Solar Suburbs

project evaluation report

June 2016

A Strategic Initiative of the Coalition for Community Energy

Project Partners:

- Solar Suburbs Association
- Alternative Technology Association
- Moreland Energy Foundation
- Community Power Agency

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Background

Solar Suburbs is a community driven initiative which has the following ultimate aims:

a) To identify the most effective strategy for maximizing the penetration of rooftop residential solar, and potentially battery energy storage and rapid app-based energy efficiency assessments for participating households across a suburb.
b) To eliminate financial and other barriers associated to accessing solar, particularly for seniors, low income and disadvantaged households. The project considered Council capacity to finance capital, in a manner similar to Environmental Upgrade Agreements that allow repayments for renewable energy upgrades through Council rates.
c) Harness community and Council interest and link with established programs in Victoria to understand the most efficacious model for application in NSW.
d) Create additional incentive-based interest within the community, Council and local groups to further maximize the penetration.
e) To develop a blueprint to replicate elsewhere within the Council and in other NSW Councils

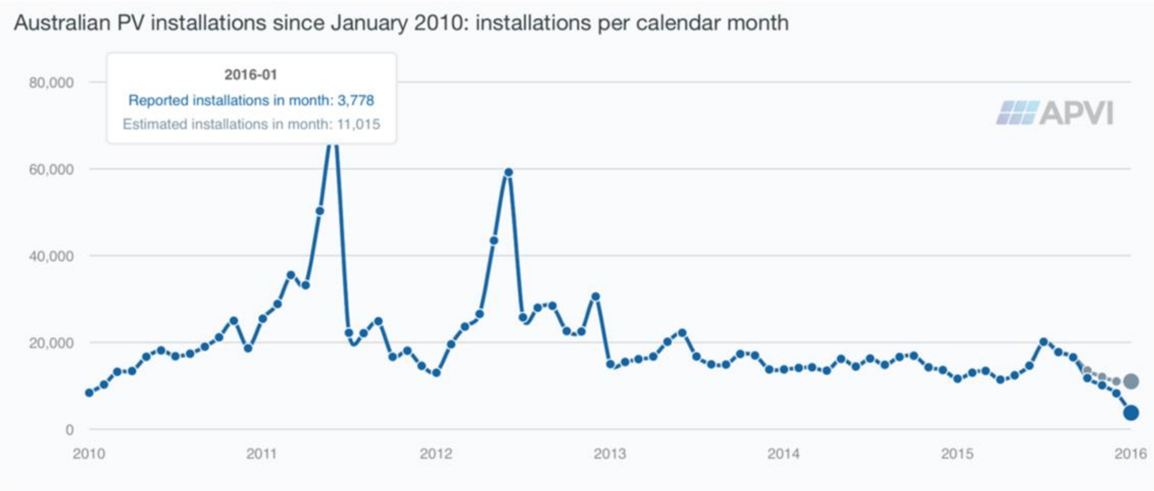
Why solar suburbs?

Solar PV is proven technology and commercially viable, with the cost to implement and corresponding return on investment improving continuously.

Diffusion rates – also known as penetration, density or take-up – range between 8.7% (in Northern Territory) and 29.6% (in Western Australia. Source: APVI, available from: http://pv-map.apvi.org.au. Accessed: 20/03/16) across Australian States, driven by a number of factors including state-based feed-in-tariffs (FiTs) which have allowed participating households to derive an income stream from feeding solar power generated by their own solar PV system to the electricity grid.

It could be argued that, following initial take-up by "early adopters" a large proportion of solar PV systems have been installed by those motivated by the financial incentives provided by the FiTs.

A number of states have either reduced or rolled back FiTs completely, sending a message to Australian households that solar PV is less economically viable than previously. Whilst there may be a number of factors that influence a household's decision to install solar PV, the rate of installation growth has slowed since the twin peaks of 2011 and 2012 (see graphic, below), reflecting the closures of the Solar Bonus Schemes in NSW and QLD, respectively.



Our research indicates that the return on investment for implementing household solar is continually improving as technology becomes more efficient and the capital cost of solar PV systems reduces, even in the absence of FiT shemes.

There is therefore an opportunity to “activate” qualifying households (those that may legally and practically install solar PV on their rooftop) that have not installed solar PV so that they are motivated by reasons other than a FiT to install solar PV.

Therefore, in the absence of strong FiT schemes which entice households via financial incentives, and in order to maximise the potential take-up via a co- ordinated campaign, there is an opportunity to introduce innovative social norm- based mechanisms that could further encourage households to decide to install solar PV.

The project plan

The Solar Suburbs project had three simple outcomes it set out to achieve:

1. Better understand the potential for Local Governments in NSW to add value to the Solar Suburbs model by, but not necessarily limited to, adopting the successful EUA-style model used in Victoria (e.g. Darebin Solar $avers)

2. Research, develop and implement methods for increasing the diffusion of renewable energy and energy efficiency technologies through:

    a. inspiring community members with social activation, and;

    b. motivating community members with easy access to the most appropriate energy technology products

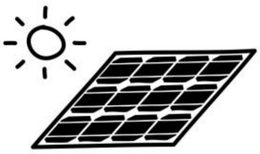
3. Document the process and tools to allow the Solar Suburbs model to be replicated across NSW.

The project was planned for delivery through three major streams of work:

Local Govt. Capacity

1. **Local Government Capacity**

Objective: Better understand the ability, interest and capacity of Local Government to support residential energy efficiency and solar action. Identify opportunities, limitations and barriers to support promotion, administration and financing of community programs.



Solar Products

2. **Solar Products**

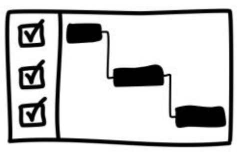
Objective: Identify the most appropriate products, packages and finance mechanisms for scaled roll out across the residential sector, potentially maximised by bulk buy arrangements.

Community Engagement

3. **Community Engagement**

Objective: Identify the most effective community engagement strategies to inform, enable and increase residential participation.

In addition to this there was to be be overarching:



Project Management

4. **Project Management**

Objective: Providing a structured, supported framework for the co-ordination and implementation of the project and the effective documentation of the Solar Suburbs model for replication across other suburbs and/or Council areas.

Key outcomes

The project has successfully achieved its objectives and has delivered or over-delivered each of the deliverables as set out in the table below.

Local Government Capacity		
1.	Desktop review of Council community programs supporting solar and energy efficiency for residents (eg. information, bulk buys, Darebin rates program).	Moreland Energy Foundation Limited (MEFL) delivered their report "*Solar Suburbs: Desktop review of council community programs*" on 20 August 2015 (Appendix B). The report provides general and specific advice for implementing community-led climate change programs in partnership with local councils.
2.	Survey and interview Sydney Metro (and regional) Councils on interest, capacity and constraints in supporting community programs. Specifically understand resourcing and administrative requirements to support promotion, administration and financing.	The project team surveyed and interviewed 10 councils (instead of five). The findings from these surveys were summarised in the report "*Solar Suburbs project. Position Paper: Local Government Capacity*" published by Solar Suburbs and the Coalition for Community Energy (C4CE) on 29 October 2015 (Appendix C)
3.	Consider legal review and related work undertaken by OEH and legislative and administrative requirements for Local Government to utilise rates scheme to support administration and financing of solar and energy efficiency installations.	A condition of this project was that a formal legal review was not to be undertaken by Solar Suburbs as similar, overlapping work had already been commissioned by OEH. The project team was issued with the legal review and related work undertaken by OEH and consideration of this information has been included in Appendix C, mentioned above.
Solar Products		
4.	Research and recommend technology / providers (including energy storage and energy efficiency assessments). Consider technology cost benefit, applicable demographics (income, age,	Alternative Technology Association provided their report "Final Report for the Solar Suburbs Coalition" on 3 September 2015 (Appendix D). The report evaluated the contextual settings that apply in the greater Sydney region before considering those technologies that had the greatest potential for offering *"good, to very good, economic value for households – as well as achieving*

	employment factors), tenancy (ownership, rental), climate (temperature, solar irradiation), tariff factors.	*environmental benefits*". A number of findings are outlined in the document and summarised below in Summary of findings
5.	Investigate financing approaches (mortgage extension, leasing / PPA options).	Section 4.1 of Appendix D addresses the financing options and considerations for solar PV, recognising that these were also largely applicable to other energy technologies.
Community Engagement		
6.	Desktop review of community engagement practices (eg social marketing).	The "Desktop review of community engagement practices" was delivered by MEFL on 13 November 2015 (Appendix E). This review considered the potential effectiveness of a number of different strategies to recruit households into the Solar Suburbs campaign, including a ranking of High to Low effectiveness for consideration by relevant stakeholders.
7.	Investigate appropriate engagement including communications, activities and incentives to activate community.	"The Solar Suburbs Model With application of the Switch framework" (Solar Suburbs, 15 November 2015) (Appendix F) This research considered the potential application to the Solar Suburbs model of the 'Switch' framework, which is an applied framework for behavioural change practitioners and others seeking to create sustained change within a community or organisational setting. The 'Switch' framework underpinned the development of a number of mechanisms and techniques that are employed by the Solar Suburbs model.
8.	Develop a plan for executing the community engagement component of the pilot.	"Internal briefing note: proposed Solar Suburbs model" (Solar Suburbs, 29 March 2016) (Appendix G) The briefing note is a high level overview document drafted for internal purposes only but available to NSW OEH to further summarise our findings.
9.	Develop information materials.	"FAQ Booklet" and "Promotions and Communications Strategy" (MEFL) (Appendix H) The FAQ booklet (for external use) and Promotions and Communications Strategy (for internal use) are designed

		to aid internal and external communication with participating Councils, constituent households, community groups and other stakeholders.
10.	Recruit community members and organisations to participate in executing the Solar Suburbs project.	The project exceeded the deliverables in this area by securing in-principle support from multiple organisations including: - Canada Bay group of citizens - Green Living Centre - Pingala Community Renewables for Sydney - Randwick City Council - Marrickville Council - Parramatta City Council - Parramatta community energy group (via Julie Owens office)
11.	Execute active community engagement and social activation.	The Solar Suburbs project team recognised mid-project that any attempt to execute a community engagement plan would be premature and underprepared without a well-considered plan for the overarching business model. Utilising the Business Model Canvas, developed by Alex Osterwalder[1], the project team developed the business model canvas provided (Appendix I). The business model canvas provided is a starting point for any group wanting to adopt the Solar Suburbs business model. It shows, among other important elements, the value proposition of the Solar Suburbs model (centre column) and the customer segments for whom the model creates value. The Solar Suburbs project has become part of the inspiration behind the Community Powerhouses component of the Homegrown Power Plan, developed by Getup! And Solar Citizens[2].

Project Management

12.	Co-ordination and project management.	Minutes of fortnightly and periodic meetings held by Solar Suburbs project team were maintained and available online to all project participants.
13.	Secretariat support.	
14.	Ongoing mentoring and advice.	This was delivered throughout the duration of the project. Project partners had between them a deep

[1] http://alexosterwalder.com/
[2] Homegrown Power Plan -Full Report.pdf p.90

		knowledge of community energy and community engagement and this was available to Solar Suburbs through formal and informal settings.
15.	Develop and document Solar Suburbs model for pilot suburb.	This document represents the delivery of this part of the project.
16.	Document Solar Suburbs model for replication across other suburbs / Councils.	This document represents the delivery of this part of the project.

Summary of findings

Local government capacity

- Most Councils either had emissions reductions and/or renewable energy (RE) targets or had taken steps to reduce their environmental footprint or facilitate households who wished to take individual action
- Drivers or champions within Council were either the environmental team or the Mayor / Councillor
- Challenges to higher uptake of residential solar PV included perceived cost of installation, lack of trusted suppliers, information saturation. SSROC's Our Solar Future aims to address these challenges.
- The majority (9 out of 10) of Councils indicated a moderate to high level of interest in a ratesbased finance mechanism to assist households to implement solar PV, with the following caveats. Such a mechanism needs to be marketed effectively to ensure widespread interest and take-up
- Overall, the majority of Councils positively indicated a willingness to review and potentially support a community led initiative that leads to an uptake of households accessing reliable solar PV solutions with minimal risk and cost to both the households and Council alike. We found that most Councils do not want to take on additional risk or cost.

Increasing the uptake of residential solar PV in NSW can be achieved by careful co-ordination of:
• elimination, minimising or managing existing barriers, and
• activating the residential household community via social mechanisms to implement rooftop solar PV.

Solar products

The Solar Suburbs Coalition commissioned the Alternative Technology Association (ATA) to undertake research and investigations into appropriate renewable energy, energy efficiency and related technologies for residential application in metropolitan Sydney.

The investigations undertaken were to include an assessment of:

- the energy characteristics of metropolitan Sydney homes, along with relevant demographic data
- the economic value of a range of technologies taking into account the metropolitan Sydney
- location, tariffs and climate
- different tenancy arrangements and considerations, and
- innovative financing options for technology uptake.

Findings - Solar Products

As noted by ATA, on average, metropolitan Sydney households are spending in the order of $2,500 per year on stationery energy. This means that broadly speaking, half of the almost two million Sydney homes are spending more than $2,500 per year on stationery energy – for whom significant financial savings can be found with technologies that will also reduce their carbon footprint.

Residential stationery energy in Sydney is largely made up of:

- mains electricity – with approximately 1.8 million Sydney homes connected to the mains electricity grid, and
- mains (LNG) gas – with approximately 1.15 million Sydney homes connected to the mains gas network. 82% of these (or approximately 940,000 Sydney homes) use mains gas for space heating or water heating – two of the largest residential energy loads.

There are a number of residential, demand-side (or customer side) technologies that offer good, to very good, economic value for households – as well as achieving environmental benefits. These include:

- high efficiency reverse cycle air conditioners (RCACs) for heating & cooling
- heat pump hot water and solar hot water systems
- induction cook tops and efficient electric ovens
- solar photovoltaic (PV) systems
- lithium-based energy storage (coupled with existing or new solar PV)
- building thermal efficiency measures such as insulation and draught sealing
- LED lighting, and
- efficient ceiling fans.

What is currently preventing a more wide-spread take up of solar PV?

As noted by ATA, Metro Sydney has the lowest rate of detached homes in the country (72%) – which may be part of the basis for its lower uptake of solar PV (13% of homes). It should be noted that there are significant variations in the rate of detached homes across the metropolitan area.

However even if one assumes that all solar PV installations in metro Sydney to date have occurred on detached homes, this still leaves in the order of one million detached homes in metro Sydney 'solar free'.

Solar PV provides the best economic return to those residents in metro Sydney that have medium to high overall electricity demand, and medium to low export rates to the grid (~ <50%). This may include, but is not necessarily limited to, stay-at-home retirees, working families (with one or more family members regularly at home during the day) and home businesses. It should be noted though that for each of these household types, day time electricity consumption can still be very low – leading to poor economic returns on PV.

Until the capital cost and/or efficiency of solar PV improve, non-financial incentives - or drivers - will be required to be employed in order to encourage the balance of households that do not fall into the former category to install solar PV.

A more wide-spread take up of solar PV is therefore currently constrained by the **up-front capital investment required**, and the corresponding length of time to achieve a return on investment. Other competing financial investments or purchasing decisions may be typically prioritised over a solar PV system in many households.

Once we overcome or eliminate the barriers, how do we actively speed up the installation density rates?

The ATA report considered the financial return on investment for various renewable energy and/or energy efficiency technologies and/or practices (including active energy management via programmed or delayed use of domestic appliances and whitegoods).

ATA was not briefed, however, to consider non-financial drivers that lead to purchasing decisions, such as *competitive altruism* (making an ostensible purchase of a good with an environmental benefit in order to signal to one's peers that one is making a sacrifice in order to benefit others, whilst also having the effect of improving one's social standing) or conforming behaviour that takes place in social groups (such as school communities, sporting clubs, religious groups, etc).

Whilst a large number of households would not achieve a significant financial benefit from installing solar PV, it is possible that these same households could achieve other benefits such as social, community, educational and/or health benefits, among others. This will be explored in the next work stream.

Community engagement

In this work stream the project team sought to build on the findings from the previous two work streams (Local Government Capacity, and Solar Products) in order to determine whether it would be feasible to implement a social norm-based campaign within a community that could lead to an increase of solar PV installation density within target geographies (e.g. suburb level) and utilising mechanisms and/or drivers that have not traditionally been engaged to promote solar PV (i.e. typically financial benefits).

The following activities were undertaken:

- **Desktop review of community engagement practices** (Appendix E): identifying the most effective strategies to recruit households into a targeted campaign and ensure that households are engaged in the campaign and participate in the desired outcome. This review considered the potential effectiveness of a number of different strategies to recruit households into the Solar Suburbs campaign, including a ranking of High to Low effectiveness for consideration by relevant stakeholders.

- **Development of a concept document, "The Solar Suburbs Model With application of the Switch framework"** (Appendix F): This research considered the potential application to the Solar Suburbs model of the 'Switch' framework, which is an applied framework for behavioural change practitioners and others seeking to create sustained change within a community or organisational setting. The 'Switch' framework underpinned the development of a number of mechanisms and techniques that are employed by the Solar Suburbs model.

- **Preparation of "Internal briefing note: proposed Solar Suburbs model"** (Appendix G): The briefing note is a high level overview document drafted for internal purposes only but available to NSW OEH to further summarise our findings. It is intended as a practical high-level guide to assist Project Manager(s) to implement the Solar Suburbs model within a target area/suburb.

- **Review of collateral "FAQ Booklet" and "Promotions and Communications Strategy"** (MEFL) (Appendix H) for appropriateness to the proposed Solar Suburbs campaign. The FAQ booklet (for external use) and Promotions and Communications Strategy (for internal use) are designed to aid internal and external communication with participating Councils, constituent households, community groups and other stakeholders.

- **Recruitment of community members and organisations:** Indicative of the support and appropriateness of the Solar Suburbs campaign, the project exceeded the deliverables in this area by securing in-principle support from multiple organisations including:

    - Canada Bay group of citizens
    - Green Living Centre
    - Pingala Community Renewables for Sydney
    - Randwick City Council
    - Marrickville Council
    - Parramatta City Council

- Parramatta community energy group

- **Preparation of a draft Business Model Canvas:** to underpin the potential organisation that could be established to be responsible for the implementation and ongoing management and scaled-up rollout of the Solar Suburbs campaign in multiple Local Government Areas. The Solar Suburbs project team recognised mid-project that any attempt to execute a community engagement plan would be premature and underprepared without a well-considered plan for the overarching business model. Utilising the Business Model Canvas, developed by Alex Osterwalder, the project team developed the business model canvas provided (Appendix I). The business model canvas provided is a starting point for any group wanting to adopt the Solar Suburbs business model. It shows, among other important elements, the value proposition of the Solar Suburbs model (centre column) and the customer segments for whom the model creates value.

What is currently preventing a more wide-spread take up of solar PV?

As discussed above, traditional approaches to increasing take up of solar PV have focused on highlighting the financial benefits that can be achieved from such an investment. However, there is currently no campaign model that enables the careful co-ordination between:

- Community-led project team
- Council(s)
- Community groups with members that represent individual households
- Individual households
- Solar PV providers
- Local and State Government stakeholders.

Specifically, in relation to this question, there is also no model that is based primarily on social-norm based mechanisms that are designed to influence the decision making and corresponding behaviour(s) of individual households vis a vis their participation in a community group dynamic.

Once we overcome or eliminate the barriers, how do we actively speed up the installation density rates?

Implementing the proposed Solar Suburbs model will actively speed up the installation density rates.

The Solar Suburbs project has become part of the inspiration behind the Community Powerhouses component of the Homegrown Powerplan, developed by Getup! and Solar Citizens.

Recommendations and next steps

Our recommendations in relation to certain stakeholders are as follows:

1. **Policy makers at the federal level:**

- Adopt the Community Powerhouses section of the [Homegrown Power Plan -Full Report.pdf] p.90

2. **Policy makers at the NSW State Government level:**

- Give importance to the role(s) of community groups in the active promotion and implementation of emission reduction initiatives such as Solar Suburbs.

3. Lawmakers at the NSW State Government level:

- Enact or amend relevant legislation to enable rates-based finance for households wishing to implement solar PV systems (and other energy efficiency technologies where applicable) and repay the capital via the rates mechanism.

- Enable solar gardens legislation and regulations.

4. NSW State Government (e.g. NSW Office of Environment and Heritage):

- Issue relevant policy and/or guidelines to Councils so that Councils have a clear and consistent indication of the goals and boundaries of the rates-based finance mechanism.

- Provide legal, financial, administrative assistance or expertise to Councils to facilitate the implementation (on either a centralised or decentralised basis) of the rates-based finance mechanism.

- Promote the rates-based finance mechanism scheme to both Councils and the public.

- Provide reasonable seed funding to implement the Solar Suburbs campaign on an ongoing basis. (In this regard the Solar Suburbs team is willing to discuss and negotiate a proposal).

- Provide resources to enable the Solar Suburbs to objectively appoint preferred solar PV suppliers and assess quality (e.g. manage a yearly tender process and conduct quality assessments across a small sample of installations).

5. NSW Councils

- Elect to implement the Solar Suburbs campaign in your LGA. A small campaign fee can be negotiated in order to cover reasonable costs of implementing the campaign locally so that it reflects and incorporates local nuances and idiosyncrasies (including liaising with community groups in the target area).

- Implement targets relating to solar installation density (% of households).

6. Energy retailers:

- Enable residential customers to participate in solar gardens (up to *x*m from household address).

Proposed next steps:

Should the NSW Government be interested to further develop the Solar Suburbs initiative (either as a partner / funder / supportive stakeholder) we would invite an opportunity to apply for seed funding and further discuss in more detail the concepts and findings outlined in this report and supporting documents. The Solar Suburbs project team would like to thank the NSW Government for the opportunity to perform this work under the *Growing Community Energy* grant scheme (2015-2016) as we believe that it has been a very effective exercise for the parties involved and the best-in-class concepts that have been developed to-date.

Appendix B - “Solar Suburbs: Desktop review of Council community programs”

(MEFL, 20 August 2015)

Solar Suburbs: Desktop review of Council community programs

Solar Suburbs

Prepared by Moreland Energy Foundation

Date – 20 August 2015

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REVISION HISTORY	**RESPONSIBLE**	**COMPLETED**
DRAFT PREPARED BY	GABRIELLE BREEN	29-07-2015
FINAL DRAFT REVIEWED BY	LUCY BEST	11-08-2015
CEO SIGN OFF	PAUL MURFITT	xx-08-2015

1 Introduction

Australian local government has a strong history of leadership on climate, and councils' ambition and action is growing rapidly. Several leading councils have recently achieved carbon neutrality for their corporate operations[1], and many local communities such as Uralla in NSW and Yackandandah in Victoria are making commitments to become zero net energy or 100% renewable. Councils' community engagement (CE) programs have evolved over time from *ad hoc* information provision to experimental outreach action projects to the recent emergence of more ambitious approaches. These latter approaches are typically scalable and involve complex partnerships, strong data management and innovative financial models. Councils are tackling more challenging areas, such as working with renters. In a context of unfavourable national policy, increasing urgency for substantive climate action, diminishing grants funding and cost-shifting to local government, it is more important than ever for councils to learn from the collective experience of others and develop effective, best-practice community programs.

Solar Suburbs has commissioned Moreland Energy Foundation (MEFL) to research the ability, interest and capacity of local government to support residential energy efficiency and solar action in NSW. This forms part of a broader project funded by the Office of Environment and Heritage, NSW to research, develop and pilot a modified Solar Suburbs model. This document outlines key considerations for councils in designing effective community programs that support solar and energy efficiency for residents, based on MEFL's extensive CE experience and the results of a desktop review. The document:

1. Presents overarching principles for undertaking effective CE
2. Outlines broad strategic options for program design, and evaluates each in terms of their potential greenhouse impact, scalability, resonance (influence), resilience to a changing climate and co-benefits
3. Assesses a suite of implementation methods with regard to operational considerations such as engagement potential, resources required and key risks
4. Compares different delivery approaches and partnership arrangements in terms of their ability to manage the above operational considerations
5. Uses case studies to demonstrate successful combinations of program strategies, implementation methods and delivery approaches relevant to Solar Suburbs.

[1] City of Melbourne, Moreland City Council and City of Yarra in Victoria, City of Sydney and Leichhardt Municipal Council in NSW, and City of Fremantle in WA.

2 Overarching principles

While the below principles will be familiar to most, it is simply astounding how many projects MEFL has come across in the CE field that have been compromised by unclear aims, poor program design, ill-founded assumptions about communities and behaviour change, different stakeholder expectations, missed opportunities, reinventing the wheel, and so on.

2.1 Outcome-focussed community engagement

The central measure of success in undertaking CE for sustainability is the environmental outcome (e.g. solar panels on roofs). This is not to say that program reach, report outputs, or community development outcomes aren't valuable; indeed they can be wonderful additional benefits of efforts to achieve short, medium and/or long-term greenhouse gas (GHG) emissions reductions. MEFL learnt the importance of an outcome-focussed approach through its Zero Carbon Moreland (ZCM) program (2008-2012), which achieved its reach targets (4,000 community members) but could not demonstrate substantial emissions reductions for its extensive efforts. Outcome-focussed CE will become increasingly important as municipalities start to expect greater climate action and councils increase their community GHG reduction goals.

2.2 Start small, do it well, and build from there

Effective CE programs should apply best practice principles such as:

- ✓ Evidence-based practice - understanding what has worked (and not worked) elsewhere and why
- ✓ Building on and leveraging existing or previous work, relationships and knowledge within Council, the municipality and by stakeholders
- ✓ Choosing the right partner/s, developing clear arrangements, and actively managing multi-stakeholder processes
- ✓ Building trust and relationships with the community
- ✓ Developing tailored messages and communication methods
- ✓ Incorporating advocacy - particularly advocacy by action
- ✓ Strong project management, and
- ✓ Robust quantitative *and* qualitative evaluation.

