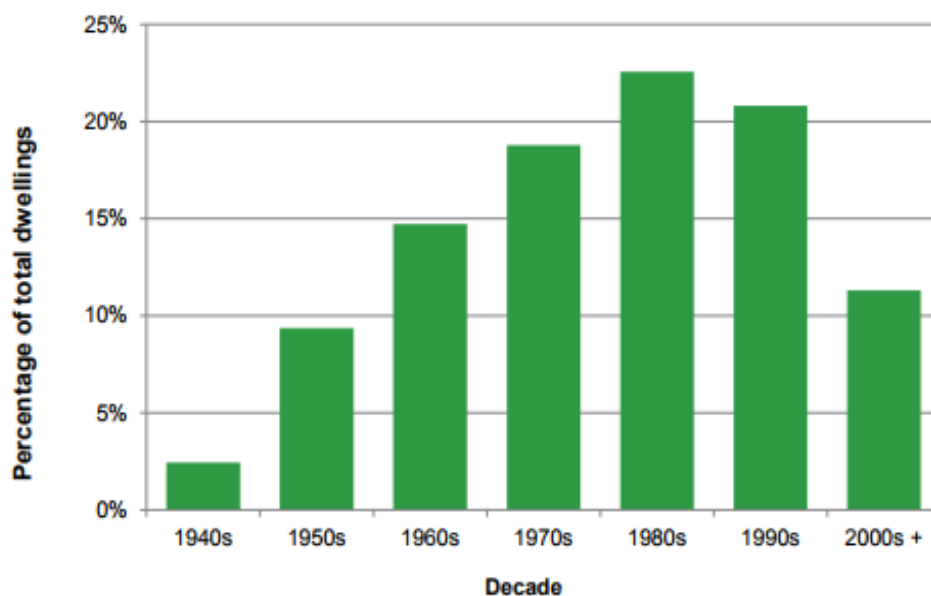


Figure 6. Proportion of dwellings in the Social Housing portfolio constructed in each decade as at October 2010 [2].

According to the FACS 2015/2016 annual report [18], in 2016 78.5% of LAHC income came from rent and other tenant charges, and 16.1% came from government grants (100% from FACS); the balance came from investment revenue (0.6%), management fees (1.2%) and other revenue (3.6%). Income from rent and other tenant charges is regulated. The rental rate paid by public housing tenants is a proportion of the tenant's income, between 25% and 30% of household income with a maximum set at market rent. In 2016 LAHC received 42% of market rent (on average) for its properties.

As identified above, LAHC (and other CHPs) have two major revenue streams, rental income and government grants. These income streams were found not be sufficient to meet the capital and maintenance needs of servicing an ageing building stock. The Audit Office of NSW noted that despite the ageing building portfolio, with associated increasing repair and maintenance needs, overall maintenance expenditure has dropped over the past decade, and that therefore there was a substantial maintenance shortfall, estimated at \$302 million in 2011. LAHC advised the Audit Office that property sales were being used to minimise this annual shortfall. The Tenants Union of NSW reported that the most common complaints to their advocacy service arise from lack of maintenance over a prolonged period [12].

4. Community Housing Asset Management and Maintenance: Energy Efficiency and Thermal Comfort

4.1. Regulatory requirements

Community Housing Providers (CHPs) operate in much the same environment as the public housing providers. CHPs are required to adhere to the relevant legislation and regulation, as well as FACS policies. The NSW Community Housing Asset Management Policy [19] sets out the maintenance requirements for CHPs, beyond those dictated by the *Housing Act 2001 (NSW)*, and the *Residential Tenancies Act 2010 (NSW)*.