Investing the time, resources and specialist skills into doing a smaller program well will build a strong foundation of long-term relationships, resources, political support, knowledge and action that can be built on and extended over time. This is especially important given the long-term nature of climate change.

3 Strategy

CE program options can be broadly characterised in terms of their different starting points. Broadly the strategies focus on targeting five specific areas: a specific community, a specific product or behaviour, a particular barrier, an existing active community or leveraging an existing or perceived opportunity. These five options are evaluated here in terms of their:

- Impact - ability to deliver measurable emissions reductions
- Scalability - potential to scale to achieve larger impacts
- Resonance - ability to influence other stakeholders / policy makers
- Resilience - support to the community to respond to a changing climate
- Co-benefit/s – provision of social and economic benefits to the local community.

The above criteria reflect the growing need by councils and other CE organisations to accomplish more with a given set of resources. It is no longer enough for a program to simply make a climate impact or provide co-benefits, we must re-think program design so it can address other criteria too. For example, scaling up CE programs often necessitates moving to less direct, on-the-ground approaches, such as working more remotely or using peer-networks.

The appropriate program type will depend on a range of factors such as council's objectives; broader climate, energy and community development strategies; previous and existing CE work; and the municipal energy profile and demographic characteristics. In practice, CE programs often involve amalgamations of program types. For example, a council might opportunistically use a grant to work with renters in the community to together identify their barriers, and then determine the best way to overcome these barriers and roll out a particular product through a tailored program[2].

3.1 Targeting community segments

Particularly useful for leveraging (or building) community relationships and knowledge

Target groups can include:

- Residents with particular needs (e.g. low income or vulnerable households or renters),
- Communities that respond better to tailored programs and communications (e.g. culturally and linguistically diverse (CALD) communities), or
- Residents making decisions with major implications for their energy consumption (e.g. home renovators or new parents).

While this approach typically produces strong engagement outcomes, the greenhouse impact will depend on the community, which may face structural barriers. For example, renters face the problem split incentives (discussed below). It is important to understand the demographics of the community segment. Continuing the renters example, segments might include student share-houses, public housing tenants, professional couples in apartments, young families and so on. Each segment differs in their energy profiles and in their receptiveness to different CE methods.

Targeted engagement can be scaled to other geographic areas and councils or can be modified for other groups, but can also be constrained by resource-intensive nature - its greatest weakness. It can be expensive if existing channels and groups are not harnessed. These programs typically have strong resonance, as stakeholders tend to value working with particular existing groups and building on the associated co-benefits between council and said groups. Such co-benefits are often strong, as

[2] Renters can be particularly challenging to engage and hence receive special attention in this report.

program designs generally emphasise co-benefits relevant to target groups. Similarly, resilience outcomes are typically strong, as targeted groups are often particularly vulnerable to a changing climate.

3.2 Targeting particular products, technologies or behaviours

Particularly useful for achieving large greenhouse gas emissions reductions

Programs that focus on the deployment of renewables (e.g. solar arrays) and/or efficient products (e.g. light globes, draught-proofing products) have a high impact because the products are chosen specifically for their public appeal, potential impact and ease of measurement. Behaviour changes (e.g. switching off appliances not in use) are more difficult to ascertain and also risk slipping back over time, but make an easy addition to a product-based program. Such programs can be tailored to the needs of particular groups (e.g. inexpensive and/or portable retrofit packages for renters) and easily scaled to further products and communities, and the economies of scale possible are significant. Resonance depends on the nature of the program – innovative, large scale and/or cost-effective programs attract more attention. Similarly, resilience outcomes and co-benefits depend on the product or behaviour targeted. For example, fans, solar, and passive cooling are all effective for a warming climate, and co-benefits can include local employment, economic development, water conservation and so on.

3.3 Addressing particular barriers to action

Particularly useful for leading the sector in a challenging area

Barriers to communities taking action on sustainability are often difficult and systemic. Particular areas where CE programs have struggled include,

- Energy literacy, including residents' limited understanding of their energy consumption and a set-and-forget approach to energy purchase decisions
- Split incentives - otherwise known as the landlord-renter problem, where landlords lack incentives to make home improvements because they won't receive the financial savings, and renters lack incentives to make upfront long-lived capital investments for a property they are leasing. (An Office of Environment and Heritage study is currently exploring split-incentives)
- Financing, not just access to finance, but also trust in a fairly priced supplier and confidence in a return on investment.

Programs that address these sorts of barriers are often more innovative and exploratory in nature (e.g. action research), and it can take time to see results or achieve a greenhouse impact. Once a solution is found though, it is often highly scalable to other communities and councils. For example the Go5 energy education campaign[3] is highly scalable. Similarly, resonance is strong where success can be demonstrated and the barrier has a high profile among stakeholders. Resilience outcomes depend on the program and nature of the barrier. Similarly, co-benefits vary, and can include comfort, financial savings, energy poverty reduction, and so on.

3.4 Community driven programs

Particularly useful for building long-term relationships and developing effective solutions

[3] http://www.go5.org.au/

Community driven programs involve working with particular geographical or imagined (shared interest) communities to identify, plan and deliver projects that meet their objectives. The balance of pre-determined council objectives versus facilitation and support to the community varies considerably in practice. In some cases the community will initiate the process. The impact depends on the community and the program design but is often lower than other approaches, particularly in initial stages which may be exploratory or focus more on co-benefits. On the other hand, local communities provide valuable peer support, program tailoring and/or extended reach beyond other program types. This is highly effective in CALD communities for example. While such approaches can be applied to other areas or modified for other groups, the resource-intensive and bespoke nature of community driven programs tends to limit their scalability. Resonance is more likely to be limited to local stakeholders unless the program is particularly innovative or successful. Resilience outcomes are typically strong, as this approach builds general community resilience, and strong community development outcomes are a typical co-benefit.

3.5 Leveraging an existing opportunity

Particularly useful for utilising external funding or value-adding to existing work

A common starting point for many councils, particularly those with limited resources, is to take advantage of a grant, rebate or subsidy, or modify an existing council service, project, event or partnership. This doesn't have to be reactive; councils can develop shovel-ready projects that align with their strategic objectives and deploy them as funding opportunities arise. Capitalising on existing communication channels and activities will reduce the effort required and enhance the value, and thereby increase the breadth and depth that can be achieved with a given budget. Modifying existing council program/s to incorporate a greenhouse element can also enhance the original program's value. The impact, scalability, resonance, resilience and co-benefit outcomes very much depend on the nature of the program.

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3.6 Which type of program is suitable when?

The strengths and weakness of each program type are summarised in the table below.

Type of program	**Impact** Ability to deliver measurable emissions reduction	**Scalability** Potential to scale to achieve larger impact	**Resonance** Ability to influence other stakeholders / policy makers	**Resilience** Support community to respond to a changing climate	**Co-benefit** Provide social and economic benefits to the local community	**Particularly useful for**
Targeting community segments	✓ x		✓	✓	✓	Leveraging (or building) community relationships and knowledge
Targeting particular products, technologies or behaviours	✓	✓	✓ x	✓ x	✓	Achieving large greenhouse gas emissions reductions
Addressing particular barriers		✓ x	✓	✓ x	✓ x	Leading the sector in a challenging area
Community driven programs	✓ x			✓	✓	Building long-term relationships and developing effective solutions
Opportunistic	✓ x	✓ x	✓ x	✓ x	✓	Leveraging external funding or value-adding to existing work

Key: ✓ - a strength x - a weakness ✓ x - a strength or a weakness depending on the situation

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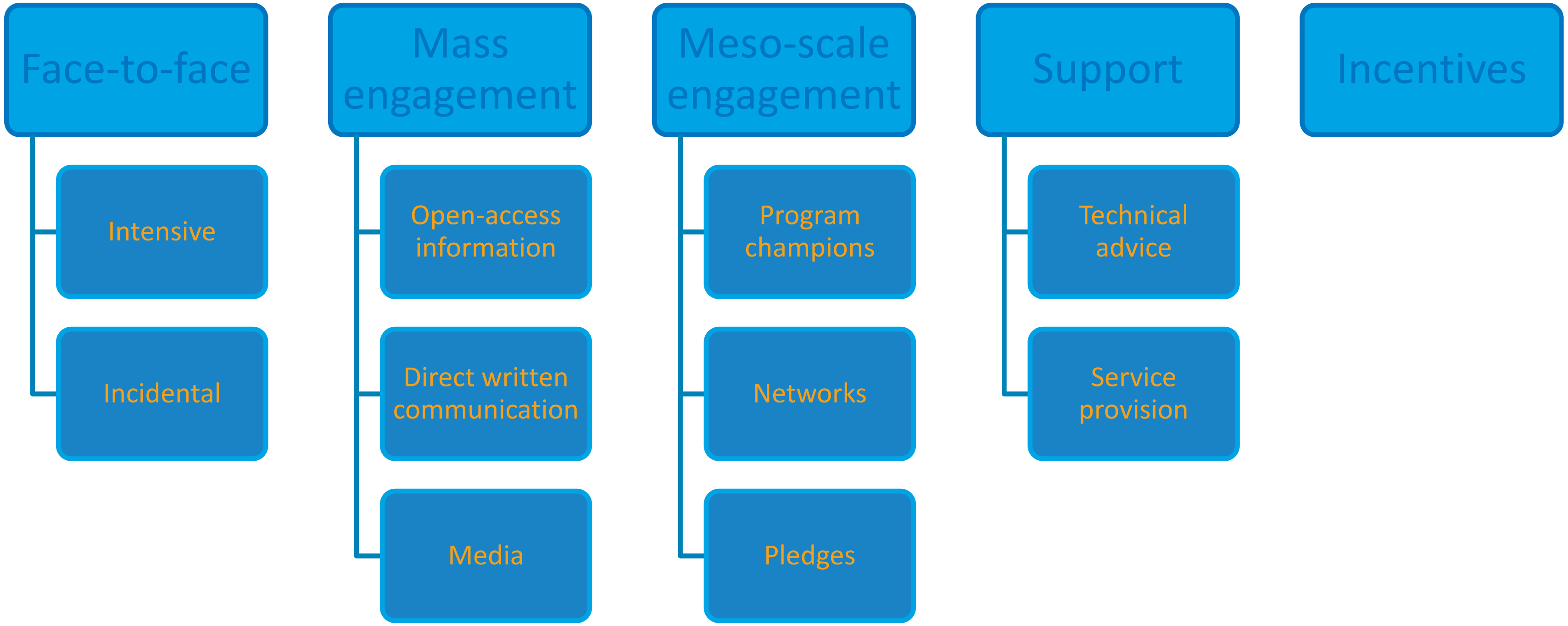
4 Method of delivery

A broad range of methods can be used to deliver CE programs, as outlined in the diagram below.



Methods vary in their engagement potential, required resources and risks.

4.1 Face-to-face engagement

Face-to-face engagement involves CE workers speaking directly to those that they wish to engage in a project, on an individual basis.

Intensive face-to-face engagement

Examples: Workshop, presentation, training, home visits, focus groups, community forums

Useful for: Training, engagement and information provision

Engagement potential: Highly effective with small to medium groups of people

Key resources required: Time-consuming; requires CE skills to do effectively

Risks to manage: Self-selection by usual suspects, information alone has limited effectiveness, occupational health and safety (OH&S)

Incidental face-to-face engagement

Examples: Stalls at events and shopping strips, door knocking

Useful for: Recruitment, information provision

Engagement potential: Moderately effective with small groups

Key resources required: Requires CE skills to do effectively

Risks to manage: OH&S

4.2 Mass engagement

Mass engagement involves communicating with the community in large volumes not in person.

Open-access information

Examples: Online resources, printed collateral

Useful for: Information provision

Engagement potential: Helps to reinforce other methods, on line information is a great method of delivery if optimised and well managed for accuracy and relevance

Key resources required: Distribution channels

Risks to manage: Information alone has limited effectiveness

Direct written communication

Examples: Mail outs; letters, forms and campaign appeals

Useful for: Targeted information provision & recruitment

Engagement potential: Effective with potentially large numbers

Key resources required: Database access, budget for upfront costs

Risks to manage: Community weariness, erosion of trust, no junk mail stickers (unaddressed mail cannot be delivered), ad hoc use of method

Media channels

Examples: Print, radio, TV, social media

Useful for: Information provision, recruitment, and (for social media) online participation

Engagement potential: Helps to reinforce other methods, and can target particular groups (e.g. youth)

Key resources required: Communications and design skills, budget for upfront costs

Risks to manage: Actual reach hard to determine

4.3 Meso-scale engagement

Meso-scale engagement is a way to reach larger portions of the community, often at a group scale, but can be in person and/or have a focussed and individualised focus.

Program champions

Examples: Community leaders, past participants, case studies

Useful for: Program credibility, motivating action

Engagement potential: Effective with large numbers; stories resonate with people

Key resources required: Good relationship with champion/s and time to build these where needed, budget and resources for sharing stories

Risks to manage: Champion fatigue

Pledges and social norms

Examples: Household or personal energy targets, action plans, joining a group

Useful for: Obtaining commitment to action

Engagement potential: Mixed; best where resident can compare themselves to others

Key resources required: Social science expertise, data management

Risks to manage: Needs follow up support and visibility to peers

Utilising existing networks

Examples: Local groups, peer networks, Council networks / communication channels

Useful for: Building program credibility, recruitment

Engagement potential: Highly effective; reach depends on networks

Key resources required: Staff time, existing social capital

Risks to manage: Limited time and resources of networks, alignment of objectives

4.4 Support

Support based engagement is a way to assist the community in taking actions that they are already interested in taking and/or have some knowledge of.

Technical advice and support

Examples: Phone helplines, technical advice sessions or forums

Useful for: Supporting interested and/or active residents

Engagement potential: Moderately effective with small to medium numbers

Key resources required: Both technical and CE skills (this combination is rare)

Risks to manage: Self-selection by usual suspects, competing with private sector

Service provision

Examples: Quotes, assessments, retrofits, installations

Useful for: Providing hands on support to act

Engagement potential: Highly effective

Key resources required: Costly unless (part or all) user-paid

Risks to manage: Competing with private sector providers

4.5 Incentives

Incentive based engagement offers drivers to action that may not otherwise have appealed to the community.

Financial incentives

Examples: Bulk buys, rebates, subsidies, financing products e.g. rates-based mechanisms, free products / services

Useful for: Overcoming real or perceived cost barriers

Engagement potential: Highly effective when supported by other methods and 'offer ends by' deadline. Greater potential to engage renters and landlords, where split incentive exists

Key resources required: Legal skills, financial model, financial resources

Risks to manage: Community trust in and reliability of innovative models, cessation of external funding

4.6 Which option is best when?

Most successful programs use a combination of options to reinforce messages, encourage participation and maximise reach. In general, time- and resource- intensive methods are the most effective but have a lower reach. Engagement methods should be assessed in terms of the likely value for effort. Many of the lower resource intensive methods of engagement can be very effective in supporting the more resource intensive methods. For example online resources supporting a direct addressed mail out.

	Low reach	High reach
High impact	Home visits Telephone advice service Project or topic specific workshops or forums	Stalls at community events Radio and television advertising or coverage Online information and advice
Low impact	Email campaigns (subscribers only) E-newsletters (subscribers only) Flyers/unaddressed mail outs	Addressed mail sent to households in large volumes

In general, it is helpful to:

- Layer messages when trying to attract a broad audience: Identify the spectrum of benefits the strategy has to offer: financial gain, improved home comfort, health benefits, connection to community, helping the environment

- Allocate resources to measures that will enable the participation of harder to reach audiences e.g. translation services, large print documents for the elderly or those with low vision, resources available on and off line
- Wherever possible, create systems to maintain engagement with community members; ongoing rather than one-off communication will sustain interest and engagement.

5 Operational arrangements

There exists a range of delivery approaches that councils can adopt. As with program strategy and delivery method, combinations are always possible. As noted in Section 2.2, it is critical to carefully think through the appropriate partner/s and/or service delivery agent for the program/s at hand, develop clear arrangements, and actively manage multi-stakeholder processes. Note the following arrangements apply equally to regions of councils, provided there is sufficient regional oversight. This has been well demonstrated by the Southern Sydney Regional Organisation of Councils (SSROC)'s Our Solar Future[4] and the Northern Alliance for Greenhouse Action (NAGA)'s recent climate adaptation work in Melbourne[5]. Regional action on mitigation and adaptation has significantly increased in scale and scope around Australia. They achieve important economies of scale and influence for CE among other things.

5.1 Council-based delivery

Some councils have developed and delivered entire CE programs from their environment, local economic development and/or community development departments. Local governments' community knowledge, networks, rates databases and existing outreach services[6] are certainly indispensable to effective local programs. On the other hand, many have put considerable effort into developing their capacity through participation in ICLEI Oceania's Cities for Climate Protection Program. Councils' reputation as a trusted and credible local organisation is also invaluable. However trust in Council can vary and is not always a given. There can also be challenges around allocating dedicated internal resources, keeping to timelines, managing financial and legal risks, and accessing expertise. Council-based programs tend to be more successful if there is an internal driver/s, but in general there is a strong case for Councils to work with other organisations in some capacity (especially for community segments facing complex barriers such as renters).

5.2 Partnering with community organisations

Many Councils consult with community groups to assist with program design and messaging, and use local networks for promotion and recruitment. It is less common to partner more formally around program design and delivery, but this has been done effectively on business programs (through traders associations) as well as through advocacy groups such as Save our Suburbs[7]. Fruitful outcomes have been achieved by working with community health service providers, local environmental groups, gardening groups, schools, and so on. The advantages to Council include the ability to test and modify their program, extend their reach through trusted and well-networked local groups, and engage hard to reach communities who may only respond if members of their own community are involved in the program. Risks can exist around the non-professional nature of

[4] http://www.oursolarfuture.nsw.gov.au/
[5] http://www.naga.org.au/climate-adaptation.html
[6] Particularly home and community care, planned activity groups, libraries, and maternal and child health services.
[7] http://www.saveoursuburbs.org.au/

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community groups, which can affect the timing of participation, availability during business hours, and quality of outputs.

5.3 Delivery through agencies

Agency-based delivery approaches are emerging as a way to access and/or build technical and CE expertise. This approach can be useful where:

- An organisation has specialist expertise in working in a particular field, for example Environment Victoria's work with CALD communities (see the GreenTown case study attached) and CitySwitch's Green Office program and business network[8],
- Council wishes to establish and provide core funding to an independent CE organisation dedicated to achieving their community greenhouse reduction goal, for example the City of Sydney and Marrickville Council created the Green Living Centre[9], the Moreland City Council created MEFL[10], and the City of Yarra created the Yarra Energy Foundation (YEF)[11], or
- Council wishes to develop a bespoke project for which it lacks internal staff resources or expertise, for example community bulk buys where Councils don't have the experience or technical expertise to recommend products
- Council does not wish to carry the risk of working directly with a commercial entity.

Advantages of agency-based delivery include access to expertise, not having to recruit or train casual or short-term staff and conducting arms-length transactions to reduce council exposure. Disadvantages include risks if the agency lacks understanding of and a relationship with the community being engaged, and the due diligence required prior to any partnership can be time consuming and administratively heavy.

5.4 Joining existing programs or using existing resources

Joining existing programs can be used to achieve economies of scale and address needs common to many Council areas, such as community bulk buys or technical advice provision. For example, more than 120 councils across Australia participate in the Garage Sale Trail[12]. The Positive Charge program is another good example of this (see case study below). It is also possible to adapt, link to and/or print resources developed by others, such as The Victorian Green Renters' Guide[13]. Advantages include access to expertise, ability to assess the program effectiveness prior to delivery, and a strong procurement process to minimise council risk. Disadvantages include the adoption of existing branding in some cases (which can be a benefit depending on Council's objectives and resources), limited ability to modify a potentially cookie-cutter approach, and a reduced level of community trust in some cases (if not delivered with Council as a major partner).

5.5 Supporting community driven programs

[8] http://www.cityswitch.net.au/
[9] http://www.greenlivingcentre.org.au/
[10] http://www.mefl.com.au/
[11] http://www.yef.org.au/
[12] https://garagesaletrail.com.au/
[13] http://environmentvictoria.org.au/rentersguide

This approach is both a strategy (discussed in Section 2.2) and a delivery approach. It is distinct from partnering with community organisations to help deliver a Council-led program as the responsibility and authority lies with the community group. Successful examples include community power projects (see the Hepburn Wind case study below), small grants programs and actions as simple as making venues available to the groups. Advantages include encouraging (and recognising) community momentum and achieving potentially strong outcomes with minimal resources. Disadvantages include the lack of strategic and operational control and the need to manage potential financial and legal liabilities for Council's contributions. In general, Councils' identity as a community leader, role as a municipal service deliverer and accountability requirements can make it difficult to share power and responsibility with volunteer-based programs. It may be preferable in some cases to partner with a third party who can manage the participation and facilitation aspects, whilst still ensuring deliverables and timelines are met.

positive charge

Case Study
Darebin Solar Saver

Happy Solar $aver customers, Melbourne

Strategy

This innovative and replicable project applied a Special Rates Charge to enable pensioner home owners to install solar PV to reduce their energy costs and improve their home comfort and resilience to heatwave events. Households were provided with energy efficiency advice and an offer of solar PV, which is re-paid through a special charge attached to the property. The finance model advantages are no GST (thus saving 10%), reduced credit risk, use of existing systems, quarterly billing, encouragement of low interest lending, provision for asset and debt transfer to new property owners, and increased household and business confidence in investment. Disadvantages included legal issues, administrative complexity (especially with a one off rollout) and additional complexity for the ratepayer.

Delivery methods

Implementation involved Special Charge Scheme approvals, advertising, recruitment of target households (including through an expression of interest survey, articles in the local paper and a direct mail out), eligibility requirements, household assessments (including a brief home energy assessment and advice), quotations, installations, and free information seminars on electricity costs and smart meters. Warranties covered the whole repayment period of 10 years. A 10 year warrantee covered the panels (which also have a 25 year production guarantee), the inverter (not the standard 5 years) and the installation. Council permitted additional work such as switchboard upgrades to be included in the Special Charge. Legal advice indicates other renewable energy or energy efficiency ‘fixtures’ could also be included.

Operational arrangements

The program was initiated and managed by the City of Darebin, Victoria, who took on minimal debt liability for their ~$1 million finance, and were prepared to have these funds returned over a 10 year period. Council also obtained grants to monitor and evaluate the outcomes for energy and costs savings and comfort levels, and the replicability of the model for use by other councils. Council engaged Positive Charge to provide phone consultation and site visits, facilitate quotation (on behalf of the solar installer and contract generation, and ensure households made informed decisions that provide genuine benefit. Solar company Sun Edison (formerly Energy Matters) carried out the installations. Reaching residents through Council was successful as Council is considered to be trustworthy, as is Positive Charge and Council’s independence and expertise in brokering purchases.

Overarching principles

The successful design involved legal advice on using a Special Rates Mechanism, a literature review and resident survey, project budget and plan, and a public tender for delivery. Monitoring and evaluation involved measurement of energy use on solar installations, and qualitative measures on comfort levels and energy savings. A post installation survey was conducted.

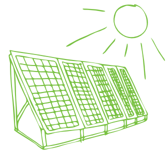
More information

Work is ongoing to scale up the project to other regions, both within NAGA and through other Councils and regional greenhouse alliances in Victoria, SA and NSW.

For more information see http://bit.ly/1NE9WGL

Positive Charge is a social enterprise created by the Moreland Energy Foundation Ltd (MEFL) with the support of Social Traders. Positive Charge delivers cost-effective community sustainability services – both reducing emissions and empowering households and businesses to better manage rising energy costs.
MEFL is a not-for-profit company established by the

Results



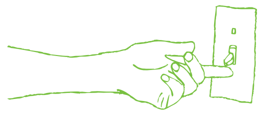
545kW
of solar PV installed (1.87kW Average system size)

292
installs in concession-card holding households, from 600 expressions of interest.

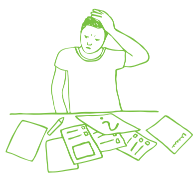
$100
average saving per year on electricity

79%
of residents with lower electricity bills than previous year.

55%
would now consider using their cooling system on hot days.



1 in 3
households now understand their electricity use better.



1 in 2
households were now less concerned about increasing electricity prices

positive charge

Case Study
Hepburn Wind


Launch of the Hepburn Community Wind Farm, 5 November 2011. Photo Karl von Moller (http://bit.ly/1TTGDIf)

Strategy

Australia's first community owned wind farm, just south of Daylesford Victoria was a community-driven project, initiated in late 2005 by a small group of Daylesford residents following a poorly-received community consultation meeting regarding a proposed wind farm. The Hepburn Community Wind Park Co-operative Ltd (Hepburn Wind) was formed and now owns and operates two turbines (total 4.1 megawatt (MW) capacity). The first export of electricity took place on 22 June 2011. An advantage of the project is that it provides a way for renters to invest in renewable energy.

Daylesford community members successfully rallied their energy behind getting community-owned local wind farms

Delivery methods

A local association was formed to garner local support for a community wind park through a broad range of educational activities, including community forums, personal visits to site neighbours, information meetings, bus tours, festival displays, newsletters and fortnightly street stalls in Daylesford's main street. Delivery of the project required more than 30 commercial arrangements to be struck, most of which have long term implications for the project. The project must also comply with a wide range of regulations, permit conditions and technical requirements.

Operational arrangements

The co-operative has over 1,900 members, the majority of whom are local, a board of nine volunteer directors and a local executive team. Shares in Hepburn Wind may only be purchased by co-operative members. The project was complex and involved multiple partners, including Victorian state government funding and advisory support, a Bendigo Bank loan, a debt guarantee from Embark Australia, energy retailer Red Energy (who purchases the total output of the wind farm), and a specialist lawyer. Hepbrn Shire Council was briefed early in the process and provided support to the project.