The Community Housing Asset Management Policy requires that all properties owned or managed by a CHP, which were funded in part or wholly by the NSW Government, are maintained in accordance with the LAHC Asset Standards outlined in Section 0. At least 70% of properties in a CHP portfolio must meet the LAHC Asset Performance Standard for the CHP to maintain registration. The Asset Management Policy contains a number of additional obligations and recommendations for CHPs, including:

- A requirement that Tier 1 and 2 providers maintain a rolling minimum 10-year asset maintenance plans with budget forecasts.
- A requirement that Tier 1 and 2 providers survey tenant satisfaction biennially, and achieve a greater than 75% satisfaction with the condition and maintenance of the property¹.
- CHPs are responsible for undertaking condition assessments on properties they manage; LAHC also undertake PAS on all properties it owns. Tier 1 and 2 providers are required to conduct property inspections at least once every three years.
- For properties owned by the NSW government, but managed by a CHP, the CHP is responsible for responsive and cyclical (planned) maintenance, whilst LAHC is responsible for structural maintenance, modifications and stock replacement.
- A requirement that public housing properties transferred to CHP management must meet the maintenance standards, or will be brought up to standard by the CHP or LAHC within a reasonable timeframe. The policy does not give guidance on how upgrades for properties transferred are funded.
- A stated preference for CHPs to apply the Asset Management Standard to the providers whole portfolio (i.e. not just those properties funded by the NSW government)
- A requirement that ‘*community housing providers should take all available steps to improve the amenity of the housing stock over time.*’

4.2. Community Housing Providers Maintenance Processes

Beyond the regulatory requirements listed above, Community Housing providers have a degree of freedom for how they manage property asset maintenance. Community Housing Providers may choose to operate a maintenance program to meet the minimum regulated standards, or may commit

¹ From 2021 this will increase to 85%.

to better maintenance standards. Many CHP commit to some form of Corporate Social Responsibility Policies, such as the NSW Federation of Housing Associations Code of Practice for Housing Associations. Additionally, many CHPs set policy directives well-beyond minimum requirements, e.g. Hume CHA include in their planned maintenance policy that ‘sustainability initiatives will be applied at every opportunity to an upgrade, environmental impact will be considered throughout ...’ and ‘the alleviation of fuel poverty and improvement in health and wellbeing of customers will be an underpinning principle in all upgrades’.

Generally, the maintenance processes in place for LAHC assets have a corresponding process in place at Tier 1 and 2 Community Housing Providers, although the terminology and details may vary slightly (e.g. [20-25]). Typical, a system will be in place for responsive or reactive maintenance, with a target timeframe for repairs based on the risk associated with a failure. Providers generally also employ some variation of the ‘deemed-to-comply’ product register to allow like-for-like replacement of components from a list of pre-approved products.

The Asset Maintenance Plan required by the Community Housing Asset Management Policy dictates that a planned maintenance process be in place for a minimum of 10-years. Again, the general process for planned maintenance in Community Housing is much the same as for LAHC. However, Community Housing Providers are free to include additional targets, assessments and processes. Some CHPs will collect additional data on their properties, and may therefore modify the property assessment processes used. Changes can include undertaking preventative maintenance inspections of items as they approach end-of-life, completing more frequent property assessments, or the inclusion or additional data into the PAS to assess the suitability of potential upgrade works.

How the planned maintenance programs and targets are determined is likely to vary slightly between CHPs. For instance: SGCH employ target lifetimes for different components and schedule maintenance at end-of-life [22]; Hume CHA use maintenance requests and stock condition reports to prioritise properties [21]; and Evolve housing contract a licensed builder to complete a three-yearly description of works required at each property to meet their maintenance objectives [25].

Capital and upgrade works in the Community Housing Sector appear to differ from the LAHC process in the same way as planned maintenance procedures, i.e. the processes is relatively similar, although terminology and business priorities may differ slightly. One important difference to note is the additional split-incentive that exists for the majority of buildings in the CHP sector (79%) where the asset is not owned by the CHP. In these cases the property owner may be responsible for some forms of maintenance (e.g. structural repairs), and the CHP may be more reticent to invest capital in upgrades to that building.

4.3. Community Housing Provider income streams

Compared to public housing providers, CHPs have access to additional income streams and have additional flexibility in their property and tenant management, for instance in how clients are matched with properties. Importantly, CHP tenants are eligible for Commonwealth Rent Assistance² (CRA), which can be recouped by the CHP to allow them to operate at a profit (Audit Office of NSW, 2013). The NSW Community Housing Rent Policy [26] sets the rent payable as a ‘percentage of the assessable household income plus 100 percent of the household’s entitlement to Commonwealth Rent

² A person is eligible for CRA if ‘the person is not an ineligible homeowner, is not an aged care resident, and is liable to pay rent other than to a state or territory housing authority.’ (Social Security Act 1991)

Assistance (CRA). This is subject to the qualification that the subsidised rent, including CRA, must not exceed market rent’.