Overarching principles

The project had a clear outcome in mind, and is an outstanding example of the level of effort, skill and resources possible from a volunteer-based community project.

Results

Hepburn Wind involves two turbines with a combined capacity of 4.1 MW, expected to produce enough electricity to power 2300 homes. The turbines have been financed by,

- $9.8 million raised by 2,000 community investors
- $975,000 in grant funding from Sustainability Victoria's Renewable Energy Support Fund
- $750,000 in grant funding from Regional Development Victoria's Regional Infrastructure Development Program
- $3.1 million loan from Bendigo Bank.

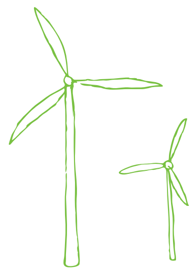
In addition, a Hepburn Wind Community Fund has been established and is projected to provide well over $1 million to local sustainability projects over the next 25 years.

More information

There are now over 70 projects under development across Australia with 19 operating community energy projects.

For more information about Hepburn Wind see http://hepburnwind.com.au/ and for more information about community power in Australia see http://cpagency.org.au/ and http://www.embark.com.au/

Results



4.1MW
capacity from two turbines (enough to power 2300 homes)

$9.8 million
raised by 2000 community investors

$975,000
in grant funding from Sustainability Victoria's Renewable Energy Support Fund

$3.1 million
loan from Bendigo bank

$1 million
projected funding from the Hepburn Wind Community Fund

positive charge

Case Study GreenTown

MEFL's Jason Cox, with community members, involved in the Green Town program.

Strategy

The GreenTown behavioural change program targeted culturally and linguistically diverse (CALD) communities across Melbourne to help them save water, energy and waste in their homes, businesses, and schools. Six projects in six different municipalities occurred under the program from 2008-2012, working with Arabic-speaking, Assyrian Chaldean, Turkish-speaking, East African and Indigenous Australian communities, newly-arrived people from Burma, and the multicultural community in a housing estate.

Delivery methods

A small group of people from each community were trained and then paid to provide free sustainability audits and retrofit products to homes and businesses of others in their community. The program also included a large facility retrofit in each community, field trips, a workshop series and extensive communications in local and CALD media.

Operational arrangements

The project was run by not-for-profit organisation Environment Victoria with funding by the Victorian Government Sustainability Fund. It was delivered in partnership with a number of community organisations, water utilities and MEFL (who provided technical training; MEFL also ran the Moreland projects), and local Councils (who provided general and waste education support).

Overarching principles

The key success factors were the passionate and inspiring local leaders in each GreenTown community, who utilised their extensive peer-based networks and helped frame environmental messages in a culturally appropriate way. Investing time into building good relationships was also crucial.

More information

For more information see http://bit.ly/1K5iirN

Results

2500
people directly reached from the first four GreenTown projects

13,000
people indirectly reached through events, face-to-face conversations and media

295
households who on average saved:

4 tonnes
of CO2e

61,000 litres
of water

191 kg
of landfill waste

The program also sparked several follow-on projects led by the communities.

Positive Charge is a social enterprise created by the Moreland Energy Foundation Ltd (MEFL) with the support of Social Traders. Positive Charge delivers cost-effective community sustainability services – both reducing emissions and empowering households and businesses to better manage rising energy costs.
MEFL is a not-for-profit company established by the Moreland City Council in late 2000 with the approval of the Victorian Office of Local Government.

Case Study
Community Bulk Buys

Strategy

During 2009, the Northern Alliance for Greenhouse Action (NAGA) developed a solar photovoltaic (PV) community bulk buy program called Delivering Clean Energy Solutions (DCES) to maximise the benefit of the Federal Government solar power rebate and help residents evaluate the various offers and choose one best suited to their needs and circumstances. This evolved into a social enterprise called Positive Charge, which offers a community service backed by local councils and run by award-winning sustainability experts, the Moreland Energy Foundation (MEFL). The approach is high impact, measurable, scalable and has high resonance (influence among stakeholders). Positive Charge deliberately targets community segments known to have high uptake rates to these services.

Delivery methods

DCES and Positive Charge have provided a range of services to residents, businesses, schools and kindergartens, including:

» Bulk buys for solar energy, solar hot water systems and electric bikes

» Free advice on efficient heating and cooling solutions, LED lighting and insulation

» Home energy assessments.

This is supported by extensive social marketing and communications. Positive Charge has also delivered sector-specific projects such as Smart Blocks; the body-corporate focused advice and assessment service in the City of Melbourne.

Operational arrangements

Operational arrangements have evolved over time. DCES emerged from NAGA's Towards Zero Net Emissions Action Plan and was a partnership between NAGA, MEFL, City of Darebin, City of Melbourne, Nillumbik Shire and Manningham City Councils and the Yarra Energy Foundation. This informed the subsequent Positive Charge business model, which is run by MEFL and has 14 Victorian council partners plus service delivery to eight councils in NSW. Positive Charge started as a multi-supplier panel procurement process, for solar PV, insulation, LED lights and electric bikes. Positive Charge then moved to a single solar PV supplier selected via a tender process.

The Alternative Technology Association (ATA)

Bob and Chris enjoy lower power bills thanks to the solar panels, that they got through the DCES scheme.

provides independent technical advice on specific products and the solar installers are Clean Energy Council (CEC) accredited.

Positive Charge offers energy efficiency information and advice. This service is delivered on line, over the phone and face to face with community engagement activity.

Positive Charge also creates solar assessments and reviews quotes for businesses, community groups and schools according to council requirements. Positive Charge also coordinates and manages solar bulk buy and other engagement projects tailored to assist councils in achieving their green house gas emissions reduction, engagement and economic and community development goals.

Overarching principles

The community bulk buy programs emphasise measurable and scalable outcomes, comprehensive monitoring and evaluation, and piloting innovative business approaches - expanding as success is demonstrated.

More information

For more information about Positive Charge see http://www.positivecharge.com.au/ and for more information about DCES see http://bit.ly/1E2CA4s

Results

In 2014-15, Positive Charge provided information and advice to:

4,400
households

600
businesses

12
precincts

10
schools and kindergartens

130
Home Energy Assessments Completed

To date Positive Charge has supported the installation of:

500
solar PV installs

equating to
2 MW
solar capacity

saving
54,000 t
CO_2e

positive charge

Case Study
Home Power Saving Program

Strategy

The Home Power Saving Program (2010-2014), delivered low-cost energy efficiency retrofits and advice to 225,000 low income households across NSW, in public, social and private housing. Most low-income households are renters rather than owners, and thus face barriers around split incentives, financing and sometimes low energy literacy.

Delivery methods

The original program provided low income households with:

» A free in-home energy audit

» A power savings kit of energy efficient products, provided free as required and fully installed by the assessor, which includes a stand-by saver power board, energy efficient light bulbs, an efficient showerhead, a tap aerator, a thermometer, shower timer, draught-proofing and door snakes

» A personalised Power Savings Action Plan to encourage households to reduce their energy consumption.

A behavioural change component was later introduced, which used incentives (free products and services), follow-up calls and visits, pledges, face-to-face contact and personalised messages and social norms. It also framed messages in terms of loss aversion.

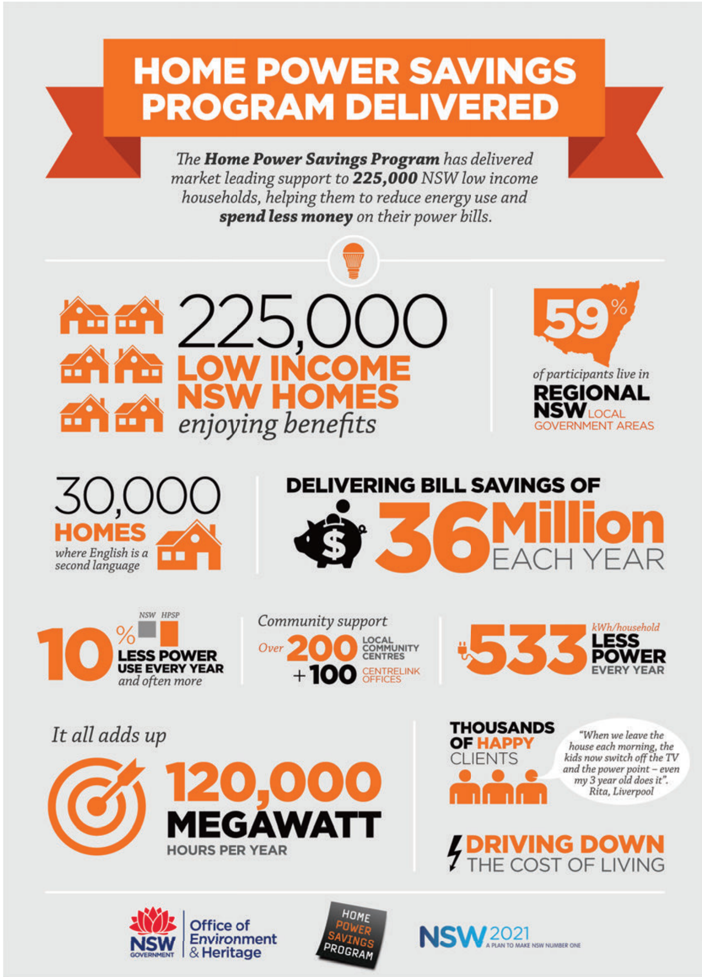
Operational arrangements

The program was run NSW Office of Environment and Heritage (OEH), who partnered with many social and environmental organisations for delivery. OEH also worked with specialists BehaviourWorks Australia and the Behavioural Insights Team to develop and evaluate the behaviour change trial.

Overarching principles

The program involved several phases of evaluation and program development. Interim evaluation of participants' energy savings indicated that on average most savings were being made through the home retrofits. The original program design was thus adapted to include specific behavioural change techniques, which were tested through a randomised control trial during 2013-2014. Following the completion of phase two, a new program will take a more targeted approach.

Results



More information

The new Home Energy Action will build on the success of the Home Power Savings Program to deliver higher cost, higher return efficiency improvements to target vulnerable, low income households (including low-income renters). It will focus on efficient appliances, home improvements and upgrading community housing properties. It will be delivered in partnership with key program partners and stakeholders across the social and environment sectors.

For more information see the Phase 1 evaluation report (2012) (http://bit.ly/1J3hm2W) and a case study by the Department of the Premier and Cabinet (http://bit.ly/1EBPqBm). For more information about the Home Energy Action program see http://bit.ly/1Jhxvp6

8 Conclusions

Local governments work in many different areas of community engagement with differing desired outcomes. When it comes to climate change programs, experience shows they are most successful when they:

- Clearly define desired outcomes and employ specific actions that can be measured in terms of their reduced GHG emissions
- Can be tailored to the requirements of the target community, product or barrier in question, based on a good understanding of the community, relevant research and similar projects elsewhere (to avoid reinventing the wheel)
- Are designed to maximise their greenhouse impact, scalability, resonance, resilience and co-benefits
- Save council resources and time by leveraging existing strengths, relationships and work, working with partners and experts, and taking advantage of internal and external opportunities
- Build trust, support and enduring relationships with partners, the community and within council – climate change is a short, medium and long-term challenge, which means that strong relationships are necessary to achieve lasting results
- Provide a specific offering from the onset to improve uptake (although offering additional guidance and information can also be beneficial)
- Carefully plan communications. For example, a broad reach is useful when the objective is to raise council's profile and improve program scalability, whereas targeting those most able to take action is economical and results in a higher rate of uptake per dollar spent.

9 Program design and communications recommendation based on conclusions

Based on the conclusions of this review a solar PV campaign is a recommended CE program that has a proven track record of achieving results, both for engagement and action on climate change. Installing solar PV is a simple and cost effective way for households to reduce GHG emissions and save on electricity bills. Solar PV is now viewed as a mainstream technology, so people are quite open to and not suspicious of it. Therefore there is a strong argument for promoting solar PV through council programs, particularly to home owners, who have the authority and financial incentive to make purchase decisions and who comprise 70% of households (Bureau of Statistics 2014).

Communications strategies for a solar PV focussed campaign

1. Tailor communications to focus on groups facing particular barrier(s) and include case studies and statistics to illustrate personal benefits, such as financial savings. For example,
   - If the barrier being addressed is cost, target low income and pensioner households with a rates based scheme and/or special discount
   - If the barrier is time, provide concise information to those who are time poor, such as working families
   - If the barrier is trust, councils need to explain why they are recommending a particular supplier or service and draw on their existing credibility
2. Distribute communications through trusted channels, including council's channels. For example,
   - For a rates based scheme, use a mail out with rates notices
   - If targeting pensioners, go to places of interest such as community centres or sporting groups
   - If targeting busy working families, promote the program through schools and workplaces
   - Council branded communication in the form of addressed letters, local newspaper articles and council newsletters
3. Be clear on your ask. For example,
   - *"Call/sign up to find out more or get a quote"*
   - *"Come along to an information session"*
4. Beware of assumptions that might be held by community members.

10 Useful resources

- **Building Social Cohesion in our Communities** has recently been released by the Australian Centre of Excellence for Local Government aims to support local governments to build strong, socially cohesive communities: http://www.acelg.org.au/socialcohesion
- **MECHanisms**: make energy change happen behaviour change toolkit by the European Commission: http://mechanisms.energychange.info/
- **Community-based social marketing framework** by environmental psychologist Dr Doug McKenzie-Mohr: http://www.cbsm.com/public/world.lasso

Interesting articles about storytelling for getting sustainability messages across: http://www.theguardian.com/sustainable-business/blog/telling-positive-stories-sustainability-marketing and http://www.futerra.co.uk/blog/seven-simple-steps-to-sustainability-stories

Appendix C - “Solar Suburbs Project. Position Paper: Local Government Capacity”

(Solar Suburbs / C4CE, 29 October 2015)

Solar Suburbs Project

Position Paper: Local Government Capacity

29 October, 2015

Background

The Solar Suburbs project team (consisting of members from Moreland Energy Foundation, Community Power Agency, and Solar Suburbs) interviewed representatives from 10 Councils and/or local government bodies (Councils) to investigate, among others:

- Emissions reductions and/or renewable energy (RE) targets
- Drivers - or champions - within Council to implement related initiatives
- Potential role of community in achieving targets and/or potential role of Council to support community-led initiative(s)
- Challenges and barriers to higher uptake of residential solar PV
- Potential interest within Council to support a rates-based finance mechanism to assist households to implement solar PV.

The purpose was to inform the development of 'Solar Suburbs' model(s) that not only overcome barriers to widespread uptake of residential solar PV but also promote active uptake by households through social activation, engagement and incentivisation.

Councils interviewed were (in alphabetical order):

(1) Auburn City Council
(2) Blacktown City Council
(3) Campbelltown City Council
(4) Canada Bay City Council
(5) Gosford Council
(6) Marrickville Council
(7) Parramatta City Council
(8) Randwick City Council
(9) Southern Sydney Region of Councils (SSROC)
(10) Waverley City Council

Whilst the interviewers were representatives of the Council / local government body, the views expressed were those of the role holder and not the formal position of the Council in question.

Findings

- Most Councils either had emissions reductions and/or renewable energy (RE) targets or had taken steps to reduce their environmental footprint or facilitate households who wished to take individual action
- Drivers - or champions - within Council were either the environmental team or the Mayor / Councillor
- Approximately half of the Council representatives either acknowledged the potential role of community in achieving Council targets or indicated a willingness to support community-led initiatives

- Challenges to higher uptake of residential solar PV included perceived cost of installation, lack of trusted suppliers, information saturation. SSROC's Our Solar Future aims to address these challenges.
- The majority (9 out of 10) of Councils indicated a moderate to high level of interest in a rates-based finance mechanism to assist households to implement solar PV, with the following caveats:
  - Finance departments will need to give approval and support, otherwise the initiative will not be progressed. Suggested means to overcome this challenge included the development of a viable business case which satisfies the Council's triple bottom line requirements
  - Any additional administration burden will need to be minimised and managed (eg impact on rates billing systems)
  - Such a mechanism needs to be marketed effectively to ensure widespread interest and takeup
  - Councils do not generally have expertise in managing finance products, which suggests a skills gap and corresponding risk
  - Imminent Council mergers are likely to delay and/or block non-core initiatives such as this one.
- Overall, the majority of Councils positively indicated a willingness to review and potentially support a community-led initiative that leads to an uptake of households accessing reliable solar PV solutions with minimal risk and cost to both the households and Council alike. We found that most Councils do not want to take on additional risk or cost.

Our position

Increasing the uptake of residential solar PV in NSW can be achieved by careful co-ordination of:

- elimination, minimising or managing existing barriers, and
- activating the residential household community via social mechanisms to implement rooftop solar PV.

NSW government, including NSW Office of Environment and Heritage (OEH), should consider undertaking the following:

(1) Enact or amend relevant legislation to enable rates-based finance for households wishing to implement solar PV systems (and other energy efficiency technologies where applicable) and repay the capital via the rates mechanism

(2) Issue relevant policy and/or guidelines to Councils so that Councils have a clear and consistent indication of the goals and boundaries of such a mechanism

(3) Provide legal, financial, administrative assistance or expertise to Councils to facilitate the implementation (on either a centralised or decentralised basis)

(4) Promote the scheme to both Councils and the public.

END

Appendix D - “Final Report for the Solar Suburbs Coalition”

(Alternative Technology Association, 3 September 2015).

ATA

Final Report

for the Solar Suburbs Coalition

September 2015

Document Information

Document Version	Date	Prepared By	Reviewed By	Comments
Solar Suburbs – Draft Report 290615 v0.1	29th June 2015	Damien Moyse – Policy & Research Manager		Initial Draft
Solar Suburbs – Draft Report 130715 v0.2	13th July 2015	Damien Moyse – Policy & Research Manager	Craig Memery – Senior Energy Analyst	Second Version
Solar Suburbs – Draft Report 170715 v0.3	14th July 2015	Craig Memery - Senior Energy Analyst	Andrew Reddaway – Energy Analyst	Third Version
Solar Suburbs – Draft Report 150715 v0.5	15th July 2015	Damien Moyse – Policy & Research Manager		First Draft for Client
Solar Suburbs – Draft Report 280715 v0.6	28th July 2015	Damien Moyse – Policy & Research Manager	Andrew Reddaway – Energy Analyst	Sixth Version
Solar Suburbs – Draft Report 300715 v0.7	30th July 2015	Damien Moyse – Policy & Research Manager	Tom Nockolds – CPA	Second Draft for Client
Solar Suburbs – Final Report 030815 v0.8	3rd August 2015	Damien Moyse – Policy & Research Manager		Eighth Version
Solar Suburbs – Final Report 100815 v1.0	10th August 2015	Damien Moyse – Policy & Research Manager		Final Version for Client
Solar Suburbs – Final Report 030915 v2.0	3rd September 2015	Damien Moyse – Policy & Research Manager		Updated Final Version for Client

Prepared for the Solar Suburbs Coalition

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Promoting Renewable Energy, Energy Efficiency and Water Conservation since 1980

Contents

Executive Summary

The Solar Suburbs Coalition commissioned the Alternative Technology Association (ATA) to undertake research and investigations into appropriate renewable energy, energy efficiency and related technologies for residential application in metropolitan Sydney.

This document is the Final Report. It outlines the research, modeling and related investigations undertaken by the ATA and includes recommendations for the development of the Solar Suburbs program.

Context

On average, metropolitan Sydney households are spending in the order of $2,500 per year on stationery energy. This means roughly half of the almost two million Sydney homes are spending more than $2,500 per year on stationery energy – for whom significant financial savings can be found with technologies that will also reduce their carbon footprint.

Residential stationery energy in Sydney is largely made up of:

- mains electricity – with approximately 1.8 million Sydney homes grid connected; and
- mains (LNG) gas – with approximately 1.15 million Sydney homes grid connected. Approximately 940,000 Sydney homes use mains gas for space heating or water heating – two of the largest residential energy loads.

In this context, a number of residential, demand-side (or customer-side) technologies offer good, to very good, economic value for households – as well as achieving environmental benefits:

- high efficiency reverse cycle air conditioners (RCACs) for heating & cooling;
- heat pump hot water and solar hot water systems;
- induction cook tops and efficient electric ovens;
- solar photovoltaic (PV) systems;
- lithium-based energy storage (coupled with existing or new solar PV);
- building thermal efficiency measures such as insulation and draught sealing;
- LED lighting; and
- ceiling fans.

A summary of technology opportunities identified for any future Solar Suburbs program, and the number of metro Sydney homes for which they are relevant, is outlined below:

Table 0: Solar Suburbs Technology Opportunities, Metropolitan Sydney

Household Energy Characteristic	No. Sydney Homes	Future Opportunity
Connected to mains electricity	1.8 million	A variety of renewable and efficient electric technologies, as per below.
Spend >$2,500 p.a. on energy	~1.0 million	Significant cost savings can be achieved by low emission technologies.
Use mains gas for space/water heating	940,000	Economics of switching to efficient electric at end of gas appliance life is compelling for these homes. Also synergies with solar PV.
Use mains electricity for water heating	1.0 million	Economics of switching to efficient electric at end of electric appliance life is compelling for these homes. Also synergies with solar PV.
"Solar-free" detached homes	~1.0 million	Economics of solar PV for medium to high electricity usage households are compelling.
Currently receive 60c gross Feed-in Tariff	~120,000	The NSW 60c gross FiT ends in December 2016, by which time the next generation of home storage technologies will likely be available. These will be economically attractive to existing solar customers losing their premium FiT.
No/underperforming ceiling insulation	~900,000	Economics and energy/carbon reductions of installing >R4.0 ceiling insulation are compelling.
No draught proofing	~1.2 million	Any insulation project should be complemented with draught proofing for best thermal performance.
Existence of inefficient lighting	'000,000s	Significant opportunity for replacement of most lighting technologies with LEDs.

Relevant considerations for the inclusion of a number of these technologies in any future Solar Suburbs program are outlined below:

Fuel Switching

In 2014, ATA conducted detailed research into the economics of using gas versus efficient electric appliances for space heating, water heating and cooking.

Overall, the economic results for switching from gas to efficient electric technologies were stronger in metropolitan Sydney than virtually any other part of the NEM. This finding presents considerable opportunities for any future Solar Suburbs program.

Heating & Cooling

It is very cost effective for metro Sydney homes to switch to RCACs for space heating when. This is particularly the case when their existing gas ducted or wall furnace heating system reaches the end of its asset life – and indeed in some circumstances, prior to.

When considering RCACs for space heating as well as cooling, sizing, along with efficiency, is important. As such, a range of RCAC sizes should be considered as part of any future Solar Suburb program. In addition, the ability of new RCACs to control humidity should also be considered.

Hot Water

In metro Sydney, around one million homes have electric hot water. Heat pump hot water, solar hot water, solar PV and even retro-fit solar collectors are all excellent replacement/complementary technologies for traditional electric storage HW systems and should be considered as part of any future Solar Suburbs program.

Around 500,000 metro Sydney homes have existing gas hot water systems – for whom switching to efficient electric offers excellent economic and environmental benefits.

Solar PV

At least one million detached homes in metro Sydney can be considered 'solar free'.

Solar PV provides the best economic return to those residents in metro Sydney that have medium to high overall electricity demand, and medium to low export rates to the grid (~ <50%).

A number of the other efficient electric technologies identified in this report can be timed to consume electricity during solar generation times (i.e. in particular space heating and cooling and water heating) and are therefore complementary to solar PV in this regard.

Financing

The value and risks of any financing products associated with solar PV (or any other technology) is critical to assess as part of any program, with a comparison of the following components (at a minimum) across suppliers/product offers:

- term;
- finance rate;
- warranties and other consumer protections;
- performance guarantees;
- system ownership; and
- early termination fees.

Should financing offers be considered as part of any program that target low income and vulnerable consumers specifically, then a higher degree of consumer protections should be sought – in particular with regards to the treatment (and potential payment for) any exported electricity to the grid.

Storage

As of mid 2015, stationery energy storage for residential application is at a critical juncture.

Currently, lithium-based storage in Australia remains more expensive to purchase and install than traditional lead acid technology. However the Tesla PowerWall announcement of April 2015 will result in lithium storage competing directly with lead acid and all other chemistries on price – in addition to it being of greater economic benefit over time. At this point, there will be no economic case for continuing to use lead acid for household stationery energy.

In addition, the new plug-and-play, packaged units will be safer, lighter, easier to install and easier to connect directly to an existing or new solar PV system.

However it may be late 2016 or even 2017 before the 'PowerWall-type' units cement their position in the Australian market. Prior to this occurring, a household installing battery storage as part of a grid connected, hybrid system (whether it be lead-acid or lithium-based technology) is likely to pay a substantial cost premium for what in 12-18 months will likely be inferior technology.

Thermal Efficiency

Approximately half to one million metro Sydney homes could usefully be upgraded with high performance ceiling insulation and draught proof sealing.

Ceiling insulation should not be undertaken in isolation of draught sealing around doors, windows, building vents and exhaust and other ceiling or wall fans – otherwise increased building thermal performance cannot be fully achieved.

LED Lighting

Given the low prevalence of LED lighting in NSW homes and the fact that parts of metro Sydney have the highest rate of halogen down lights in the country, an efficient lighting program is worthy of consideration.

Any such program should focus purely on LED lighting technology – as LEDs are significantly more efficient even as compared with CFL technology; have considerably longer asset lives and have less environmental issues associated with their waste stream.

Technology & Supplier Assessment

Should Solar Suburbs decide to promote, recommend or deliver specific technologies and/or specific suppliers to household energy consumers as part of a future stage of the program, then it is advisable to undertake a product and supplier review, specific to the technologies in question.

Individual technologies can vary in their size, component configuration, application and the structure and terms and conditions of their contractual arrangements. Technologies and technology suppliers need to be assessed on a comparative basis so as to ensure the best value for money, highest quality and strongest consumer protections possible are achieved for program participants.

The Efficient, Renewable All-Electric Home

Over the past few years, a range of technology, energy market and other factors have emerged that point toward an energy future where the cheapest energy management options for households also happen to contain a high degree of renewable energy and energy efficiency solutions.