There is limited information on the importance of CRA in the Community Housing sector. The Community Housing Peaks Policy Network surveyed 24 CHPs with 4 in NSW, to understand the role of CRA [27]. The study estimated that CRA constituted 30 – 39% of surveyed CHPs income stream (range 18.2% – 41%), and found that for the majority of CHPs (20) 70% or more of their tenants received CRA. The study gave an example illustrating that CRA can increase rental income per tenant by up to 66%, and reported on the findings of an earlier modelling study [28]³ that a public housing provider with 500 properties would incur a \$780,000 p.a. deficit, compared to a \$438,000 p.a. surplus for a comparable CHP with access to full CRA. The same study found CRA funding was predominately funnelled to ‘providing better repairs and maintenance’ (83%) or providing ‘additional or improved services for tenants’ (75%).

FACS Provide grant funding to CHPs for *managing tenancies in public, community and Aboriginal Housing Office properties. It also includes providing private rental market assistance as an alternative to Social Housing and to assist people to transition out of Social Housing.* Total grants in 2015-16 equalled \$80,098,417.

³ This study found an optimal level of title transfer (rather than just management transfer) of 10-20% to allow the CHPs to access equity funding. This level of title transfer would allow the construction of 75 new dwelling or refurbishment of 174 dwellings (of the portfolio of 500). Note: the modelling assumed 31% of income was CRA.

5. External Funding for Energy Efficiency Upgrades in Social Housing in NSW

5.1. NSW Office of Environment and Heritage Home Energy Action Plan

The NSW Office of Environment and Heritage is currently facilitating a major grant scheme to encourage energy efficiency upgrades in the Social Housing sector. The Home Energy Action Plan has two major streams; the appliance replacement offer, covering 50% of the cost of replacing existing fridges and TVs with high efficiency models, and the Community Housing stream. The Community Housing stream offers CHPs up to 50% co-funding for a range of energy efficiency upgrades. The upgrades currently offered under the scheme are:

- Ceiling insulation for uninsulated ceilings;
- Hot water heat pumps to replace electric storage systems;
- Lighting upgrades to LEDs
- Installation of solar PV (must be installed and tied to a single property);
- Draught proofing
- Reverse Cycle Air Conditioning

The critical factor for eligibility for the government subsidy is the proposed upgrade works achieving a positive benefit to cost ratio when a cost benefit analysis is undertaken. The HEA program engages technical consultants to work directly with the Social Housing Providers to gather the necessary information to undertake a CBA for their portfolio.

The CBA tools developed by OEH for the HEA program must adhere to the NSW Treasury CBA guidelines [29]. The treasury guidelines indicate the CBA should consider direct and indirect economic, social and environmental impacts of a proposed action. Where there is uncertainty regarding the impacts of an intervention, it is recommended that the CBA draw on available information, describe and discuss the unquantified impacts, and provide an outline of data limitations and all assumptions made. The guidelines identify a number of forecasting methods which may be used to inform the CBA. Of relevance to the current study are the use of non-random experiments with baseline data (i.e. the living laboratory monitoring work), meta-analysis of previous studies (i.e the assessment of health and other co-benefits), and simulation studies.

There is a potential opportunity to work with OEH to develop the cost benefit tool to better reflect to full range of benefits from the energy efficiency upgrades already funded by the HEA program (i.e. to incorporate tenants co-benefits into the CBA), as well as to develop new CBA tools for additional technologies using meta-analysis or simulation forecast methods.

5.2. Clean Energy Finance Corporation

The Clean Energy Finance Corporation (CEFC) is a Commonwealth entity established ‘to help mobilise investment in renewable energy, low-emissions and energy efficiency projects and technologies in Australia, as well as manufacturing businesses and services that produce the required inputs [30]’. The investment mandate includes a specific direction to include a focus on ‘energy efficiency technologies for the built environment.’ The CEFC have a funding program specifically aimed at Social Housing Providers; however, this is directed towards the construction of market-leading energy efficient community housing. For instance, the CEFC committed up to \$170 million in financing to St George Community Housing to improve the sustainability of 500

new dwellings to achieve an average 7-Star National Housing Energy Rating System (NatHERS) rating.