Major residential appliances (e.g. hot water, space heating and cooling) have fixed asset lives and need to be replaced from time to time. Choosing the right technology at each of these decision points, in the context of a longer term plan to make a home as efficient and renewably-powered as possible, will come at very little (if any) additional cost and deliver long term economic and environmental savings.

Educating the community in this regard means residential consumers making better decisions when appliance replacement comes up, irrespective of whether they purchase any specific technology through Solar Suburbs.

It is strongly recommended that any future program have such an educational/advice component.

1.0 Introduction

The Solar Suburbs Coalition commissioned the Alternative Technology Association (ATA) to undertake research and investigations into appropriate renewable energy, energy efficiency and related technologies for residential application in metropolitan Sydney.

The investigations undertaken were to include an assessment of:

- the energy characteristics of metropolitan Sydney homes, along with relevant demographic data;
- the economic value of a range of technologies taking into account the metropolitan Sydney location, tariffs and climate;
- different tenancy arrangements and considerations; and
- innovative financing options for technology uptake.

This document is the Final Report. It outlines the research, modeling and related investigations undertaken by the ATA and includes recommendations for the development of the Solar Suburbs program.

ATA wishes to thank the Solar Suburbs Coalition for the opportunity to work on this exciting project.

2.0 Energy Context

The objective of this section is to provide a broad overview of energy usage, energy spending, fuel and appliance types and related energy characteristics as relevant to metropolitan Sydney. This data and information provides general context for understanding which technologies and what households are best targeted by any future Solar Suburbs initiative.

2.1 Spending on Energy

In 2012, NSW households spent an average of $5,148 per annum on energy[1]. This included:

- $1,976 per year on energy sources used within the dwelling (such as electricity or gas); and
- $3,120 per year for fuel for vehicles.

It should be noted that NSW closely reflects the national average when it comes to spending on energy.

At a national level, the type and number of energy sources used within a dwelling influenced annual energy costs. Households with electricity-only connected to their dwelling spent the lowest amount on stationery (i.e. dwelling) energy ($1,508 per annum). This however may have little relevance in NSW due to the range of climatic zones and energy unit costs across the country.

Overall, Australian households' average expenditure on energy represented 5.3% of total gross annual household income (2.0% for stationery energy and 3.2% for fuel for vehicles). Vulnerable consumers however can spend up to 10% (and more) of their income on energy.

2.1.1 Spending by Climate Zone

The ABS publish spending on energy by climate zone. Metropolitan Sydney falls largely across Climate Zones 5 (Warm Temperate) & 6 (Mild Temperate).

Average annual expenditure on energy for dwellings (i.e. stationery energy) in Australia in 2012 was $2,028. In the two relevant Sydney zones, annual expenditure on energy was:

- Zone 5 - $1,872 per annum (8% below the average);
- Zone 6 - $2,236 per annum (10% above the average).

Unlike sources of energy for dwellings, expenditure on fuels for vehicles did not generally vary significantly across climate zones.

Since mid-2012 however, NSW has experienced relatively significant retail energy prices rises.

According to St Vincent de Paul (2013)[2], annual energy bills (electricity and gas) for dual fuel Sydney households with average consumption increased by approximately $165 (due to energy price increases).

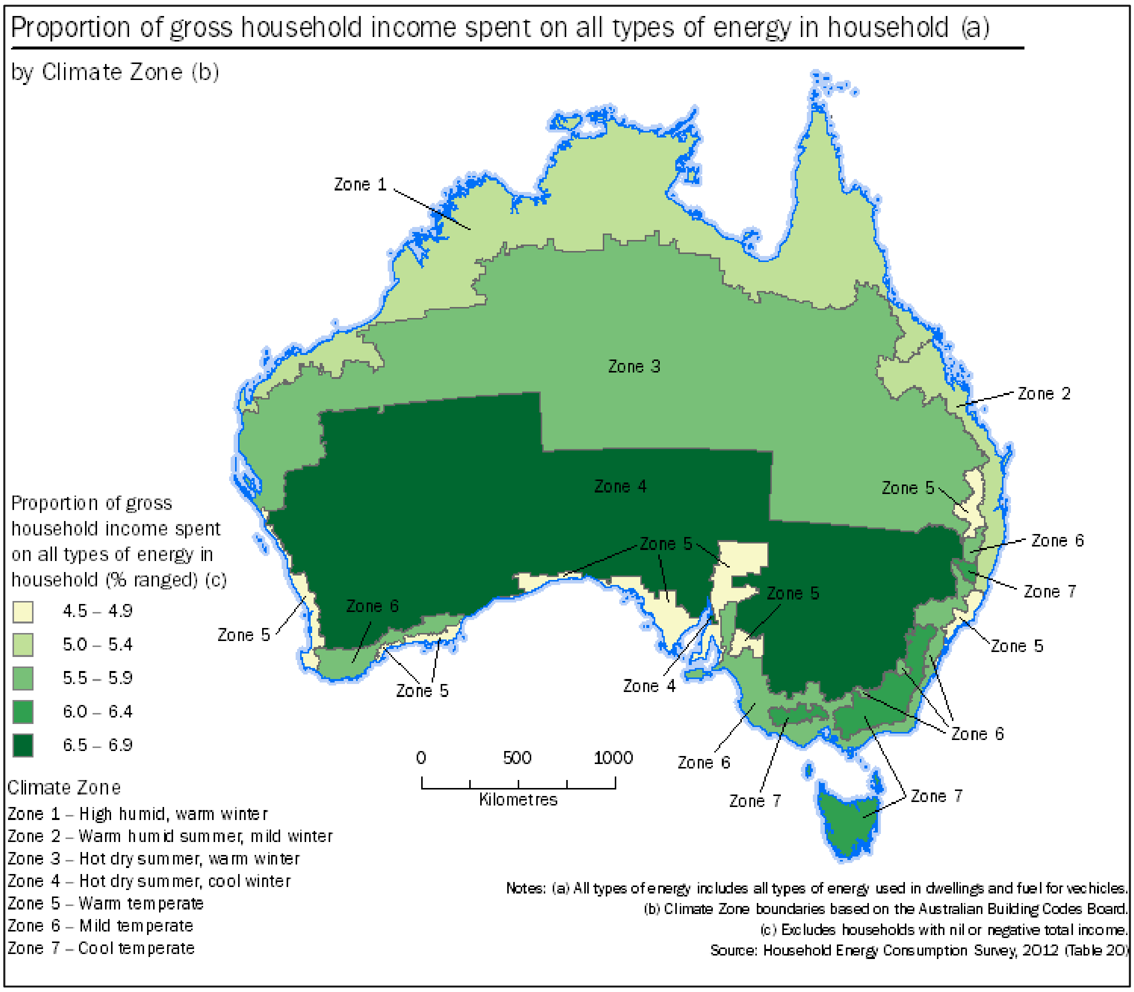
1 http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4670.0main+features132012
2 https://www.vinnies.org.au/page/Our_Impact/Incomes_Support_Cost_of_Living/Energy/NSW/

In 2014, St Vincent's estimate that the annual energy cost for dual fuel households with typical consumption levels increased by a further $125 and $230. The 2014 price rises are largely associated with gas bills increases of 16 to 20 percent. AusGrid in NSW also state that their typical electricity customer in 2014 had a bill of approximately $2,300.

This data accords with the estimates by the Australian Energy Regulator[3] (for 2014) that suggests that average NSW electricity bills alone (i.e. not including gas) are above $2,000 per annum.

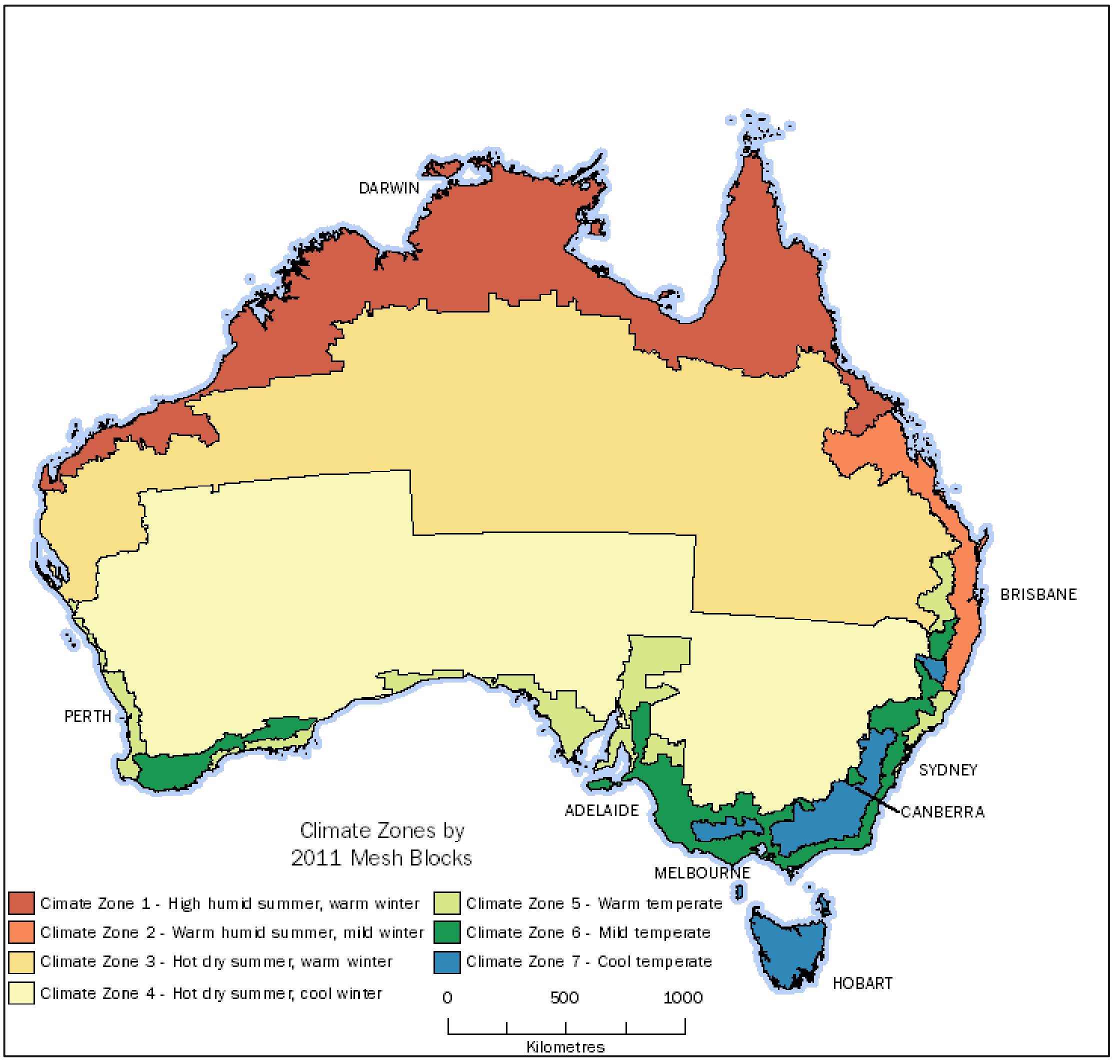
Public data does not exist on price trajectories for 2015, but on the basis of the above, it can be confidently assumed that metro Sydney households on average are spending in the order of $2,500 per year on stationery energy.

Figure 1: Proportion Household Income Spent on Energy, ABS 2012



3 http://www.abc.net.au/news/2015-03-25/electricity-chart-1/6346630

Figure 2: Australian Climate Zones, ABS 2012



2.2 Energy Sources

For colder climate zones, electricity and mains gas (with no other sources of energy) were the most common energy sources used in households. More than 50% of the homes in Zones 5 and 6 (56% and 63% respectively) used electricity and mains gas only. It can be assumed that all of these homes currently have a connection to the mains electricity grid.

2.2.1 Gas Connections

According to the relevant NSW DNSPs, and correlated with ABS connections data, metropolitan Sydney has in the order of 1.15 million residential connection points to the mains gas network[4].

[4] Total: 1,146,785 residential connections. Source: Residential connections by distributer in 2013 (AER decisions) distributed by ABS - 2011 Census Table Builder; 3218.0 (2014); 4602.0.55.001 (2011), grown out one year at average population growth for 2011-13.

Grattan (2014)[5] was able to use ABS data to broadly understand the gas connection profile of NSW homes – i.e. those end uses that mains gas is connected for. The following table indicates the percentage of NSW homes that have specific mains gas connection profiles:

Table 1: NSW Residential Mains Gas Connection Profile

Connection Profile of Mains Gas	Label	% of NSW Homes
Cooking Only	C	18%
Space Heating Only	S	20%
Space Heating & Cooking	SC	12%
Space Heating & Water Heating	SW	10%
Space Heating, Water Heating & Cooking	SWC	20%
Water Heating	W	5%
Water Heating & Cooking	WC	15%

The data above indicates that of NSW homes that have mains gas connected, approximately 82% of these use mains gas for space heating or water heating – two of the largest residential energy loads.

2.2.2 Gas Consumption

In 2014, ATA conducted detailed research and modelling[6] into the economics of using gas versus efficient electric appliances for space heating, water heating and cooking.

As part of this research, ATA modelled the annual gas and electricity consumption of various gas (both existing and new) and efficient electric (new only) appliances for different sized homes in metropolitan NSW (as well as other locations throughout NSW and Australia).

The following table outlines the findings of this energy consumption modelling:

5 http://grattan.edu.au/wp-content/uploads/2014/10/817-gas-at-the-crossroads.pdf
6 http://www.ata.org.au/wp-content/projects/CAP_Gas_Research_Final_Report_251114_v2.0.pdf

Table 2: Annual Gas Consumption by Appliance Type & Household Size, NSW

Home Type/Size	End Use	Existing Gas Consumption (GJ)	Electric Consumption of Existing Gas (kWh)[7]	New Gas Consumption (GJ)	New Electric Consumption (kWh)
Existing Large Home	C[8]	2.00	-	2.00	278
Existing Large Home	S[9]	16.31	84	13.05	607
Existing Large Home	W[10]	27.79	-	27.79	2,057
Existing Medium Home	C	2.00	-	2.00	278
Existing Medium Home	S	13.46	69	10.77	488
Existing Medium Home	W	19.17	-	19.17	1,291
Existing Small Home	C	2.00	-	2.00	278
Existing Small Home	S	7.72	43	6.18	290
Existing Small Home	W	12.72	-	12.72	887
New Apartment	C	2.00	-	2.00	278
New Apartment	S	13.46	69	10.77	488
New Apartment	W	12.72	-	12.72	887
New Detached Dwelling	C	2.00	-	2.00	278
New Detached Dwelling	S	16.31	84	13.05	607
New Detached Dwelling	W	27.79	-	27.79	2,057

The previous ATA research also considered the prevalence of different sizes of homes in metropolitan Sydney. According to the ABS[11], metropolitan Sydney has the following breakdown with regards to household size:

Table 3: Household Size as a Proportion of Total NSW Homes

Home Type/Size	% of Total
Existing Large Home	29.7%
Existing Medium Home	37.6%
Existing Small Home	32.7%

[7] This relates solely to the electricity consumption associated with the electric fan in a gas wall furnace.
[8] Cooking: Assumes replacement of old gas cook top and oven with either new gas cook top and oven or new induction cook top and electric oven.
[9] Space Heating: Assumes replacement of old gas wall furnace with new 5 Star gas wall furnace or new reverse cycle air conditioners, sized to meet building heating demand. Note: Existing ducted gas units, where they exist in NSW, will consume more gas than identified in the table above.
[10] Water Heating: Assumes replacement of gas instantaneous or storage HW system (dependent upon household size) with new 5 Star gas instantaneous or storage HW system or efficient electric heat pump HW system.
[11] ABS Census, 2011.

2.3 Dwelling Types

The most common type of dwelling structures across all climate zones were separate houses.

The highest rate of separate houses were in Zones 3, 4 and 7 (93%, 89% and 87% of dwellings respectively), with more than half of the dwellings in these zones aged 30 years and over. By contrast, the lowest rates of separate houses were for Zones 5 (72%) which was significantly lower than the national average, and may also contribute to Zone 5's relatively lower energy expenditure and consumption values.

Around a quarter of households in Zone 1 (26%) had either a solar electricity or hot water system (or both) in their dwelling, significantly higher than the national average of 15%. By contrast, only 8% of households in Zone 7 had a solar electricity or hot water system.

2.4 Energy Appliances

2.4.1 Hot Water

Electric hot water systems were more common than other systems in Zones 1, 2, 3 and 4, while mains gas hot water systems were more common than other systems in Zones 5, 6 and 7.

2.4.2 Lighting

There were similar average numbers of compact fluorescent lamps installed in key living areas in households across all climate zones (around three to four globes per dwelling).

Households in Zones 1, 3 and 4 had higher numbers of fluorescent tube lights installed in key living areas (1.63, 1.69 and 1.19 respectively) compared to the national average (0.79)[12].

Households in Zone 6 had the highest number of halogen lights in key living areas (4.11) compared to the national average (3.66). Incandescent lights were generally more prevalent in colder zones.

2.4.3 Heating & Cooling

Reverse cycle air conditioners and electric heaters were the most common winter heating appliances in households across all climate zones (0.36 and 0.33 systems per household respectively).

Households in Zone 5 had the highest number of reverse cycle heat pump systems per household compared to the national average (0.43 compared with 0.36). This concurs with other ABS data[13] suggesting that 44% of NSW homes use electricity as their main heating source.

The average number of ducted gas heating systems per household differed across all climate zones. Households in Zones 6 and 7 had the highest average number of ducted gas systems per household compared to the national average (0.35 and 0.25 respectively compared to 0.16). Overall, ABS[14] suggests that 25% of NSW homes use mains gas as their main heating source.

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[12] http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4670.0main+features100072012#Endnotes
[13] http://www.abs.gov.au/ausstats/abs@.nsf/mf/4602.0.55.001
[14] http://www.abs.gov.au/ausstats/abs@.nsf/mf/4602.0.55.001

Reflecting cooling requirements in hot climates, households in Zone 1 had the highest average number of ceiling fans per household (3.78) compared to the national average (0.77). While RCACs were popular across all climate zones, the average number per household was highest in Zone 1 (0.93) compared to the national average (0.53).

2.4.4 Energy-related Behaviours & Perceptions

More than a third (38%) of households in Zone 6 and nearly half (45%) of households in Zone 7 used draft proof sealing on their doors and windows (more than the national average of 30%). Zone 1 had the lowest proportion of households who used draft proof sealing (8%).

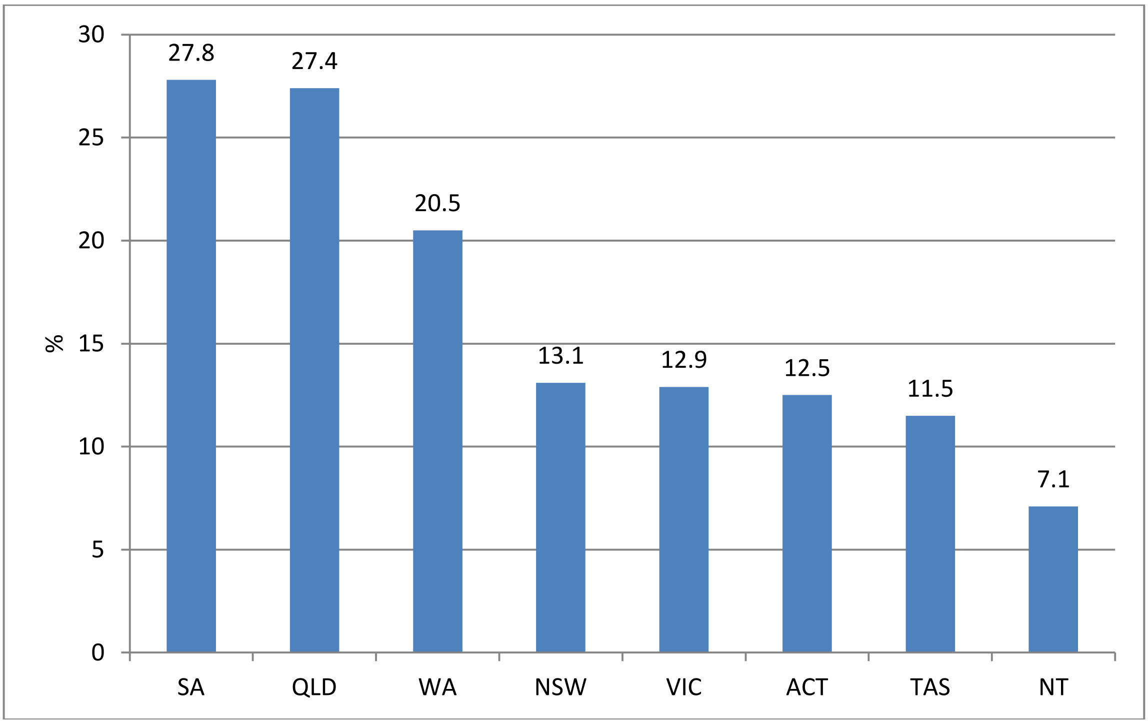
Home heating was most commonly perceived as the main contributor by households in Zones 7 and 6 (55% and 43% of households respectively). Water heating was most commonly perceived as the main contributor in Zones 2 and 5 (32% and 27% of households respectively).

2.5 Solar

Despite the generous policy incentives (earlier) and significantly falling costs (later), metropolitan Sydney (and NSW in general) has experienced less uptake of solar photovoltaic technology than many other parts of Australia over the past decade.

According to the Australian Photovoltaic Institute[15], as of April 2015, NSW has approximately 850 megawatts (MW) of installed solar PV capacity. This comprises approximately 13% of all NSW households – which is in line (on a percentage basis) with Victoria, the ACT and Tasmania, but is significantly lower than SA, QLD (around half) and WA (approx. 30% less):

Figure 3: Proportion of Households with Solar Energy, APVI



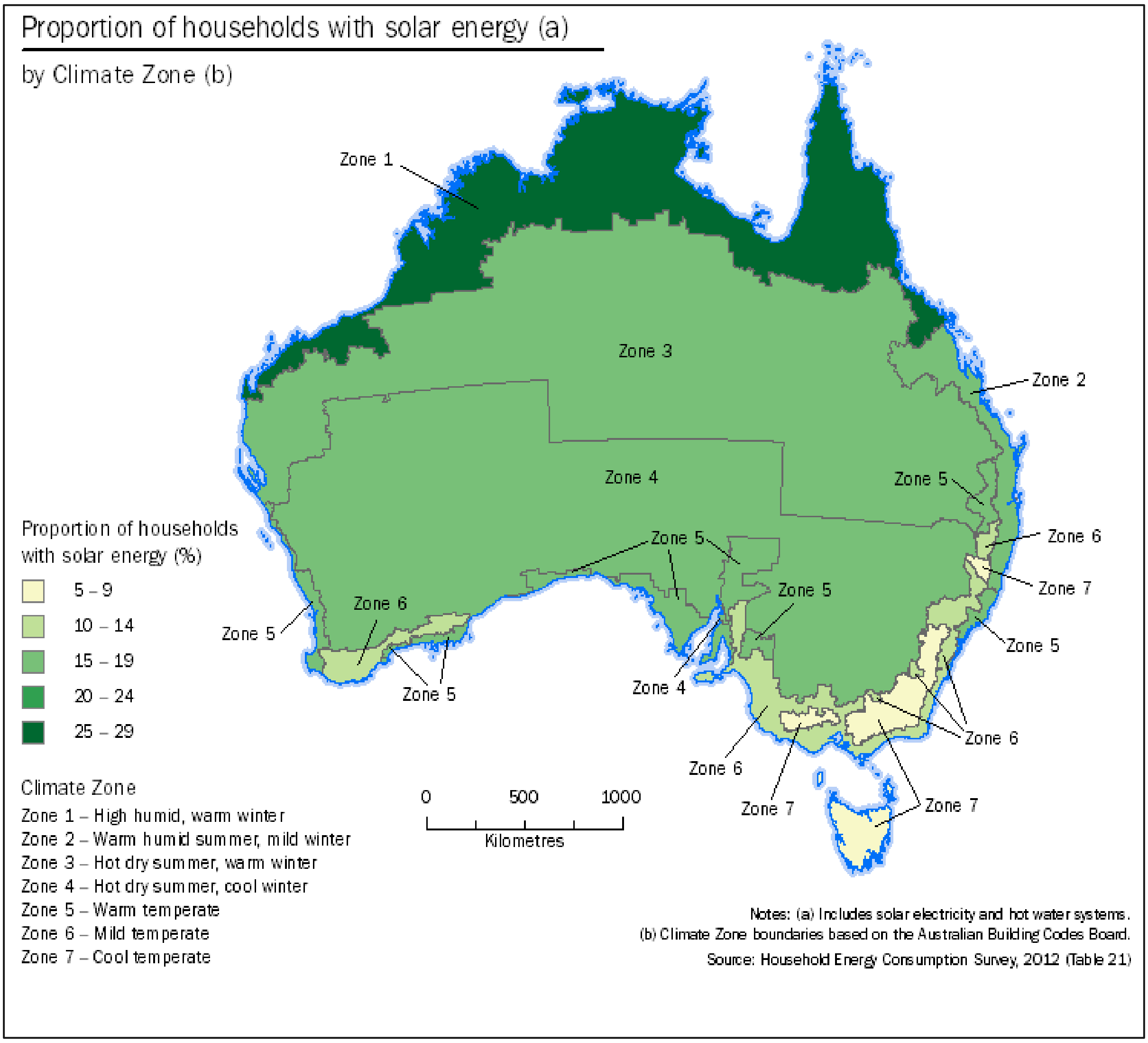
[15] http://pv-map.apvi.org.au/historical#11/-33.8453/151.0929

The online APVI solar map also allows installations by postcode and LGA to be analysed. A cursory glance of metropolitan Sydney identifies that the proportion of homes with solar PV is highest in the outer western and outer northern suburbs; whilst closer to the CBD and eastern suburbs, this proportionate percentage reduces significantly.