The CEFC also has a funding program aimed at the retrofitting of the existing building stock to improve energy efficiency, aimed at both commercial and residential buildings. To date the majority of investment through this program has been directed at commercial building upgrades works; however, the program can support Social Housing Providers to upgrade their residential stock, by aggregating the costs of an energy efficiency project rolled out to a large number of dwellings.

Direct financing from the CEFC is available for projects over \$20 million, and ‘smaller scale’ projects (generally between \$10,000 and \$ 20 million) are financed via the CEFC co-financing programs with Westpac, NAB and CBA. The Social Housing Provider benefits from a 0.70% rate discount, longer loans terms, and flexible repayment strictures to match the cash flow cycles of a provider.

For businesses, the CEFC have a range of technologies which qualify for funding (e.g. LED lighting, variable speed drives) as well as the option to bundle a range of upgrade technologies in a single project. The bundled approach has typically relied on expected improvement to the NABERS rating of a commercial building (i.e. must improve the rating by 2 stars, or achieve a 4 star or better rating), however this is not applicable for residential buildings.

CEFC funding is therefore available to support Social Housing Providers to implement energy efficiency upgrades to their portfolio; however, the exact design of the eligible upgrade has not previously been determined. There is a potential opportunity for the current project team to support the CEFC to develop a fact sheet for Community Housing Providers to access this funding, and identify points of friction and traction in this funding model.

6. Preliminary opportunity identification for RP3044 outputs

Through the literature review and interviews undertaken for the current report, a number of opportunities have been identified by which the current project can influence the existing maintenance processes to mainstream low carbon retrofits. These opportunities may involve analysis of the data being collected through our living laboratories, or additional activities. The current monitoring project is collecting the following information.

1. Temperature at 20 minute intervals in main living area, and 1 hour interval in the master bedroom, bathroom, and 1 other location.
2. Relative Humidity at 20 minute interval in main living area, and 1 hour interval in bathroom or other room with mould issue.
3. Energy consumption at 1 minute interval for total consumption and up to five sub circuits.

The details of the three living laboratories are provided in Table 2.

Table 2. Location and details of living labs monitored under RP3044

Living Laboratory	Location	# properties	Retrofits
1: Sustainable Port Kembla	Port Kembla	13	To be determined by SBRC, likely to include: <ul style="list-style-type: none"> • Ceiling fans, • External and internal shading, • Skylight replacements, • Internal zoning,
2: OEH Home Energy Action:	Housing Plus (Bathurst, Orange) AHO (Narrabr.) Evolve (Parramatta)	21	<ul style="list-style-type: none"> • Solar PV (7); • Draught-proofing (10); • HP HWS (4); • Reverse Cycle AC (17);
3: LAHC Cladding Upgrades	Bathurst, Dubbo, Narromine	8	Wall insulation

The preliminary opportunities identified are listed below. These preliminary opportunities were presented for discussion at the RP3044 steering committee workshop held in December 2017. It must be noted that not all of these activities can be supported under the current RP3044 project, and the monitoring and analysis of the living laboratory data will necessarily remain the major focus of the project team.