This may reflect the far higher density of housing and lower proportion of greenfield developments in inner and eastern Sydney – meaning a lower proportion of homes there are suited to solar PV due to lack of roof space and higher shading.

The ABS also publishes data on the proportion of Australian homes with solar energy by climate zone – including both solar PV and solar water heaters. As can be seen from the figure below, only 10-14% of homes in Zone 5 (which incorporates large swathes of metro Sydney); have installed solar energy, compared with and 15-19% of homes in Zone 6.

Figure 4: Proportion of Households with Solar Energy, ABS 2012



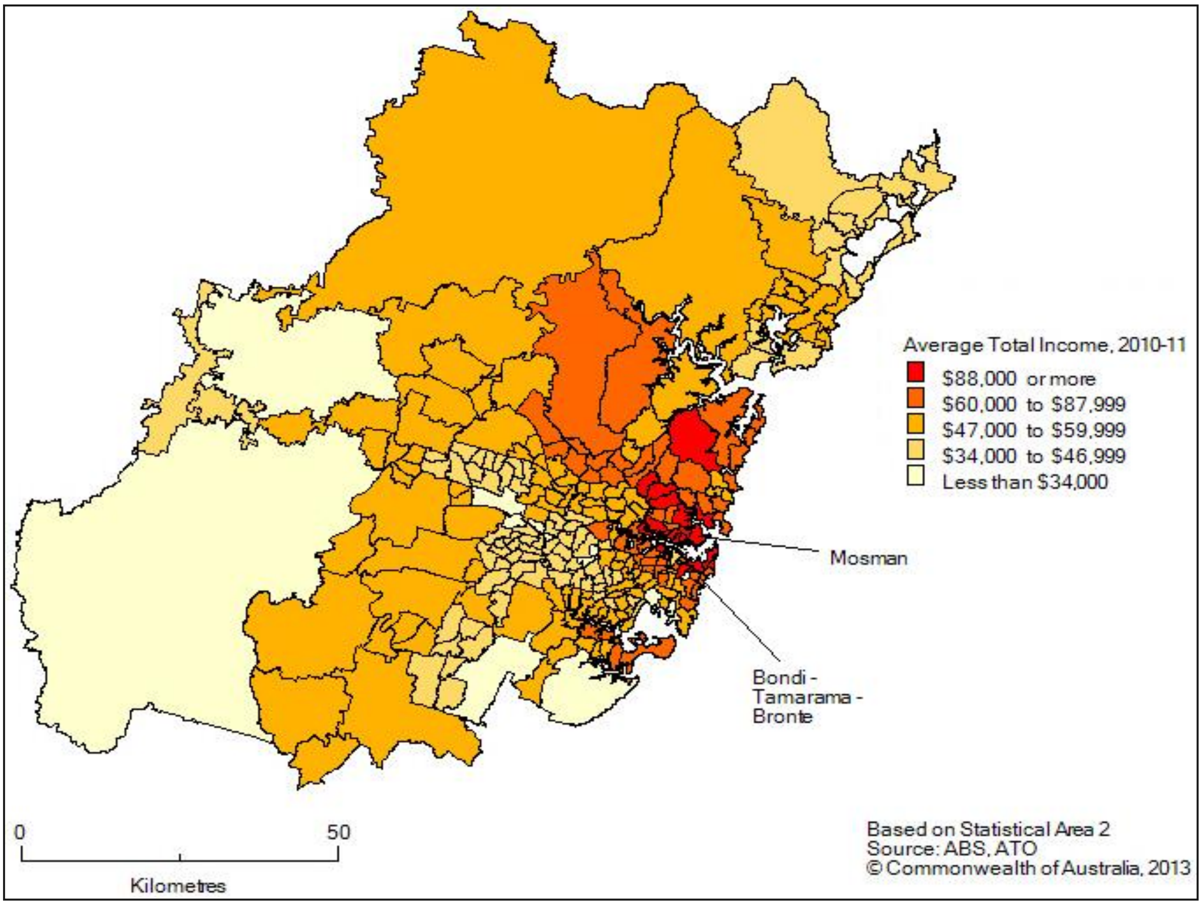
This accords with data from the Clean Energy Council[16] regarding the top 10 NSW solar postcodes (2012):

- **2830:** Dubbo and surrounds (28.0%);
- **2477:** Alstonville, Rous, Meerschaum Vale (21.2%);
- **2486:** Banora Point, Tweed Heads South, Bilambil (20.0%);
- **2400:** Moree, Taloona (19.4%);
- **2880:** Broken Hill, Silverton (19.2%);
- **2484:** Murwillumbah (18.4%);
- **2147:** Seven Hills, Lalor Park (18.2%);
- **2478:** Ballina, Lennox Head (17.3%);
- **2483:** Brunswick Heads, Ocean Shores, Billinudgel (16.6%);
- **2550:** Bega, Candelo, Kanoona, Wolumia (16.6%).

Perhaps somewhat surprisingly, given the increasingly favourable economics of solar PV in NSW, the majority of these locations are regional (and likely middle to lower income) locations.

A quick comparison of the most recent ABS income data for NSW (2010/11)[17] demonstrates that the increase in household income has some correlation with a reduction in the penetration of solar PV (i.e. household income increases with closer proximity to the Sydney CBD and metropolitan coastline):

Figure 5: NSW Average Total Income by Statistical Area, ABS 2010/11



[16] http://reneweconomy.com.au/2012/the-top-solar-postcodes-and-australias-solar-capital-28344
[17] http://www.abs.gov.au/ausstats/abs@.nsf/mf/6524.0.55.002#Anchor5

3.0 Fuel Switching

As outlined above, in 2014, ATA conducted detailed research and modelling[18] into the economics of using gas versus efficient electric appliances for space heating, water heating and cooking.

ATA's methodology for the research modelled six different household types, and compared the 10-year costs of installing and running gas, as compared with efficient electric appliances in existing and new homes.

Different replacement cases took into account whether the existing gas appliance/s were near the end of their asset life, or not. The analysis was conducted across 26 different gas pricing zones (eight in NSW) and took into account the impact of different climate conditions.

For details of the ATA methodology, please refer to **Appendix A** or to the source report.

3.1 Changing Technology & Economics

Space heating and water heating are the two most energy intensive activities that residential energy consumers typically use reticulated gas for, particularly in cold and temperate climates. Cooking is the third – albeit significantly lower end use – for residential gas.

Electrical technology used to heat air and water is becoming increasingly efficient. Residential scale reverse cycle air-conditioners (for space heating) are reaching co-efficients of performance (CoP) of 5.0 and over – which means that for every 1 unit of energy input to the system, 5 units are generated to heat air. CoPs for the most efficient electric heat pumps (for water heating) now exceed 4.0.

Compared with the most efficient equivalent gas appliance that have a CoP of around 0.8 – 0.9, an efficient air-conditioner or electric water heater now uses 1/7th to 1/5th of the input energy for the same end use. While CoPs for electric appliances may continue to improve, gas appliances are forever limited to 0.9 at best.

In addition, induction cook tops, that offer high efficiency and similar (or greater) amenity to gas cook tops, have become increasingly affordable in recent years and continue to drop in price as they gain popularity as a mass market product.

At the same time, wholesale gas prices are increasing across Eastern Australia as a result of the expansion of Australian gas exports. These two trends (increasing gas prices and improved electric performance) are changing the customer economics of gas versus electricity.

3.1.1 Consumer Purchasing Behaviour

Approximately 7% of all Australian households replace their gas hot water systems each year, in keeping with a typical asset life of 10 to 15 years. Space heaters tend to have slightly longer asset lives.

18 http://www.ata.org.au/wp-content/projects/CAP_Gas_Research_Final_Report_251114_v2.0.pdf

As such, each year at least 1 in 10 NSW households is likely to be facing a gas appliance replacement decision. When faced with this decision, according to industry data, the majority choose a ‘like for like’ replacement. This common approach ignores the impact of running cost, determined by technology efficiency and future energy prices, on the total cost of purchasing, owning and operating the appliance over the life of the system.

3.2 Modelling Results

The economic results for each Household Scenario for all locations modelled included the following capital cost assumptions for each case:

Table 4: Capital Cost Assumptions by Replacement Case

No.	Replacement Case	Capital Cost Assumptions
1	Switching a gas appliance, within 5 years of end of life, staying on gas network	Gas & Electric
2	Switching a gas appliance, not within 5 years of end of life, staying on gas network	Electric Only
3	Switching one gas appliance, of any age, disconnecting from gas network	Electric Only
4	Switching two gas appliances, at least one is within 5 years of end of life, disconnecting from gas network	1 Gas & 2 Electric
5	New & existing homes, not currently gas connected, choosing efficient electric instead of gas	3 Gas & 3 Electric
6	All gas appliances switched: one is within 5 years of end of asset life, avoiding $2,000 replacement capex	1 Gas & 3 Electric

All economic results assume a discount rate of 5.5% - reflective of the cost of residential mortgages, which is considered an appropriate time cost of money for household investment.

Results are presented by appliance type (i.e. space heating, water heating, cooking) and replacement case for each Household Scenario. Net Present Value (NPV) over a ten year period. Payback time of the efficient electric alternative/s to equivalent gas appliance/s based on discounted cash flows (as per above) are indicated as per below, along with ATA’s advice:

Table 5: Explanation of Results Table

Colour	Economic Result	ATA Advice
$NPV	A positive NPV with payback time of 5 years or less	Definitely choose efficient electric over gas: any extra up-front cost will be recouped through savings within five years
$NPV	A positive NPV with payback time of between 6 and 10 years	Consider choosing efficient electric over gas: any extra up-front cost will be recouped through savings within ten years
- $NPV	A negative NPV over 10 years	Choosing electricity over gas is unlikely to save any money: any extra up-front cost will not be recouped within ten years

The economic results for metropolitan Sydney are presented below:

Table 6: Economic Results, Gas versus Efficient Electric, Metropolitan Sydney

Gas Zone: Jemena/AGL Greater Sydney			**Electricity Zone: Ausgrid**			
Example Location: Hurstville, 2220, NSW			**Climate Zone: Balanced Moderate Demand**			
Household Scenario	Ref home	Small home	Large home	Public housing	LPG home	New build
Switching a gas appliance, within 5 years of end of life, staying on gas network.						
Space Heating	$1,345	$1,166	$1,284	$1,847	$1,688	$2,114
Hot Water	$342	-$471	$519	-$123	$2,195	$740
Cooking	-$259	-$102	-$348	-$259	n/a	-$348
Switching a gas appliance, not within 5 years of end of life, staying on gas network						
Space Heating	-$1,455	-$1,034	-$2,116	-$1,153	$72	n/a
Hot Water	-$1,158	-$1,671	-$1,281	-$1,323	$636	n/a
Cooking	-$2,059	-$1,902	-$2,148	-$2,059	n/a	n/a
Switching one gas appliance, of any age, disconnecting from gas network						
Space Heating	$936	$1,256	$320	$1,163	n/a	n/a
Hot Water	$1,416	$596	$1,429	$1,177	n/a	n/a
Cooking	-$236	-$286	-$185	-$236	n/a	n/a
Switching two gas appliances, at least one is within 5 years of end of life, disconnecting from gas network						
Space Heating + Cooking	$1,954	$1,623	$1,988	$2,381	n/a	n/a
Hot Water+ Cooking	$1,134	-$36	$1,497	$595	n/a	n/a
New & existing homes, not currently gas connected, choosing efficient electric instead of gas*						
All Heating & Cooking	$6,416	$4,868	$7,029	$6,378	$6,838	$7,519
All gas appliances switched: one is within 5 years of end of asset life, avoiding $2,000 replacement capex.						
All Heating & Cooking	-$96	-$293	-$833	-$33	$3,888	-$493

** Assumes full CAPEX on both electric and gas sides.*

As can be seen, there are a significant number of scenarios where metropolitan Sydney households will be economically better by switching from gas to efficient electric technology. In particular:

- switching space heating to efficient electric involved considerable economic gain in most scenarios;
- switching hot water to efficient electric, where an existing gas hot water system is near the end of its asset life, is at least comparable with a new gas hot water system; and is significantly better where it involves disconnecting from the gas network (either as the last gas appliance, or in combination with cooking).

- connecting a new homes to mains gas is not economic in any household scenario modelled (this finding was consistent across the NEM); and
- switching all three gas appliances over to efficient electric, where only one is near the end of its asset life, is broadly equivalent (in terms of 10 year cost) to staying with gas.

Overall, the economic results for switching from gas to efficient electric technologies were stronger in metropolitan Sydney than virtually any other part of the NEM.

3.2.1 Additional Findings

Sensitivity analysis was undertaken to test the results against a range of forecast gas prices for NSW; as well as the use of off-peak tariffs or solar PV to power hot water appliances.

These results are contained in **Appendix B** and find that:

- the modelling results were not particularly sensitive to different gas price trajectories – whilst they changed the magnitude of the numbers; they largely did not change an uneconomic investment into an economic one (or vice versa); and

- running efficient electric hot water systems on off-peak tariffs or solar PV significantly improves the economics.

4.0 Solar PV

Solar photovoltaic (PV) is now a mature technology in the NSW market for residential (and commercial) applications. In order to provide the current economic value of solar PV in metro Sydney, ATA undertook modelling considering different sized systems for different household types.

The modelling was conducted using the ATA-developed 'Sunulator' simulation tool. Sunulator utilises two decades of location-specific solar irradiance data from the Bureau of Meteorology; and models generation, on-site consumption and grid export on a 30-minute basis over 30 years.

This approach takes account of climate variability and gives the most accurate picture of how much solar generation will be consumed on-site (and when), versus exported (and when). In addition, Sunulator can also analyse the value of solar energy stored and used from batteries (this capability was utilised in the storage modelling section later in the report).

The households modelled for solar PV, and their energy usage/characteristics, were as follows:

Table 7: Solar PV Households Modelled

Name	Household Description	Annual Usage (kWh)
Low – Out	Low usage customer, typically out during the day	1,800
Low – In	Low usage customer, typically at home during the day	1,800
Medium – Out	Medium usage customer, typically out during the day	5,000
Medium – In	Medium usage customer, typically at home during the day	5,000
High – Out	High usage customer, typically out during the day	9,000
High – In	High usage customer, typically at home during the day	9,000

ATA modelled two different system sizes (2kW and 4kW), which encompasses (and can provide guidance on) the majority of residential system installed in Australia. Economic results, including export rate, are presented in the tables below:

Table 8: Solar PV Modelling Results, 2kW Systems

	Low-Out	Low-In	Medium-Out	Medium-In	High-Out	High-In
System Cost $	3,700	3,700	3,700	3,700	3,700	3,700
Export Rate	76%	67%	54%	30%	35%	13%
Bill Saving p.a.	$260	$307	$366	$485	$462	$569
Payback[19] (yrs)	23	18	14	9	9	8

[19] Discounted payback – in line with current mortgage rates.

Table 9: Solar PV Modelling Results, 4kW Systems

	Low-Out	Low-In	Medium-Out	Medium-In	High-Out	High-In
System Cost $	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
Export Rate	86%	82%	70%	57%	57%	35%
Bill Saving p.a.	$448	$491	$601	$734	$730	$951
Payback (yrs)	22	19	14	10	10	7

As can be seen, solar PV can be considered quite economic for metro Sydney households with medium to higher electricity usage. Even for medium-usage households that are not typically at home during the day, a 14-year discounted payback represents a better-than-term deposit return on their capital invested.

For lower consumption households, it's the high export rate from these system sizes that drives the poorer economics. These households will typically be better off investing in other efficient technology; considering moving away from gas (to increase their electric day-time consumption); or installing only relatively small solar PV systems.

4.1 Financing Options

As the levelised cost of energy (i.e. cost per kWh) of solar PV has now fallen significantly below the level of peak retail energy tariffs, a number of innovative financing products have emerged that allow solar customers to defer the capital cost associated with system purchase and installation. The two most common of these products currently available in Australia are:

- solar leasing – whereby the solar customer enters into an agreement to defer the capital cost of the system and to repay this:
  - via a fixed recurring payment;
  - over a fixed term, and
  - including a financing rate of interest;

- power purchasing agreements (PPAs) – whereby the solar customer enters into an arrangement to defer the capital cost of the system and to buy electricity generated by the system at an agreed rate (i.e. c/kWh) and for an agreed time period.

Both of these products vary considerably with regards to their contractual conditions, terms and related characteristics. These characteristics include (but are not limited to):

- term length;
- repayment amounts;
- price per kWh;
- financing rate;
- early termination fees;
- system ownership (both during and at the end of the contract period);
- responsibility for, and service level of, warranties and system performance.

As the benefits (and costs) of solar leasing and PPAs are different for different consumers and each specific product, they should be assessed on their merits. However, a discussion of the main considerations of these financing products is provided below.

4.1.1 Financing Rate

Generally speaking, suppliers of leasing/PPA product offers are looking to extract a commercial return from the contractual relationship with a solar customer. In broad terms, this means the financing rate embedded in leasing/PPA products is typically at the higher end of personal (i.e. non-mortgage) consumer finance.

ATA has reviewed many leasing and PPA product offers over the past few years and the majority involve financing rates upwards of 15% - that is, as high, or higher, than typical credit card rates.

This level is also significantly higher than the investment returns achievable by most residential consumers (e.g. term deposits, shares, superannuation). This means that using a leasing or PPA product to allow investment of existing capital in alternative profit-making avenues is likely to result in a customer being worse off over time.

As such, from a purely economic perspective, financing solar through the majority of leasing or PPA products should be thought of almost as a ‘last resort’ – one that should only reasonably be considered after the following options have proven unachievable (and in the order set out):

1. The use of savings/capital upfront;
2. The extension of a household mortgage;
3. The acquisition of a personal loan;
4. The use of a credit card with a lower interest rate than the best leasing/PPA offer available.

4.1.2 System Ownership, Maintenance & Warranties

Both leasing and PPA products can offer non-financial benefits, or consumer protections, which are not traditionally offered as part of upfront purchase offers and which can be of value to a solar customer.

These largely relate to system ownership during the life of the financing term and associated responsibilities for system performance or warranties that may reside with the supplier.

For example, during the term of either a solar lease or a PPA, the ownership of the system may reside with the supplier – with ownership not transferring to the customer until the term ends and the system is ‘paid off’. Alternatively, system ownership may never transfer to the customer and at the end of the contract term, either a new term/contract is negotiated or the system is removed by the supplier.

Should system ownership be retained by the supplier during the contract term, then this typically confers responsibilities on the supplier to ensure system performance. This may include:

- warranties for all component parts and workmanship being extended to cover the life of the contract term;
- a performance guarantee – e.g. a guarantee for a minimum amount of generation per month or per year, with financial recompense for under performance;

- other responsibilities on the system supplier.

These supplier responsibilities potentially offer real value to a solar customer over the longer term – and may offset the additional cost imposed by the financing rate embedded in the leasing or PPA offer. Each offer should be considered on its merits in this regard.

It should also be noted that in ATA's experience, it is more likely that a PPA (as opposed to a leasing product) will offer either extended warranties for the life of the contract term, or performance guarantees, or both. PPAs appear slightly more favourable to ATA in this regard.

4.1.3 Consumer Protections

Under a solar leasing arrangement, there are no 'energy-specific' consumer protections and the consumer may carry the volume risk associated with failure of the system. Australian Consumer Law (ACL) applies.

Under a PPA, the PPA provider carries the volume and availability risk for the duration of the contract and is required to hold a current exemption for retail licensing. This exemption comes with conditions that offer consumer protections over and above those provided by ACL.

4.1.4 Immediate Benefits

The other key point for a solar customer in considering leasing or PPA products is whether the repayments are less (or unfortunately more) than the reduction in the monthly/quarterly/ annual electricity bills that the solar system achieves.

As an example (and in relation to solar leasing):

- If the repayment under a solar leasing product is $50 per month for 10 years; and the solar system achieves an average bill reduction (over the course of the year) of $30 per month; then that customer will be around $240 worse off per year until the beginning of year 11;

- Alternatively, if the benefit to the solar customer of the same system was greater than $50 per month over the course of the year, then that customer will be better off from day one – and could be reasonably satisfied that the financing product was a good deal.

Alternatively, most PPAs are structured in a way that the customer agrees to purchase all of the electricity generated by the solar system, regardless of whether the customer consumes the electricity or not[20] [21].

Under this arrangement, any electricity that is exported to the grid will likely attract a feed-in tariff payment that is less than the cost per kWh charged to the customer. Should this be the case and the customer have a mid to high level of export, that customer is likely to be worse off for the contract term.

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[20] http://www.aer.gov.au/sites/default/files/AER%20-Alternate%20energy%20sellers%20-%20Final%20statement%20of%20approach%20-%20July%202014.PDF

[21] https://www.dews.qld.gov.au/energy-industry/renewable-energy/projects/solar-power-purchase-agreements

Leasing and PPA products are often marketed on the basis of claimed electricity bill reductions – from day one. However, accurately estimating electricity bill reductions from a specific solar PV system size is difficult and requires competent use of a modelling tool that analyses accurate generation and consumption data on an interval basis.

This is a service that is not provided by the solar industry, which tends to provide a monthly (or sometimes a daily or annual average) generation estimate – a metric that is not useful in understanding likely bill reduction. In addition, historical interval consumption data is not readily available for most NSW households.

In the majority of circumstances therefore, a new solar customer will have little knowledge about the electricity bill impact of various system sizes – leading to uncertainty over whether any payments (whether they be through a leasing product or a PPA) will be less than, or more than, the long term bill reduction benefit.

In saying this, it is technically possible for a PPA product to ensure that the customer is (or is likely to be) better off from day one. Generation can be monitored separately from export (this requires additional metering technology) and customers can only be charged for the difference. Alternatively, a maximum volume of generation could be charged to the customer per month or per year that is set closer to likely on-site usage.

These approaches require specific contractual arrangements and potentially additional infrastructure and should also be assessed on a case by case basis – particularly when considering these products in the context of low income and vulnerable consumers.

Of note, ATA reviewed the current list (July, 2015) of retail licence exemption applications to the AER (which are required for PPA-type products) and found that only one of nine suggested that exported energy would be exempted from payment.

4.2 Renters & Apartments

Recently solar leasing and PPA products have been touted as potential 'solutions' to overcoming barriers to more difficult PV installations associated with rental tenancies and/or apartment buildings.

When discussing the barriers associated with renters and apartments, it is worth being specific about what these actually are – so that any potential solution can be considered in this context.

4.2.1 Renters

With regards to rental tenancies (which may involve detached dwellings, semi-detached dwellings or apartments), specific issues for consideration are as follows:

- The majority of sustainable technologies involve major assets with relatively long asset lives and relatively significant capital costs – i.e. from many hundreds to many thousands of dollars[22];

[22] Lighting & draught proof sealing are two of the few examples of technologies that may not involve considerable capital costs.

- The economic benefits of these technologies are experienced as cost savings on energy (electricity or gas) bills – which are typically paid for by the tenant;

- These first two points create what is known as a 'split incentive':
  - there is an economic incentive from the renter's perspective to have efficient technology installed as it will reduce their energy costs; however
  - there is no incentive for the landlord to invest in the technology themselves as they will not benefit from any future energy cost reductions.

- In addition, the majority of sustainable technologies require expert installation, often involving some type of changes to the building fabric or structure. Landlords can be resistant to major changes being made to their rental properties and indeed these types of changes are typically prohibited in tenancy contracts without landlord permission.

- Finally, even if landlord permission is obtained, the renter must way up the benefit (either direct economic and/or broader environmental) of investing in a major piece of technology that they may only benefit from for a relatively short period of time. According to the ABS (2007/08)[23], the vast majority of renters move at least once in a five year period. Many sustainable technologies take this long (or longer) to pay for themselves.

In relation to this last point, one potential opportunity may be public or social housing (i.e. people renting their home from, or with the assistance of, a state housing authority). The ABS states that these tenants "were less likely than the general population to report being a recent mover"[24].

State housing authorities typically manage major appliances within their housing stock and have ongoing maintenance and upgrade programs regarding their replacement. The relevant NSW authority could be consulted with to re-orient their appliance programs to deliver sustainable technologies that also deliver wider program objectives (e.g. safety, comfort, amenity, etc).

The split incentive issue can be partly overcome by leasing arrangements or PPAs – as these products allow the deferment of upfront costs. This avoids the need for a landlord to invest in a solar installation. And provided the tenant is charged at a lower rate than they currently pay for electricity, and they do not have to pay for exported electricity (or use the majority of it on-site), in theory the renter can re-coup the economic benefits offered by solar PV.

However the following complicating issues remain:

- The landlord's permission still needs to be obtained to undertake the installation;
- What happens when the tenant wishes to move out of the premises prior to the contractual period ending? Are there significant contract termination fees? Does the system get removed or can any new tenants take over the existing contract?
- What happens regarding the ownership of the system at the end of the contract period?

Each of these issues requires definitive solutions to be written into any contractual arrangement.

ATA has provided the following advice to renters over many years regarding renewable and energy efficient upgrades:

[23] http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features30Dec+2010
[24] http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features30Dec+2010

Working with your Landlord

Before you undertake any alterations to a rental property you must have the owner's written permission, but don't let this discourage you. Some landlords will agree to improving the resale value of their rental property if it keeps their tenants happy – even better if they're doing their bit for the environment at the same time.

If you have any concerns about contacting your landlord contact your State or Territory tenants union or tenants advocacy service.

The Australian Taxation Office offers tax deductions for energy efficiency improvements made to rental properties. Maintenance, repairs and servicing costs such as sealing cracks and gaps and repairing damaged insulation can be claimed at the end of each financial year. The depreciation on capital improvements such as erecting a pergola or replacing an inefficient hot water system can be claimed over a specified period of time.

When writing to your landlord (example letter below), point out the benefits of the repairs and any available rebates they can receive to make sustainable changes to the property. If you are offering to make some minor changes yourself, outline what you would like to do and how much it would cost so that you can be reimbursed.

If you receive no reply after a few weeks, send a follow up note, asking if they have received your letter and if they have had time to consider your request.

Even with the landlord's approval, once your lease expires certain measures may require you to restore the property back to the condition it was in when you moved in. You need to check your lease document or clarify this with the landlord.

Sample Letter to Landlord

[Your name and address]
[Date]
[Landlord's or agent's name and address]

Dear …

Re: Repairs to [your address]
We would like to undertake the following alterations to the premises to improve the water and energy efficiency of the home.

We are willing to conduct the following repairs and request your permission to do so. We would appreciate being reimbursed for the cost of the products outlined below:
- Item Cost $
- Item Cost $

The following repairs we are unable to undertake:
- Item Cost $
- Item Cost $

The Australian Taxation Office offers tax deductions for improvements made to rental properties. I have included a copy of the brochure outlining the tax deductions available. [Attach brochure: www.environment.gov.au/settlements/local/publications/pubs/brochure5.pdf]

I look forward to hearing from you. I can be contacted on [phone] during daytime hours.
Yours sincerely,
[Your name]

4.2.2 Apartments

When it comes to apartments, a different range of issues and potential barriers arise. Firstly, apartments may be tenanted by renters – in which case the split incentive issues discussed above will often apply.

Apartments can also have other 'physical' issues that can create complexity for the introduction of sustainable technologies.

Apartments often involve smaller floor spaces and building footprints (per dwelling unit) than detached or semi-detached homes. Many apartments have no dedicated/private outdoor space as they are located above (or below) the ground floor; or no private outdoor space has been designed on purpose. This can cause difficulties for the physical installation of larger technologies such as heat pump hot water systems and RCACs which require the installation of outdoor air compressors and tanks.

Further, due to the co-location of dwelling units within one or few buildings, the ownership and access to roof space is more complex.

Sometimes the roof space is legally designated to be common property, for which decisions regarding maintenance and upgrades need to be made at a Body Corporate level. Other apartments involve roof space that is privately owned/controlled by the tenant directly underneath it – meaning anyone not residing on the top floor (often the majority of dwellings/tenants in the block) has no access rights to any part of the roof. This can obviously cause difficulties for the installation of any technologies that require roof access (e.g. solar PV and solar hot water).

Many apartment blocks take a different approach to space heating/cooling and hot water due to the potential economies of scale of providing centralised systems for these services. Centralised space heating and hot water can sometimes be more economically provided using central gas boilers or similar technology and any replacement program that seeks to utilise individual appliances may involve considerable changes to existing infrastructure investments (and administrative arrangements) that may still be in relatively good working order.

Finally, electricity metering and infrastructure arrangements are also important when it comes to apartments. Apartment units may:

- have their own, individual electricity and/or gas meters and be billed separately through the retailer of their choice. This means that any sustainable technology installed that saves on energy costs will be a direct saving to an individual apartment – as opposed to the broader apartment block;

- have a single gas meter and gas retailer for the entire apartment block – feeding a centralised gas system that provides space heat or hot water to all dwelling units and which is charged on a proportionate basis to all tenants through the Body Corporation;

- have an embedded network arrangement for electricity – meaning that a single, 'parent' meter and retailer provides electricity to the entire apartment building and then each dwelling unit has its own individual 'child' electricity meter. Tenants are billed on their proportionate usage but by the Body Corporate (or an energy services contractor managing the entire site), as opposed to having their own individual retailer.

This last arrangement can offer potential benefits for the installation of solar PV – as the generation from the PV system can be shared amongst tenants, irrespective of where the physical solar array is positioned. However embedded networks are not common in residential apartment buildings in Australia and are unlikely to be economically attractive to install as part of a single solar project at a given apartment block site.

Common area loads are the last, and probably the main, opportunity for investment in major sustainable technologies in apartment blocks.

All apartment blocks have common areas which in turn have energy requirements (e.g. for lighting, space heating/cooling, offices, computers, etc). Energy bills for common areas are typically paid for by the Body Corporate, which then charges tenants proportionally through their strata fees.

Technologies that deliver energy reductions and bill savings for common areas (e.g. solar PV, RCACs or efficient lighting) can be paid for by the Body Corporate (using sinking funds for capital works projects or the like) with cost reductions being passed on to all tenants equally via lower strata fees.

An excellent resource for the potential management of sustainable technology projects in apartment buildings with strata arrangements is the City of Melbourne's 'SmartBlocks' program (http://smartblocks.com.au/). The site includes a number of case studies of successful sustainability projects delivered in apartment buildings across Melbourne.

5.0 Storage

In 2015, the most common storage technology/chemistry used in household storage systems in Australia remains the lead-acid battery. As demand for more advanced energy storage grows, there is an increasing focus on lithium-based batteries.

For household systems, lithium has seen considerable advancements in recent years and a steady decrease in cost as manufacturing scale has increased.

Going forward, lithium is likely to remain the preferred chemistry for household stationery energy storage for the foreseeable future – for a range of technical reasons and global influences. These are discussed in detail in **Appendix C**.

5.1 The Economics of Battery Chemistries

In order to understand the economic value of storage over time, a metric must be used that can effectively be compared across different battery chemistries.

Storage costs are typically presented in dollars per kilowatt hour ($/kWh). Whilst somewhat useful, this metric is limited in comparing the relative costs and value to the end user of different battery chemistries. This is because different battery chemistries contain different properties with regards to 'useable' energy capacity.

In the same way that the end user is interested in the 'life-cycle' costs and value of demand-side energy technologies such as solar photovoltaic (PV), it is life-cycle costs and value that must be properly analysed when considering the utilisation of storage in either a hybrid (grid-connect) or off-grid scenario.

The relative costs and value of storage to the end user are a function of:

- capital cost;
- any required maintenance costs;
- the 'useable' energy capacity – largely determined by the optimal depth of discharge employed in ongoing operation;
- the battery capacity at a given charge/discharge rate – known as the 'C-rate'; and
- asset life (which is typically a function of the number of cycles at a given depth of discharge and varies significantly between batteries as a function of the quality of manufacture).

The discharge rate is the time – usually expressed in hours, our parts of an hour - it takes to discharge a battery before it is fully discharged. Where the battery is discharged at a constant rate over a number of hours, this is referred to as the 'C' rate[25].

The capacity of some batteries (specifically lead acid-based technologies) is reduced if the battery is discharged over a shorter period. In the case of lead acid, C10 to C20 – discharging over 10 to 20 hours - tends to be the highest level of discharge without significantly reducing the capacity of the battery).

[25] As an example, many small batteries are rated at the 'C20' rate – meaning they will deliver that amp hour capacity if discharged over 20 hours. The types of batteries in standalone power systems are rated at the 'C100' rate which means that they are rated assuming discharge over 100 hours or 4 days.

At these discharge rates the energy output capacity is reduced as well as the asset life, expressed as an absolute number of charge cycles before the battery fails or suffers depletion of capacity. This is an important consideration for households or businesses who may wish to access the energy stored in a battery relatively quickly (e.g. a daytime or evening peak).

Newer lithium-based technologies do not suffer from these charge/discharge constraints in the same way – improving their effective operation. Hence the discharge rate of lithium batteries can comfortably exceed C1, with the capacity of other components typically being the limiting factor, not the battery.

The following table provides qualitative guidance as to the strengths and weaknesses of different battery chemistries in relation to the five properties listed above:

Table 10: Strengths & Weaknesses of Different Battery Chemistries

	Flooded Lead Acid	Gel Lead Acid	AGM Lead Acid	Lithium
Capital Cost	Low	Medium	Medium	Medium-High
Maintenance Costs	High	Low	Low	Very Low
Useable Energy Capacity	Low	Low - Medium	Low - Medium	High
Lifetime Cycles at High DoD	Very Low	Low	Low	High
Capacity at High Discharge Rate	Low	Low	Low	High

A specific example of the correct economic valuation of two different battery chemistries is presented below – that of conventional lead acid (e.g. absorbed glass mat [AGM] or sealed gel) versus lithium-iron phosphate (LiFePO4), which is one type of Lithium battery. These numbers are indicative only and it should be noted they do not take account of the additional potential charge/discharge constraint on the conventional lead-acid batteries:

Table 11: Relevant Economics for Comparing Battery Chemistries

	AGM/Gel	LiFePO4
Amp-hours	260	300
Voltage	12	3.2
kWh – 'Nameplate' Capacity (per Cycle)	3.12	0.96
Capital Cost	\$459	\$540
Maintenance Cost (per annum)	-	-
\$/kWh – 'Nameplate' Capacity	\$147	\$563
Cycles (10 Years)	3650	3650
Recommended Depth of Discharge for 3650 Cycles (10 years)	15%	70%
kWh – 'Useable' Capacity (per Cycle)	0.468	0.67
\$/kWh – 'Useable' Capacity	\$981	\$804
\$/kWh/Cycle – 'Useable' Capacity, 10 year basis	\$0.27	\$0.22

5.1.1 Tesla

In late April 2015, the US EV manufacturer 'Tesla' announced their wholesale prices (to US installers) for home storage systems via their new 'PowerWall'. Tesla advertise '7.0kWh daily cycle models'[26], which refers to useable capacity – indeed Tesla cars are specified on usable, rather than nameplate, capacity.

The Tesla 7.0kWh PowerWall is advertised at a US wholesale price of $429/kWh. This is in line with the very lowest forecast of all international forecasts currently available. This price suggests Tesla will accelerate the decrease in costs of battery technology below 2015 levels.

ATA understands Tesla batteries are expected to be available in the Australian market from early to mid-2016 – however prices are as yet unknown.

On 2nd May 2015, Bloomberg reported[27] that SolarCity, a US-based distributed energy and energy storage retailer/installer, had begun taking orders for energy-storage systems using the 10kWh PowerWall unit, and will commence installations in October.

The SolarCity product includes the 10kWh PowerWall unit along with an inverter, control systems and maintenance agreement – and quotes a fully installed lease payment of US$5,000 (retail to end customer) on a nine-year lease; or US$7,140 to buy and install the same system outright.

Details (such as product specifications) for the SolarCity product remain minimal, however in theory, the SolarCity product may only require solar modules and the necessary framing and wiring to complete the system (or indeed no additional components for those customers with existing PV, if their existing PV array is able to be configured for the input voltage range required for the Tesla battery.

The Tesla and SolarCity announcements are clearly a step change with regards to the customer-side economics of both on-grid (and to a lesser extent off-grid) solar-battery systems.

5.2 Modelling

ATA conducted modelling to understand the value proposition to a metro Sydney residential customer of installing energy storage, either:

- coupled with an existing solar PV system;
- as part of a new solar-battery system; or
- as a battery only installation.

All scenarios considered involve remaining grid-connected.

The modelling sought to understand the value proposition of installing the technology now (i.e. 2015); as well as installing it at two future times – 2020 and 2025. Economic inputs have been defined for each of these three time periods, taking into account reductions in component capital and operating costs over time.

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[26] Tesla also announced a 10kWh model suggesting that the battery is designed to be discharged to its maximum depth of discharge no more than 50 times per year. It is unclear, however, what the daily limit of discharge would be for the 10kWh battery.

[27] http://www.bloomberg.com/news/articles/2015-05-01/solarcity-taking-orders-for-tesla-batteries-starting-at-5-000

Two different load (consumption) sizes were modelled – that of 10kWh per day (medium usage customer) and 25 kWh per day (high usage customer).

Grid connected solar/battery system design attempts to capture a range of economic benefits, including:

- the increased utilisation of renewable energy (which provides electricity for on-site consumption or battery charging at significantly lower cost than peak grid tariffs[28]);
- the potential of charging the batteries from off-peak grid tariffs; and
- the reduction of the customer's kW demand, leading to savings against a potential BAU demand (kW) tariff.

5.2.1 System Design

As the grid remains available for back-up (or even primary electricity source) in a grid-connected scenario, system size and configuration must be carefully optimised for best economic return.

To do this, ATA modelled a number of different system sizes; as well as two different battery management strategies, in order to find the most economic cases. The following components form the basis of the on grid system designs modelled:

- Solar PV modules with associated framing, mounts, wiring, connections;
- Single string DC to AC inverter;
- Inverter-charger (for year 2015 only);
- AC to DC battery charger (for year 2020 & 2025);
- Lithium battery bank with battery management system and 50 Amp sensor clip;
- Labour for installation & commissioning.

Given the economic imperative for more frequent, deeper cycling of grid-connected storage, ATA utilised the 7kWh daily cycle PowerWall as the basis for battery design, with the following systems being modelled:

- 2kW solar PV + 7kWh useable storage;
- 4kW solar PV + 7kWh useable storage;
- 5kW solar PV + 14kWh useable storage;
- 7kWh useable storage only; and
- 4kW solar PV only (for comparison purposes).

Customers with existing PV (sunk cost) were also considered in the modelling.

ATA has assumed that the Tesla PowerWall (and/or similar competitors) will be widely available in the Australian market by 2017. This means that the physical design of on grid systems will be different prior to 2017 as compared with post.

[28] In Sydney in 2015, the levelised cost of electricity from a solar PV system without storage is roughly equivalent to an off-peak tariff (i.e. $0.10/kWh).

In 2015, on grid solar/battery systems are typically installed in an AC-coupled arrangement – particularly for larger sized homes/loads. This involves the installation of both a grid feed, string inverter as well as a separate inverter-charger.

The Tesla PowerWall however has been designed to operate at a higher DC voltage level (i.e. 350-450 volts DC) than traditional batteries with an in-built voltage converter – meaning it can be directly charged from a solar array. This avoids the need for a dedicated inverter-charger, provided the customer does not want to charge the batteries from the grid (i.e. AC, and potentially from an off-peak tariff).

This is a significant technical advance over storage technologies commercially available in 2015.

Once in place, the PowerWall however could also be charged from the grid directly using a cheaper AC to DC battery charger. Tesla manufacture such a charger for their electric vehicles currently and as part of a direct discussion with ATA, stated that a home-battery charger could be purchased in Australia in 2016 for around $800.

Based on the above, for the purposes of the modelling, ATA assumed:

- that for 2015, a typical AC-coupled system with both string inverter ($0.79/watt) and separate inverter-charger ($1.33/watt) would be installed;
- that from 2017, a PowerWall (or similar storage unit) could be installed and charged directly from a solar array (but not from the grid) and avoiding the need for any dedicated battery charger (known as the 'Solar Buffer' battery management strategy);
- alternatively from 2017, a PowerWall (or similar storage unit) could be installed and charged directly from a solar array and from the grid with a dedicated AC to DC battery charger ($500 capex from 2017). This is known as the 'Tariff Optimisation' battery management strategy.

5.2.2 System Prices & Tariffs

ATA have assumed significant annual reductions in the price of AC to DC chargers and storage (in the order of 9-10% per annum); with only very small or no annual reductions in the price of modules, string inverters and labour costs. This is in line with current technology price forecasts.

In 2017, ATA commenced using the $/kWh prices announced by Tesla for the 7kWh daily cycle unit (approx. AUD$549/kWh retail).

Component replacement has also been taken into account as per the off-grid modelling approach. ATA also included a small 'containerisation factor' in the modelling – as the industry changes to plug-and-play packaged systems. This factor acts to reduce the installed capex and increases from 5% in 2017 to 20% in 2025.

Two tariffs were also selected for analysis[29], including:

- a flat tariff ($0.23.5/kWh)[30]; and

[29] All tariffs were indexed at 1% per year.

[30] This was selected after a review on available tariffs on the AER's Energy Made Easy tariff comparator site. $0.235 represents a relatively competitive flat tariff available in the market in 2015.

- a two-part time-of-use tariff ($0.12/kWh off-peak; $0.2975/kWh peak). The levels for the two-part tariff were chosen in order to align the overall annual bill costs between a customer on ether flat or ToU.

The system designs, capital and operational expenditure modelled for the 'Solar Buffer' strategy for each system size and configuration, are presented below. The main difference in capex between these, and the capex inputs for the 'Tariff Optimise' strategy, was an additional $500 from year 2017 for an AC to DC battery charger to allow charging from the grid:

Table 12: System Design, Capex & Opex - 'Solar Buffer' Strategy

	Small	Medium	Large	Battery Only	PV Only	Unit
PV Modules	2.0	4.0	5.0		4.0	kW
DC to AC Inverter	2.0	4.0	5.0		4.0	kW
Inverter-Charger (2015 only)	5.0	5.0	7.5	7.5	-	kW
Batteries (Useable Capacity)	7.0	7.0	14.0	7.0	-	kWh
Labour	32 - 12	32 - 12	40 - 16	5	5	hours
2015:						
Capital Cost	18,055	21,975	31,120	13,050	6,700	$
Operating Cost p.a.	50	50	100	50	50	$
2020:						
Capital Cost	7,018	10,668	15,235	3,704	6,372	$
Operating Cost p.a.	50	50	100	50	50	$
2025:						
Capital Cost	5,239	8,485	11,590	2,447	6,059	$
Operating Cost p.a.	50	50	100	50	50	$

5.3 Results

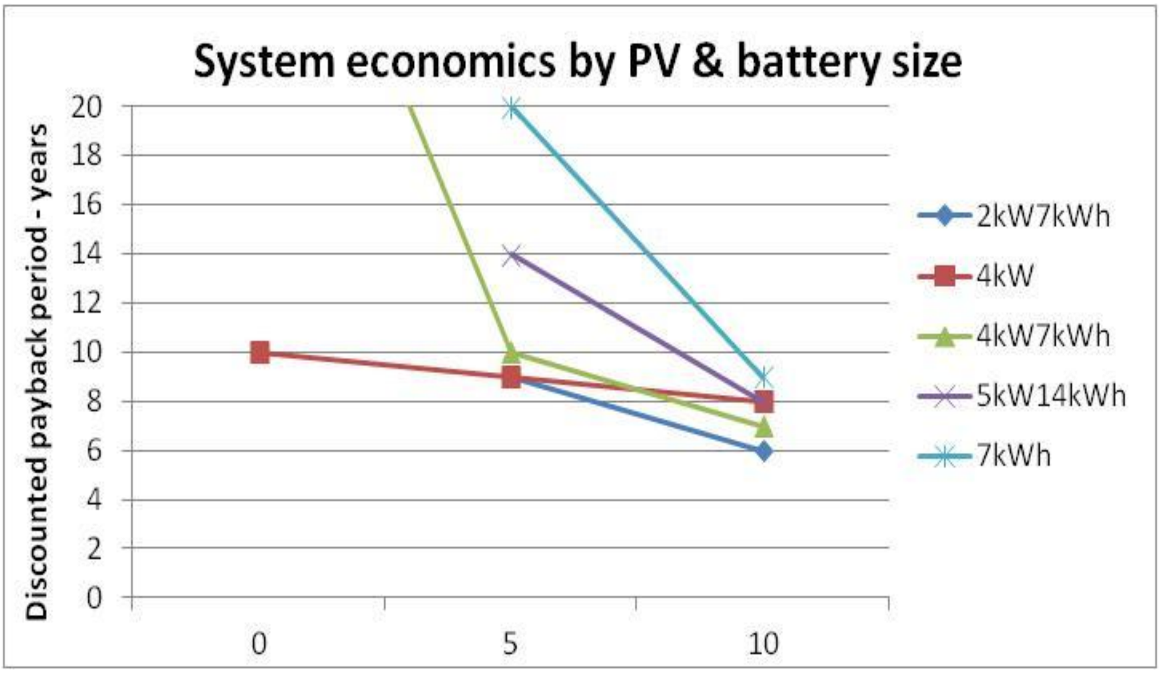
The modelling results for each system size/configuration are presented below.

Each scenario has been simulated on a half hourly basis, with regards to energy flows and economic costs/benefits. This takes into account real world variability in both solar resource and consumption and is a key difference between this and much of the publically available analysis on the customer side economics of storage.

All results are presented in 2015 dollars, with cash flows being discounted by 2.5% - indicative of the real cost of current mortgage finance. Discounted payback periods have been calculated taking into account effects such as:

- replacement of inverter and batteries at the end of their asset life; and
- progressively reduced panel output due to degradation.

Figure 6: Payback for High-usage Sydney Household, ToU Tariff, PV with Battery Charger



The chart above indicates the payback period for a High usage, Sydney household installing new PV and new batteries, with the ability to charge the batteries both directly from the solar and from the grid from an off-peak tariff.

Key observations include:

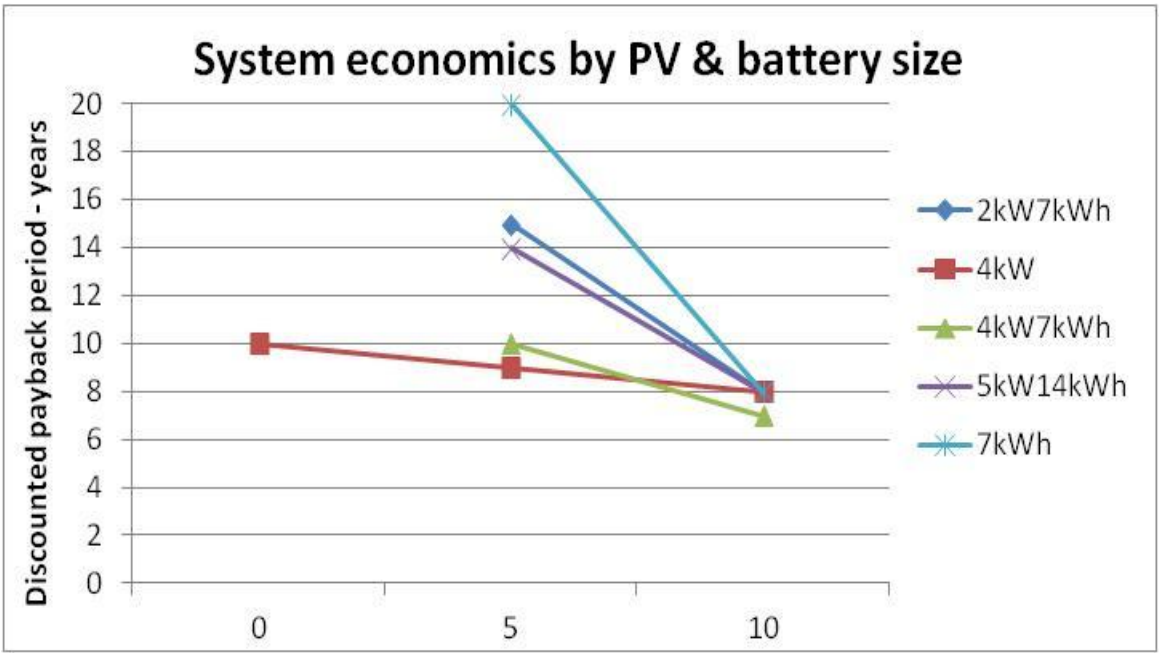
- a 4 kW solar system alone installed in 2015 already has a payback period within ten years;
- installing a 2kW or 4kW solar system with a 7 kWh (usable) battery becomes relatively economic by 2020 (or once the Tesla prices cement in the Australian market – whichever comes first); and
- all options become economic by 2025, including a battery without a solar system.

The next chart indicates the payback time for a High usage, Sydney household installing new PV and new batteries, but without the ability to charge the batteries from the grid. The customer is on a time-variant tariff.

As can be seen, the economics for this second household are slightly worse under this scenario than the previous one that allowed charging of the batteries directly from the grid on an off-peak tariff.

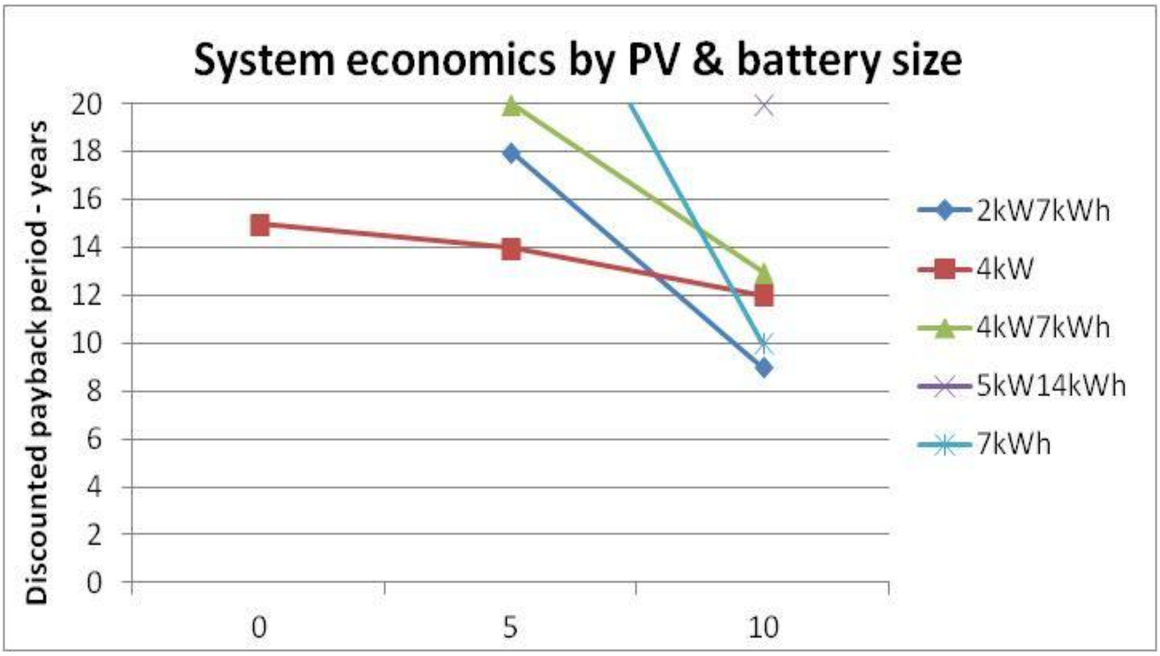
This result is due to the small additional upfront cost of an AC to DC battery charger (post 2017) in the first household being outweighed by the economic value of being able to fully utilise the storage capacity of the batteries.