Table 3. Preliminary opportunity identification for RP3044 outputs

#	Action	Purpose	Assumptions
1	<p>Work with OEH to develop cost-benefit assessments for additional upgrades beyond the current scope of HEA. This likely will require thermal simulation of typical Social Housing dwellings.</p> <p>Initial suggestions of upgrades to consider: Ceiling fans, External shading, Wall insulation, Floor insulation. Additional upgrades may include roof ventilation, sealing extraction fans, low E glazing and Double and/or Secondary Glazing.</p>	<p>Allow additional retrofits to be co-funded under the HEA scheme, to achieve deeper energy savings/comfort improvements from future program activities</p>	<p>OEH are open to inclusion of additional options.</p> <p>The additional upgrades are likely to achieve a BCR > 1.</p> <p>Thermal simulation is acceptable evidence for OEH to approve a CBA tool.</p>
2	<p>Work with OEH to extend the current cost-benefit analysis tools to incorporate co-benefits (particularly improved comfort and associated health benefits) based on analysis of previous studies.</p>	<p>To improve the business case of the currently offered upgrades, as well as design a method for co-benefit CBA, and thereby allow SHPs to upgrade more properties, which may not have achieved BCR>1 on direct benefits only.</p>	<p>Sufficient evidence exists to incorporate consideration of some co-benefits.</p> <p>OEH are receptive to this work, and will adopt altered CBA tools.</p>
3	<p>Develop an ‘upgrade trajectory’, or bundle of complementary upgrades prioritised for implementation, for a small number of Social Housing building typologies (e.g. detached, semi-detached, apartment) in a range of climate zones to determine the best method to reduce energy demand.</p> <p>This would consider appliance, component and more substantial upgrades (e.g roof replacements, recladding, etc...)</p>	<p>To move to consideration of upgrades on a property scale, rather than at the specific technology level, and thereby realise greater savings.</p> <p>To identify complementary upgrades (i.e. upgrades which require similar trades, or interact strongly) and advocate for them to be implemented as a bundle.</p> <p>To allow housing providers to include energy upgrades in their longer term (10 – 15 year) asset management plans.</p>	<p>Assessing and implementing upgrades on a technology basis misses an opportunity to achieve deeper cost-effective energy upgrades.</p> <p>Longer term upgrade planning would reduce implementation overheads, and allow more funding to be directed to upgrades.</p>

#	Action	Purpose	Assumptions
4	<p>Prepare data collection checklist to outline the data required to assess the appropriateness of a property for different upgrades that may be implemented in the future. E.g. what pieces of information are needed to determine if it is appropriate to install a particular upgrade at a particular property,</p>	<p>To identify to the SHPs what data may be required for engagement in future upgrade projects, and thereby allow them to pro-actively collect the data and avoid additional scoping cost for future programs.</p>	<p>The availability of appropriate data has limited the ability of SHPs to implement upgrades.</p> <p>Poor data reliability and completeness present an additional risk to SHPs for involvement in upgrade programs.</p> <p>SHPs are easily able to capture additional data regarding their properties, given sufficient time.</p>
5	<p>Undertake Life Cycle Cost Analysis for a range of building components and fixed appliances, and identify the items for which energy efficient alternatives should be installed for responsive and planned maintenance.</p> <p>A specific focus of the LCCA would be to consider the maintenance cost implications of measures, and question whether perceived maintenance requirements are necessary.</p>	<p>To encourage SHPs to install more efficient building components and technologies as part of their BAU responsive and planned maintenance processes.</p>	<p>There are building components and technologies for which there is a compelling LCC case for installing more efficient (and expensive) replacements.</p> <p>CHPs are not currently undertaking LCC for these items.</p> <p>Like-for-like replacement of building components and fixed appliances is a missed opportunity to incrementally improve the performance of the Social Housing stock.</p>
6	<p>Explore, using modelled PV production, the likely self-consumption of PV by Social Housing tenants with AC installed, in a range of climate zones and for a range of typical AC consumption patterns. This activity would also consider the effects of battery storage.</p>	<p>To ascertain the BCR of installing AC and PV in poor quality housing to achieve acceptable thermal conditions without exacerbating fuel poverty, and thereby provide a benchmark for assessing alternative upgrade options.</p>	<p>Providing acceptable thermal conditions is a primary driver for SHP installing energy efficiency upgrades, and many SHP may look to achieve this with AC and PV installations.</p> <p>Fabric first energy efficiency upgrades may provide a higher BCR than AC and PV</p>

#	Action	Purpose	Assumptions
7	Identify building structure related Mould risk factors, and optimal remediation and avoidance strategies for SHPs	Mould is a significant issue, related to both the thermal performance of a building and the health of tenants. This activity would aim to identify strategies that would address the underlying mould risk factors, whilst also improving the thermal comfort of dwellings.	<p>Mould is a significant issue in Social Housing, and is closely related to the thermal characteristics of dwellings.</p> <p>Works focussed on mould remediation and/or avoidance are interrelated with many energy efficiency upgrades, and will have strong health benefits. There may therefore be additional appetite within SHP to undertake these works.</p>

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