Figure 7: Payback for High-usage Sydney Household, ToU Tariff, PV without Battery Charger



The next chart indicates the payback period for a medium usage, Sydney household installing new PV and new batteries, with the ability to charge the batteries both directly from the solar and from the grid from an off-peak tariff:

Figure 8: Payback for Medium-usage Sydney Household, ToU Tariff, PV with Battery Charger



Compared with the High-usage household, payback is longer as there is less consumption to offset and therefore less displacement value. Under this scenario, no options achieve <10 year payback until (or just before) 2025.

5.4 Discussion

As can be seen, the modelling results are relatively favourable for solar today, and solar with batteries in the future, with some scenarios achieving economic outcomes in, and in all reality prior to, 2020.

The definition of ‘economic’ (versus ‘non-economic’) in this context is a key point for consideration.

In financial terms, ATA would consider ‘economic’ to be a payback of upfront and ongoing costs within about 10 years – as this will mean costs have been fully recovered before the batteries need replacement (incurring further material capex). Also, for many households, 5 to 10 years is considered a suitable investment.

However, the experience of solar PV in NSW and elsewhere demonstrates that some households will install systems with longer paybacks than this. Material solar PV uptake occurred from 2009 in Victoria for example, even when for many consumers, particularly those who over-sized systems after premium feed-in tariffs were closed to new entrants, payback was often no better than 15 years. Indeed, this is still the case.

In addition, from the end of 2016, in the order of 100,000[31] NSW solar households will lose their premium gross feed-in tariff as that scheme is due to close. For these customers, investment in on-site storage will greatly offset their reduced benefit from moving from a $0.60/kWh gross payment to a new, very low (or zero) payment for feed-in.

Of course, the majority of energy consumers do not undertake detailed economic analysis as part of a technology purchase decision. At best, the majority may rely on some form of independent consumer guidance through various media, forums or trusted organisations – such as a program run under the Solar Suburbs initiative.

With regard to energy storage, and in line with the research and modelling in this chapter, any such program should focus on:

- lithium-based technologies only;
- packaged systems that allow simple integration with existing solar PV; or combined new solar PV/storage systems; and
- the inclusion of the ability for battery charging from the grid on off-peak tariffs; where the upfront system costs remain low.

[31] Taking into account the legislated objective of 300MW for the original gross feed-in tariff and assuming an average system size of 2.5kW.

6.0 Energy Efficiency

At a residential level, energy efficiency investment in NSW for most of the past decade has been largely driven by the NSW Energy Savings Scheme (ESS)[32].

The ESS is a market-based scheme that places a mandatory obligation on NSW energy retailers and other large energy users to support a certain level of investment in energy efficiency each year. This investment in turn provides an incentive to households and businesses to invest in eligible energy efficiency technologies that are made cheaper to purchase by the scheme.

Since its inception, the ESS has predominantly delivered more efficient lighting technology – firstly into NSW homes; and then increasingly into NSW businesses:

> *"As in previous years, most certificates were created from projects using the Deemed Energy Savings Method, and most of those were commercial lighting replacement activities using the Commercial Lighting Formula sub-method. Lighting projects have been the dominant energy savings activity under the scheme, which include activities such as replacing fluorescent tubes with more efficient LED tubes and installing occupancy sensors to control lights in low use areas."* [33]

In April 2015, the NSW Office of Environment and Heritage (OEH) commissioned a review of the ESS, in the context of the NSW Government committing to strengthening the scheme from 2015 onwards. As part of this review, an *Options Paper* was prepared that canvassed a range of different (and increased) future targets as well as expanded technology eligibility.

The Options Paper considered the potential future breakdown of certificates:

- for a range of future targets;
- by sector (i.e. residential or commercial or industrial); and
- by end use (e.g. lighting, heating, hot water, etc).

This breakdown was based on the sector opportunities for specific technologies, based on both their economics and their existence (or lack thereof) within that sector:

Table 13: Proportion of Certificates created by End Use (Residential Sector) – NSW ESS[34]

End Use & Sector	Targets Option 1 (5% to 2020)	Targets Option 3 (6.5% to 2020)	Scheme Duration (6.5% to 2025)	Combined Option (8% to 2025)
Residential Sub-total	*33.3%*	*37.7%*	*37.7%*	*45.3%*
Appliances	3.0%	3.5%	4.3%	2.1%
Hot Water (domestic)	8.7%	6.3%	6.3%	22.8%
HVAC	0.0%	0.0%	0.0%	5.6%
Lighting	21.6%	27.9%	27.1%	14.8%

[32] http://www.ess.nsw.gov.au/Home
[33] http://www.ess.nsw.gov.au/How_the_scheme_works/Scheme_Performance/Annual_compliance_report_-_2013
[34] http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0010/558865/part-2-options-paper-april-2015.pdf: Page 140

Of note, the higher target (Target Option 3) is predicted to result in a relative shift in activity from the industrial sector to the residential sector. It is unknown (as of July, 2015) as to which future target the NSW Government will select.

As can be seen however, efficient lighting is projected to comprise 65% - 75% of measures delivered in the residential sector. Hot water is a distant second – although under the 'Combined' target option, this rises to almost 50% of residential activities and displaces a considerable amount of lighting activity.

It should also be noted that the NSW ESS is set to be expanded to cover natural gas-based measures – indeed the Options Paper states that *'with the expansion of the scheme to cover gas under the combined preferred option, both the industrial and residential share of certificates increases'*.[35]

Whilst gas appliances for space/water heating may decrease in capital cost due to inclusion within the ESS, this will remain the case for equivalent efficient electric technologies. As such, the findings and recommendations of ATA's gas versus electricity research (Chapter 3.0) will hold.

6.1 Lighting

Aside from the ESS Options Paper, accurate data regarding the existence of efficient (or inefficient) lighting in NSW homes is somewhat difficult to obtain. Looking specifically at metro Sydney, the Southern Sydney Regional Organisation of Councils (SSROC) undertook a household energy survey[36] in 2005. The survey identified the following with regards to the existence of different lighting technologies in the nine relevant LGAs:

> "The predominant lighting type for survey respondents was incandescent globes. Compact fluorescents are used in 19.6% of households, with generally up to 4 bulbs installed."
>
> "Based on the large proportion of one to four light bulbs it can be assumed that most households have mixed lighting. The high number of incandescent light bulbs indicates that there should be the capacity to switch to compact fluorescents."
>
> "Less than one in five households have a compact fluorescent bulb in use."

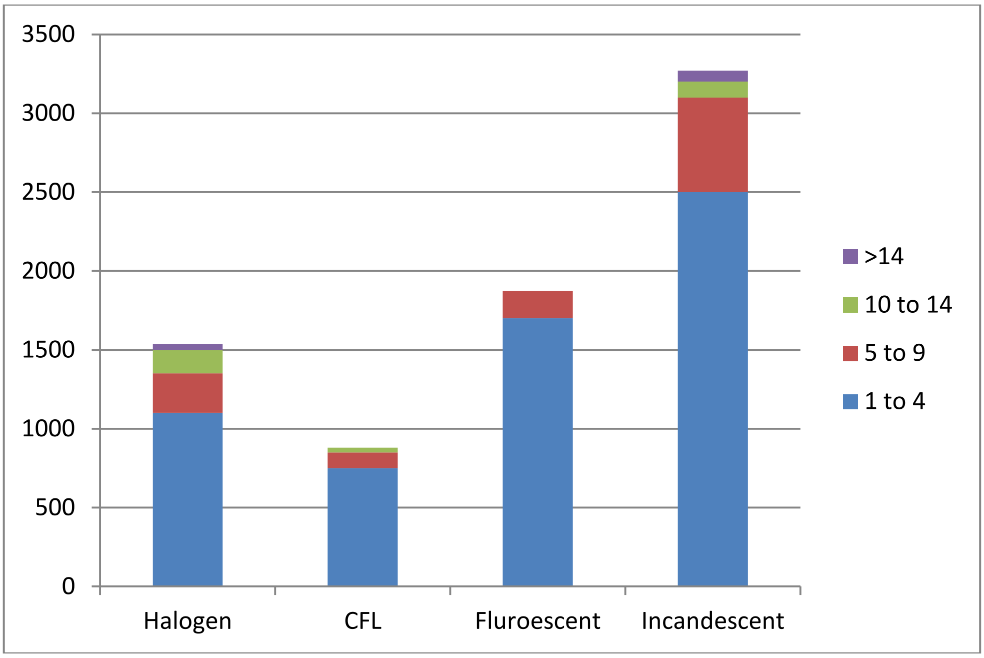
Since 2005 however, the following factors will have had a material impact on the distribution of different lighting technologies throughout NSW:

- the NSW ESS;
- the reduction in price and increased acceptance of compact fluorescent lights;
- the more recent reduction in price, increased awareness and availability of LED lights; and
- increased awareness of the inefficiency of halogen lights.

According to the ABS, parts of metro Sydney (ABS Climate Zone 6) have the highest number of halogen lights installed in homes (4.11) as compared with the national average (3.66).

[35] http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0010/558865/part-2-options-paper-april-2015.pdf: Page 139
[36] http://ssroc.nsw.gov.au/wp-content/uploads/2015/04/Who-Is-Emitting-What.pdf

Figure 9: Distribution of Lighting Technologies in SSROC Households, 2005



In ATA's experience with the performance and economics of efficient lighting technology over the last decade, and from the experience with the Victorian Energy Efficiency Scheme, it can be relatively confidently assumed that:

- the ESS is likely to have delivered a significant amount of compact fluorescent lighting into NSW homes since 2009; and
- the ESS is likely to have delivered a smaller proportion of LED lighting into NSW homes in the latter part of the ESS's existence.

Finally, it is now commonly understood that LED lighting offers significant energy reductions and financial returns even as compared with compact fluorescent lighting for all types of lighting replacement – including traditional single lamps, down lights, outdoor lighting and fluorescent tubes.

6.2 Insulation & Draught Sealing

It is relatively well understood that insulation, particularly ceiling insulation, can cost effectively deliver significant energy reductions for space heating and cooling.

A well-insulated ceiling can reduce energy use associated with heating and cooling by between 20 and 40 percent. Under floor and wall insulation can further reduce these energy costs by five to ten percent[37].

The cost benefit of retro-fitting ceiling insulation is significantly better than for floor/wall insulation. This is largely due to the relatively higher costs and complexity of effectively installing insulation under existing floors and in existing walls.

[37] http://www.environment.nsw.gov.au/households/insulation.htm

A 2014 report[38] by Sustainability Victoria (SV) documented the energy reductions and cost benefit of a variety of energy efficiency measures, including ceiling and wall insulation.

Through specific retrofit trials, SV found that ceiling insulation and draught sealing measures paid for themselves in little over six years; whilst saving almost 20 percent on total energy bills and increasing a home's thermal performance (star rating) by more than 1.5 stars.

In contrast, wall insulation achieved one third less energy savings (as compared with ceiling) and came at a relatively higher upfront cost. – leading to a payback time of over 38 years. Wall insulation was less effective than ceiling insulation in improving in the building's thermal performance (around 1 star increase).

Accurate data regarding the existence of insulation in NSW homes is somewhat difficult to obtain. Much of the relevant ABS data is from the 2005 Census, undertaken prior to the Australian Government's Home Insulation Scheme in the late 2000's.

The ABS did however in 2014 publish a household survey[39] regarding energy use. This survey found that:

> *"The majority of Australian households (68%) had some form of insulation in their homes. While 14% of households did not have any insulation, 18% of households did not know whether they had insulation."*

Looking again more closely at metro Sydney, the 2005 SSROC household energy survey[40] found:

> "Around 65% of respondents living in detached houses (single occupancy dwellings) and approximately 56% of respondents in dual occupancy dwellings indicated they have insulation. Of those households living in a detached house with an air conditioner, 72% have ceiling insulation."
>
> "Although insulation is widely installed in houses in the region, there is still a significant number that require insulation."
>
> "Encouraging people to insulate could lead to significant savings off energy bills, in particular for the 28% of single occupancy dwellings that use an air conditioning unit but have no insulation. Any programs should encourage householders to consider all aspects of insulation, including sealing off draughts and effective window coverings."

The Australian Government's Home Insulation Program (HIP)[41] ran for just over 12 months in 2009 and 2010. The original intent of the program was to insulate the estimated 2.9 million homes without ceiling or roof insulation in Australia[42].

An Audit Report by the Commonwealth Auditor General after the closure of the program in 2010 estimated that

- 150,000 Australian homes were insulated with non-foil insulation; and
- 50,000 Australian homes were insulated with foil insulation, under the program[43].

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38 Page 9: http://www.sustainability.vic.gov.au/~/media/resources/documents/services%20and%20advice/households/energy%20efficiency/rse014%20households%20energy%20report_web.pdf

39 http://www.abs.gov.au/ausstats/abs@.nsf/mf/4602.0.55.001
40 http://ssroc.nsw.gov.au/wp-content/uploads/2015/04/Who-Is-Emitting-What.pdf
41 http://www.australian-government-insulation-rebates.com/Rebates/insulationgrant.html
42 http://www.australian-government-insulation-rebates.com/Rebates/insulationgrant.html

Taking into account that:

- in the order of two-thirds of metro Sydney homes had insulation as of 2005; but
- some (potentially many) of these will have replaced their existing insulation under the national HIP; and
- metro Sydney homes will comprise (likely significantly) less than half of the 200,000 homes targeted by the HIP;

it can be considered that there remains substantial opportunity for insulation to be installed in metro Sydney homes generally.

Insulation should not be undertaken in isolation of draught sealing around doors, windows, building vents and exhaust and other ceiling or wall fans – otherwise increased building thermal performance cannot be fully achieved. As such, any future program supporting any type of insulation should ensure draught sealing measures are equally supported and promoted to potential program participants.

6.3 Ceiling Fans

Ceiling fans are increasingly energy efficient and able to be utilised in both summer and winter to reduce energy use associated with mechanical air conditioning.

In summer, fans typically cool people by increasing evaporation from their skin – enhancing the effectiveness of sweating as a way of losing heat. Fans also increase the rate of heat transfer from surfaces by reducing the thermal resistance of the thin air film next to the surfaces and by moving cooler air past them.

As such, fans can be used with an air conditioner in summer to provide the same level of comfort at a higher thermostat setting, potentially reducing cooling energy use by around a third if the thermostat is set 3^{0}C higher. Designed and positioned well, this may allow split system air conditioners to be sized smaller.

In winter, ceiling fans with a reverse function can also be used for pushing warm air from the ceiling down to floor level – further reducing reliance on mechanical air conditioning.

It should be noted however that modern fans can vary considerably in terms of their efficiency – recent tests by Choice magazine[44] demonstrate that new ceiling fans can range between 48 to 100 watts of power.

Some modern ceiling fans however use significantly less power than this – with a few achieving less than 20 watts when on maximum speed; and down to only four watts on the lowest speed setting. This represents an 80-95% energy reduction on the models tested by Choice.

When coupled with associated energy reductions in mechanical air conditioning systems, ceiling fans are worthy of consideration in any future Solar Suburbs program.

[43] http://www.anao.gov.au/~/media/Uploads/Documents/2010%2011_audit_report_no_12.pdf
[44] https://www.choice.com.au/

7.0 Recommendations

On average, metropolitan Sydney households are spending in the order of $2,500 per year on stationery energy. This means that broadly speaking, half of the almost two million Sydney homes are spending more than $2,500 per year on stationery energy – for whom significant financial savings can be found with technologies that will also reduce their carbon footprint.

Residential stationery energy in Sydney is largely made up of:

- mains electricity – with approximately 1.8 million Sydney homes connected to the mains electricity grid[45]; and
- mains (LNG) gas – with approximately 1.15 million Sydney homes connected to the mains gas network. 82% of these (or approximately 940,000 Sydney homes) use mains gas for space heating or water heating – two of the largest residential energy loads.

In this context, the preceding chapters highlight a number of residential, demand-side (or customer-side) technologies that offer good, to very good, economic value for households – as well as achieving environmental benefits. These include:

- high efficiency reverse cycle air conditioners (RCACs) for heating & cooling;
- heat pump hot water and solar hot water systems;
- induction cook tops and efficient electric ovens;
- solar photovoltaic (PV) systems;
- lithium-based energy storage (coupled with existing or new solar PV);
- building thermal efficiency measures such as insulation and draught sealing;
- LED lighting; and
- ceiling fans.

Relevant considerations for the inclusion of a number of these technologies in any future Solar Suburbs program are outlined below.

7.1 Heating & Cooling

Home heating is perceived to be the main contributor to energy bills in one part of metro Sydney (ABS Climate Zone 6). Zone 6 also has the highest average number of ducted gas systems per household compared with the national average.

The other part of metro Sydney (ABS Climate Zone 5) has the highest number of RCACs per household as compared with the national average. Both of these facts present opportunities.

According to ATA's research (Chapter 3.0), it is highly economic for metro Sydney homes to switch to RCACs for space heating at (and sometimes prior to) their existing gas ducted or wall furnace heating system reaches the end of its asset life.

In addition, for those metro Sydney homes with existing RCACs installed, it will be significantly cheaper to use these for space heating than existing (or new) gas systems.

[45] http://www.strategy.planning.nsw.gov.au/sydney/the-plan/

When considering RCACs for space heating as well as cooling, sizing, along with efficiency, is important.

Smaller RCACs (i.e. <4.0kW heat output) have higher operational efficiency than larger units (i.e. >5.0kW heat output). However smaller systems are designed to service smaller rooms and spaces and will run inefficiently (i.e. use more input electricity) if they are trying to heat an area that is larger than its rated capacity.

As such, a range of RCAC sizes should be considered as part of any future Solar Suburb program.

In addition, some new RCACs also have the ability to control humidity: de-humidifying during the summer months and increasing humidity during winter. The 'drying-out' of room air due to the convective heat from an RCAC is a common complaint from many energy consumers and **should be considered in the promotion of these appliances**.

7.2 Hot Water

Water heating is a significant overall energy user in NSW and was put forward as the primary energy expense in ABS Climate Zone 5.

Across NSW, almost 66% of existing homes use electricity for water heating – with the majority of these systems comprising electric storage (resistance) water tanks[46]. In the context of metro Sydney, this broadly equates to around one million homes with electric hot water.

Heat pump hot water, solar hot water, solar PV and even retro-fit solar collectors are all excellent replacement/complementary technologies for traditional electric storage HW systems and should be considered as part of any future Solar Suburbs program.

Less than a third (29.1%) of NSW homes heat water with gas. Transposed to a metro Sydney level, this broadly equates to around 500,000 homes with existing gas HW systems. **Switching these to efficient electric as they retire offers excellent economic and environmental benefits.**

7.3 Solar PV

Metro Sydney has the lowest rate of detached homes in the country (72%) – which may be part of the basis for its lower uptake of solar PV (13% of homes). It should be noted that there are significant variations in the rate of detached homes across the metropolitan area[47].

However even if one assumes that all solar PV installations in metro Sydney to date have occurred on detached homes, this still leaves in the order of one million detached homes in metro Sydney 'solar free'.

Solar PV provides the best economic return to those residents in metro Sydney that have medium to high overall electricity demand, and medium to low export rates to the grid (~ <50%). This may include, but is not necessarily limited to, stay-at-home retirees, working families (with one or more family members regularly at home during the day) and home businesses.

[46] The ABS data treats solar HW system separately – with 8.5% of NSW homes heating their water with solar technology in 2014.
[47] For example, in Clovelly in Sydney's east, detached homes comprise only 30% of the dwelling stock.

It should be noted though that for each of these household types, day time electricity consumption can still be very low – leading to poor economic returns on PV.

Obviously a number of the other efficient electric technologies identified in this report can be timed to consume electricity during solar generation times (i.e. in particular space heating and cooling and water heating) and are therefore complementary to solar PV in this regard. **Communicating this through the Solar Suburbs program will be of high importance.**

Ultimately, the only way to ensure optimal economic returns (should this be of interest to the consumer) is to undertake a detailed analysis of a household's energy consumption data – where this is available. This is not something offered by the solar installation industry, however is a service that ATA offers through the application of its in-house modelling tool – the 'Sunulator'.[48]

7.3.1 Financing

The value and risks of any financing products associated with solar PV (or any other technology as they emerge) is also critical to assess as part of any technology and supplier assessment program.

These need to be assessed separately from standard (upfront purchase) technology offers, with a comparison of the following components (at a minimum) across suppliers/product offers:

- term;
- finance rate;
- warranties and other consumer protections;
- performance guarantees;
- system ownership; and
- early termination fees.

Should financing offers be considered as part of any program that target low income and vulnerable consumers specifically, then a higher degree of consumer protections should be sought – in particular with regards to the treatment (and potential payment for) any exported electricity to the grid.

Financing products should only be entertained for low income and vulnerable consumers where they can guarantee a financial benefit to the participating consumer from day one.

7.4 Storage

As of mid-2015, stationery energy storage for residential application is at a critical juncture. Currently, lithium-based storage in Australia remains more expensive to purchase and install than traditional lead acid technology. This is despite lithium being more economic over time – due to its greater utilisation capacity and longer asset life.

The Tesla PowerWall announcement of April 2015 changes this dynamic and will result in lithium storage competing directly with lead acid and all other chemistries on price – in addition to it being of greater economic benefit over time. At this point, there will be no economic case for continuing to use lead acid for household stationery energy.

[48] Please refer to **Appendix D** for an explanation and example output of the Sunulator solar simulation tool.

In addition, the plug-and-play, packaged 'PowerWall-type' units will be safer, lighter, easier to install and easier to connect directly to an existing or new solar PV system.

However the Tesla PowerWall will not be available in Australia until 2016 – and it may be 2017 before its direct competitors drive down prices and this form of storage technology cements its position in the Australian market.

Prior to this occurring, a household installing battery storage as part of a grid connected, hybrid system is likely to pay a substantial cost premium for what in 12-18 months will likely be inferior technology. This needs to be considered in the potential promotion of storage products through any future Solar Suburbs program.

7.5 Thermal Efficiency

The literature review identified that at least half of metro Sydney homes do not have, or have old (and likely underperforming) ceiling insulation. On top of this, only about a third of metro Sydney homes have installed draft proof sealing on their doors and windows.

This leaves something in the order of half to one million metro Sydney homes that could usefully be upgraded with high performance ceiling insulation and draught proof sealing.

Ceiling insulation should not be undertaken in isolation of draught sealing around doors, windows, building vents and exhaust and other ceiling or wall fans – otherwise increased building thermal performance cannot be fully achieved. **As such, any future program supporting any type of insulation should ensure draught sealing measures are equally supported and promoted to potential program participants.**

7.6 LED Lighting

Given the low prevalence of LED lighting in NSW homes and the fact that parts of metro Sydney have the highest rate of halogen down lights in the country, an efficient lighting program is worthy of consideration.

Any such program should focus purely on LED lighting technology – as LEDs are significantly more efficient even as compared with CFL technology; have considerably longer asset lives and have less environmental issues associated with their waste stream.

The most common lighting replacements for households, and which could be focussed on as part of any such program, are:

- general, single bayonet and edison lamps;
- halogen down light replacements (240 Volt, GU10 connections);
- halogen down light replacements (12 Volt, MR16 connections);
- T8 fluorescent tube replacements.

A summary of technology opportunities identified for any future Solar Suburbs program, and the number of metro Sydney homes for which they are relevant, is outlined below:

Table 14: Solar Suburbs Technology Opportunities, Metropolitan Sydney

Household Energy Characteristic	No. Sydney Homes	Future Opportunity
Connected to mains electricity	1.8 million	A variety of renewable and efficient electric technologies, as per below.
Spend >$2,500 p.a. on energy	~1.0 million	Significant cost savings can be achieved by low emission technologies.
Use mains gas for space/water heating	940,000	Economics of switching to efficient electric at end of gas appliance life is compelling for these homes. Also synergies with solar PV.
Use mains electricity for water heating	1.0 million	Economics of switching to efficient electric at end of electric appliance life is compelling for these homes. Also synergies with solar PV.
"Solar-free" detached homes	~1.0 million	Economics of solar PV for medium to high electricity usage households are compelling.
Currently receive 60c gross Feed-in Tariff	~120,000	The NSW 60c gross FiT ends in December 2016, by which time the next generation of home storage technologies will likely be available. These will be economically attractive to existing solar customers losing their premium FiT.
No/underperforming ceiling insulation	~900,000	Economics and energy/carbon reductions of installing >R4.0 ceiling insulation are compelling.
No draught proofing	~1.2 million	Any insulation project should be complemented with draught proofing for best thermal performance.
Existence of inefficient lighting	'000,000s	Significant opportunity for replacement of most lighting technologies with LEDs.

7.7 Technology & Supplier Assessment

Should Solar Suburbs decide to promote, recommend or deliver specific technologies and/or specific suppliers to household energy consumers as part of a future stage of the program, then it is advisable to undertake a product and supplier review, specific to the technologies in question.

Individual technologies can vary in their size, component configuration, application and the structure and terms and conditions of their contractual arrangements. Technologies and technology suppliers need to be assessed on a comparative basis so as to ensure the best value for money, highest quality and strongest consumer protections possible are achieved for program participants.

Technology and supplier assessments typically involve:

- specifying the technologies to be assessed, including the development of specific scenarios, system sizes, component configurations and contractual arrangements for qualified suppliers to respond to with their product offer;

- releasing a public call for supplier responses (a 'Request for Quotation' or RfQ) to a project brief outlining the above technology specifications and identified roles and responsibilities of the supplier;
- once received in full, an assessment and ranking of the supplier responses and product offers on the basis of an agreed set of assessment criteria and weightings; and
- selection of a preferred supplier/s based on the outcome of that assessment.

Example assessment criteria (at a minimum) and their potential weightings that ATA used as part of solar PV and solar hot water technology assessments are outlined on the following page.

The range of appropriate criteria should always be considered as part of each technology and supplier assessment process.

With regards to weightings, whilst *Price* is an important consideration in the overall assessment, given:

- the cost effectiveness of many renewable and efficient electric technologies;
- the range of brands and manufacturers currently in the marketplace; and
- the need to ensure system performance for the consumer over the longer term;

ATA place a higher value on the combination of *Product Quality* and *Warranty* in this regard.

ATA also conduct sensitivity analysis on different weighting combinations in order to understand the sensitivity of each supplier's product offer to each of the criteria.

Tender proposals that maintain a high ranking with slight adjustments to the relative weighting for each of the criteria can be assumed to provide the best value for money overall. Where sensitivity analysis reveals more than one provider is in contention, more detailed analysis can be undertaken.

Table 15: Example Assessment Criteria & Weightings

Criteria	Description	Weighting
Price	Average cost per watt, post STCs, for each system size assessed. Prices across each supplier are normalised using a price spread factor. This is typically between 150% and 300% of the normalised reference price.	30%
Quality	A score related to the quality of system components (both panel and inverter). These scores are based on a review of the specification sheets, taking into account performance criteria and independent testing and assessment information; any public assessment in regards to the international 'Tier-ing' system; as well as consumer experience (as evidenced through the ATA forums and Whirlpool).	25%
Warranty	The following four warranty parts are assessed: • Performance of panels (% output at time intervals); • Panel warranty (for product failure); • Inverter warranty (for product failure); and • Installation warranty (provided by the Australian based installer / supplier, minimum 5 years and must reside with local installer. This is a key aspect that will be directly asked of the suppliers through in RfQ).	25%

Customer Service	A qualitative assessment focusing on pre-installation site inspections and support; as well as after sales support, particularly the company's willingness to act on behalf of the customer once the installation warranty period has ceased but component warranties are still active.	10%
Experience & Reliability	A qualitative assessment taking into company longevity; designer/installer accreditations and experience; total number of installs per annum; experience with residential sites.	10%
Total		**100%**

7.8 The Efficient, Renewable All-Electric Home

Over the past few years, a range of technology, energy market and other factors have emerged that point toward an energy future where the cheapest energy management options for households also happen to contain a high degree of renewable energy and energy efficiency solutions. These factors include:

- the substantial reduction in the price of solar PV;
- the increased performance and reduced price of heat exchanger technology – this being the fundamental component of heat pump air conditioner and hot water systems;
- increasing electricity tariffs (over the past five to ten years);
- increasing mains gas tariffs (over the coming five to ten years); and
- the coming price reductions and performance improvements of storage.

Major residential appliances (e.g. hot water, space heating and cooling) have fixed asset lives and need to be replaced from time to time. Choosing the right technology at each of these decision points, in the context of a longer term plan to make a home as efficient and renewably-powered as possible, will come at very little (if any) additional cost and deliver long term economic and environmental savings.

It is this long term plan, and the information and advice required to educate consumers regarding the realisation of a high renewable, high efficiency, low cost home that a program like Solar Suburbs can work to deliver.

Educating the community in this regard means residential consumers making better decisions when appliance replacement comes up, irrespective of whether they purchase any specific technology through Solar Suburbs.

ATA would strongly recommend that Solar Suburbs have such an educational/advice component to any future program.

8.0 Appendix A – ATA Fuel Switching Methodology

For six different household types, ATA estimated the 10-year costs of replacing gas appliances with like-for-like gas appliances or efficient electric alternatives. In a residential setting, an individual consumer may be considering:

- switching one or two gas appliances with electric appliances, but retaining an existing reticulated gas connection or LPG gas system for any gas appliance/s that remain;
- a complete switch from gas to electric appliances, with subsequent:
  - disconnection from the reticulated gas network; or
  - termination of the use of LPG; or
- establishing a new connection to the reticulated gas network, and purchase of new gas appliances, for:
  - an existing home without mains gas; or
  - a newly built home.

The economics of the gas and electric choices is sensitive to a wide range of interrelated factors, which include:

- whether or not an appliance is at or near the end of its asset life;
- whether the decision incurs the cost of a new connection or new fixed charges;
- whether the decision avoids the cost of existing fixed charges;
- current gas and electricity tariffs and tariff structures;
- forecast prices for electricity and gas;
- the annual input energy use of individual gas and/or electric appliances, which is itself influenced by:
  - building type, size and thermal performance;
  - the type and mix of existing appliances in the home;
  - climate zone (with particular reference to space and water heading loads and the performance of electric systems); and
  - consumer financial expectation, including the cost of capital and return on investment expectations for any individual consumer; and
  - consumer behaviour.

8.1.1 Household Scenarios

In line with the above, ATA developed six 'Household Scenarios' that could be applied to each location modelled.

The scenarios considered a range of housing types and sizes, with differing characteristics in terms of gas and electric appliance use and overall energy use. The exception to this is the newly built home scenario (*Scenario 6: New Build*). As there are no existing appliances in place, a consumer is assumed to choose between installing either gas or electric appliances as the initial appliance investment.

8.1.2 Replacing Gas Appliances in Existing Homes

Household Scenarios 1 to 5 consider cases where a decision to replace one or more existing gas appliance is made, either:

- at the point where it has failed, or is highly likely to require replacement within five years. In this case, replacing it with one appliance avoids the capital expense of another in the near to medium term, hence the up-front cost impact on the consumer will be the difference in capital cost between the two appliances; or
- while the existing appliance is still in good working order and unlikely to require replacement in the next five years. In this case, the decision does not lead to any avoided capital cost in the near to medium term and up-front cost to the consumer will be the full capital cost of the new appliance.

The options are either to:

1. replace the gas appliance/s with a new, efficient gas appliance (this is considered the *Business as Usual* (BAU) case; or
2. replace the gas appliance/s with an efficient electric appliance/s.

Under option 2, there is also the case where a consumer replaces all gas appliances with efficient electric, avoiding the need for an existing gas supply. In this case, the consumer:

- avoids the ongoing fixed charge incurred by maintaining a gas connection; and
- usually incurs a charge for temporary or permanent isolation of the gas supply to their home.

8.1.3 Connecting Existing All-Electric Homes to Gas

Household Scenarios 1 to 5 also consider the case where an established all-electric home has the option to connect to an existing gas network and install gas appliances. The available options are to:

1. connect one or more efficient gas appliances to the gas network, with or without some number of efficient electric appliances. In this case, the use of any one appliance avoids the capital expense of another, hence the up-front cost impact on the consumer will be the difference in capital cost between the two appliances; or

2. install efficient electric appliance/s and not connect to the gas network. Under this option, the consumer also avoids any ongoing fixed charge incurred by maintaining a gas connection.

In option 1 above, there is also an establishment cost to connect the home to the gas network in the street, including the installation of a gas meter. On the advice of gas network businesses and in order to be conservative, ATA have not attributed this cost to the householder, as businesses are likely to subsidise this cost as an incentive to the consumer to connect to the network.

8.1.4 Choosing Appliances for New Homes

Household Scenario 6: *New Home* considers the case where a new home is built and either:

1. connects one or more efficient gas appliances to the gas network, with or without some number of efficient electric appliances. In this case, the use of any one appliance avoids the capital expense of another, hence the up-front cost impact on the consumer will be the difference in capital cost between the two appliances; or

2. installs efficient electric appliance/s and does not connect to the gas network. Under this option, the consumer also avoids any ongoing fixed charge incurred by maintaining a gas connection.

9.0 Appendix B – Gas Modelling Sensitivity Analysis

9.1 Sensitivity to Gas Price Trajectories

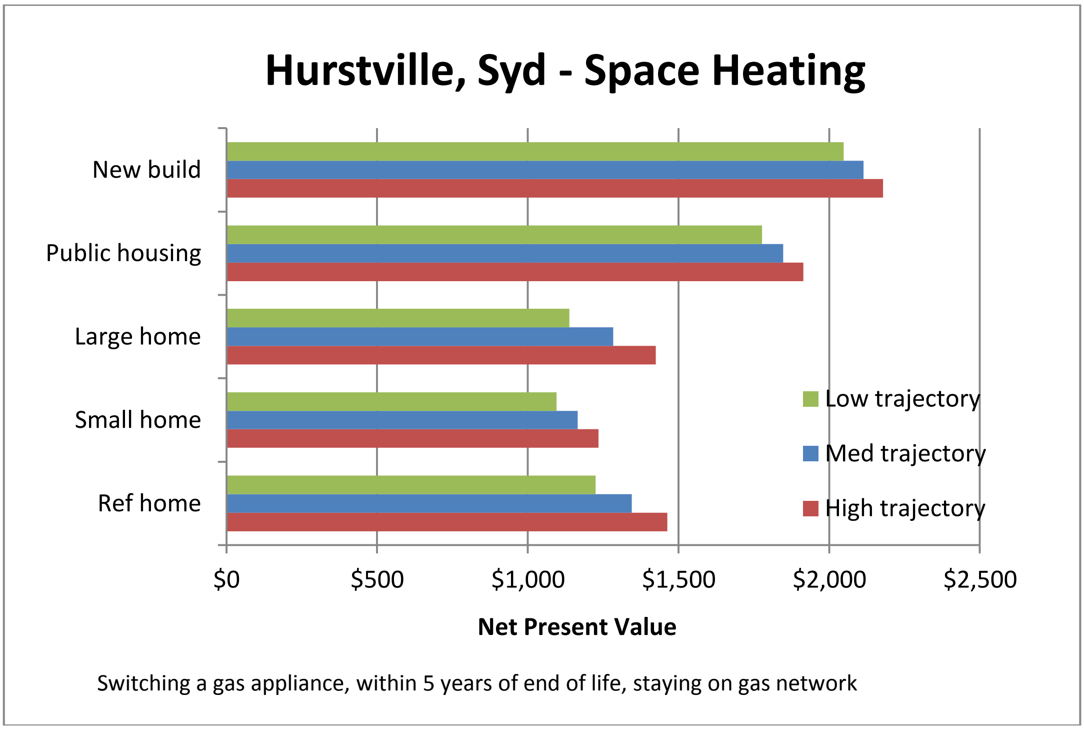
Sensitivity analysis was undertaken to test the results against a range of forecast gas prices for NSW. ATA adopted low and high ranges for the purposes of comparison against the 'medium' price trajectories used in the table above.

ATA found that the results were not particularly sensitive to different gas price trajectories – whilst they changed the magnitude of the numbers; they largely did not change an uneconomic investment into an economic one (or vice versa). As such, future gas prices had little impact on the findings.

As an example, in metropolitan Sydney, switching to reverse cycle air conditioners (RCACs) for space heating within five years of the end of a gas appliance's asset life and remaining connected to the gas network for other appliances was economic for households connected to mains gas under the medium trajectory for gas prices.

A high trajectory meant the economics of this scenario became more compelling; whilst even under a low trajectory, the case remained strong. The chart below shows NPV variations over 10 years:

Figure 5: Sensitivity of NPV to Gas Price Forecasts, Sydney, Space Heating



9.1.1 Use of Off-Peak Tariffs / Solar PV

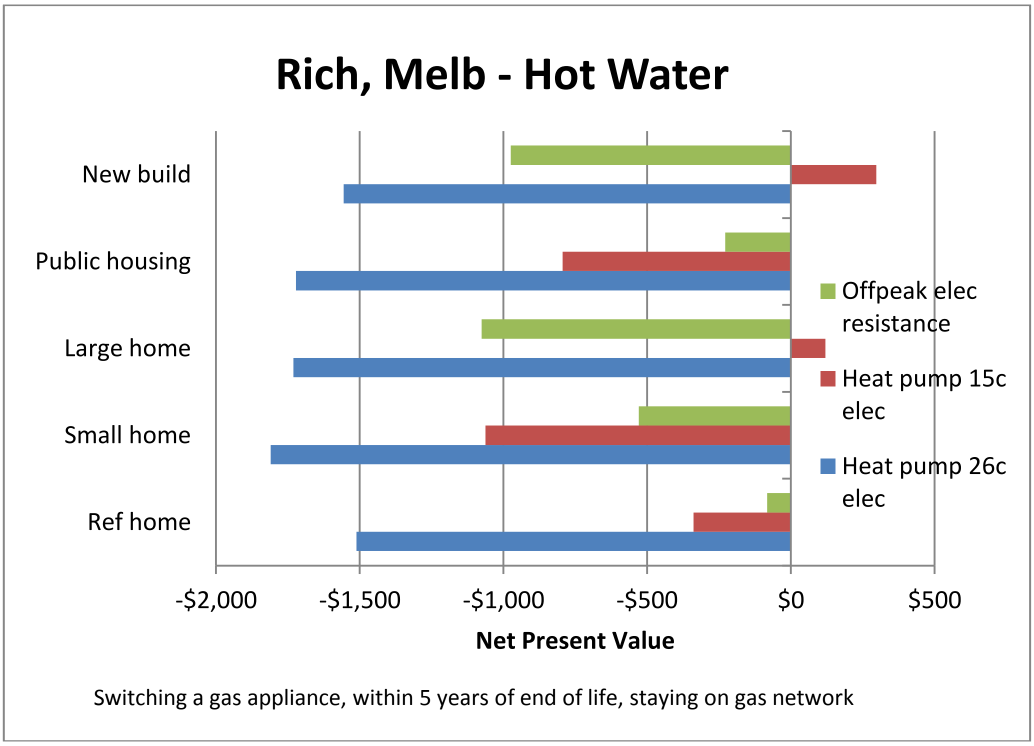
The analysis above did not consider whether a household was able to run a new efficient electric appliance on an off-peak tariff or directly from solar PV (in particular, a hot water system).

In 2015, the levelised cost of energy from a household solar PV system is broadly equivalent to an off-peak tariff – i.e. the solar system provides electricity at around $0.10 - $0.12/kWh, when the upfront costs are amortised over the life of the system (25 years).

As such, this makes the comparison of the economics of heat pump or electric boost-solar hot water systems run on off-peak tariffs or direct from solar PV straight forward.

As an example, heat pump hot water systems were largely found to be uneconomic in Richmond (Melbourne) when compared with new gas instantaneous or gas storage hot water systems. However running the heat pump on an off-peak tariff/solar PV (assumed 15c/kWh) changed this finding significantly:

Figure 6: Sensitivity to availability of Off-Peak, Richmond, Hot Water, Single Appliance



The table above outlines the 10 year NPVs of changing only the hot water system to an efficient electric heat pump – but remaining connected to the mains gas network.

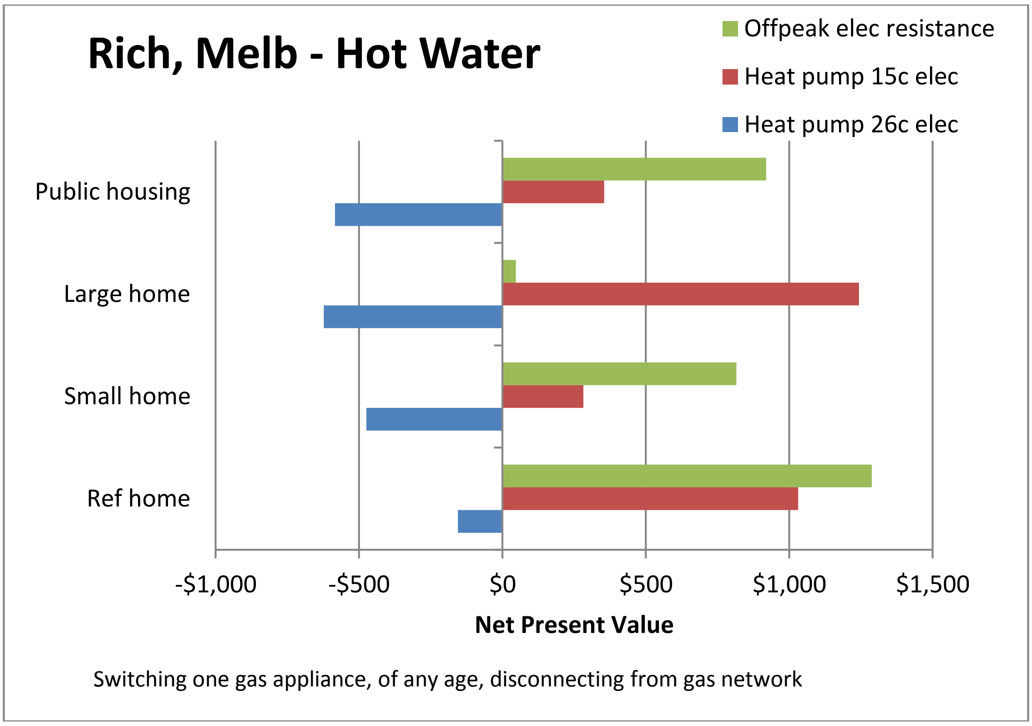
As can be seen, running the heat pump on off-peak/solar PV (the red bar) improves the 10 year NPV considerably – turning it positive (or near positive) in three of the five scenarios modelled.

The results for metro Sydney would be an improvement on those in the table above – as heat pump hot water system (and RCACs) achieve better performance in the warmer climate; and the avoided mains gas tariff is significantly higher than in Melbourne.

Once complete disconnection from, or avoided connection to, the mains gas network is taken into account, the off-peak/solar PV scenarios achieve an even better economic result.

The chart below again considers the case for running a heat pump hot water system on off-peak/solar PV in Melbourne and disconnecting from mains gas – with all scenarios turning from negative (over 10 years) to positive NPV. Once again, the results for metro Sydney would improve upon those below:

Figure 7: Sensitivity to availability of Off-Peak, Richmond, Hot Water, Last Appliance



The two charts above also consider the economics of a new electric resistance water heater[49], as compared with a new gas hot water system.

Some households (such as those in apartments) may not be able to install more efficient heat pump hot water systems (due to reasons of space). ATA analysed the sensitivity of using off-peak rates/solar PV for new electric resistance water heaters in this regard.

9.1.2 Relative Cost of Gas v Electricity

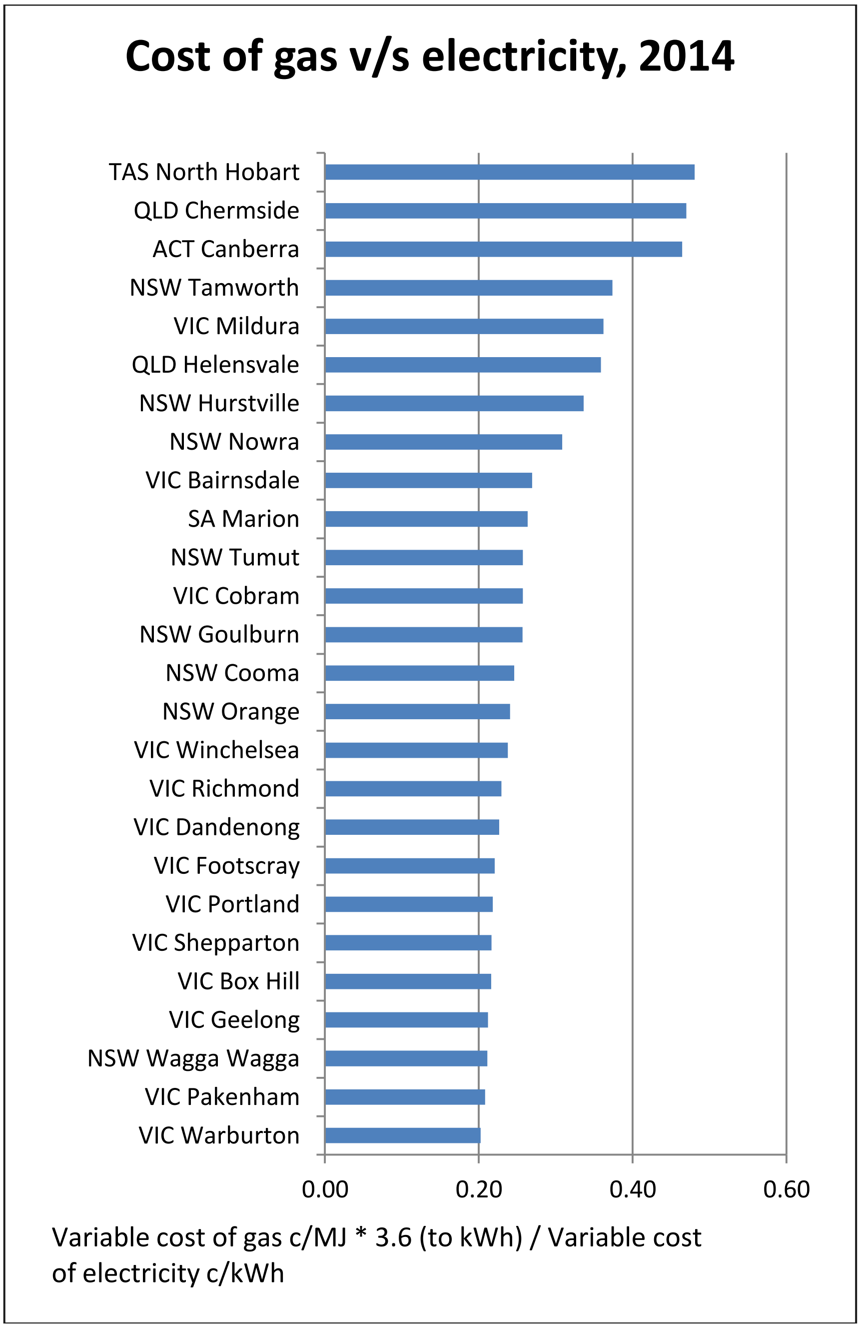
Through the research, ATA found that the relative cost of gas versus electricity (variable charges) in each location was an important factor in the economic case for switching:

As can be seen in the chart below, the majority of the NSW gas zones are in the top half of the chart – meaning that relative to electricity, the price of mains gas in these zones was relatively high.

[49] The electric resistance water heater is assumed to cost $1,500 to purchase and install. Modern electric instantaneous units can be purchased for a retail price in the order of $800 and deliver hot water much more efficiently than older style electric resistance units.

Metropolitan Sydney (captured under gas zone 'NSW Hurstville') has a factor of 0.34 for the price of mains gas compared with electricity. This means that on an equivalent energy unit basis, gas costs around a third of what electricity costs. This compares with the majority of Victorian zones where mains gas costs around one-fifth the price of electricity.

Figure 8: Relative Usage Cost of Gas v Electricity in each Gas Pricing Zone



10.0 Appendix C – Storage Chemistries

10.1.1 Lead-Acid

Lead-acid batteries consist of lead and lead-sulphate plates suspended in a sulphuric acid electrolyte. They are a reliable and well-understood chemistry that is relatively forgiving to mild overcharging, although over-discharging can impact lifespan considerably.

In years past, the most common type of lead-acid batteries in household-scale stationary power systems were flooded cell types. In more recent times there has been a trend towards prioritising safety and lowering maintenance requirements, resulting in a shift from flooded to sealed lead-acid batteries that have no risk of acid spillage or need to check cell electrolyte levels or check for internal corrosion.

Sealed lead-acid batteries come in two main designs—AGM (absorbent glass mat) and gel cell.

Gel cells have their electrolyte as a gel to prevent spillage and stratification (where the acid density of the electrolyte varies from the bottom to the top of the cells), while AGM batteries have liquid electrolyte, like flooded-cell batteries, but it is absorbed into fibreglass separators between the cells to provide the same benefits as the gel type.

Because both gel and AGM have the electrolyte effectively immobilised, they are safe and no longer need equalising charging; thus they don’t need to be topped up with distilled water like flooded cells do.

The main failure mode of lead-acid batteries is corrosion – typically accelerated by higher temperatures. Lead-acid batteries are also constrained by what’s known as the ‘Peukert effect’ – which expresses the capacity of a battery in terms of the rate at which it is discharged. As the rate increases, the battery's available capacity decreases.

As a result of this property, in applications where long life is and frequent discharge is required, researchers from the CSIRO state that lead-acid batteries shouldn’t be discharged faster than a 10 C10 rate (‘C’ being the reference to the charge/discharge time and is a unit published by battery manufacturer’s as part of the product specifications). This is equivalent to discharging at one-tenth of the rated capacity of the battery in any hour.

This is a limitation of lead-acid technology for those users who wish to utilise a significant proportion of a battery’s capacity in a relatively short time period (e.g. during typical residential evening peaks).

10.1.2 Lithium

Lithium offers considerable advantages over lead-acid. Lithium iron phosphate ($LiFePO_4$) batteries have higher storage densities (more energy can be stored in a battery of a given volume), greater power densities (batteries can produce far greater instantaneous power outputs without damage), much better charging efficiency and longer life spans than any lead-acid formats.

They currently have higher capital costs but increasingly lower lifetime costs – with more ‘useable’ energy capacity and longer asset lives than lead-acid. This is likely to continue to improve as the global push for lower cost batteries for electric vehicles continues.

Lithium batteries are not constrained by the Peukert effect. According to the CSIRO, most lithium storage systems can be used at up to a 3C rate, (being 30 times higher than the C10 rate of LA batteries). Given that there are few applications that require such fast charge or discharge, there is effectively no practical limit on discharge rate and lithium manufacturers typically publish charging capacity at the ‘C1’ rate.

Their longer asset lives, higher charging and discharging efficiency and their ability to provide capacity over very short charge/discharge periods enables smaller capacity banks to be used as compared to lead-acid.

Lithium batteries must have an effective battery management system (BMS). This enables each cell in the battery bank to be individually monitored when charging and discharging. Overcharged cells and cells discharged below the minimum voltage point can fail.

Some batteries, particularly smaller format lithiums, are supplied with a fully integrated BMS. Larger format cells typically come with the BMS modules supplied separately—fitted once the bank is assembled in the final location; or may (as is the case with the new Tesla PowerWall) have the BMS integrated.

10.1.3 Other Chemistries

There are a variety of other storage chemistries that can be used for household energy storage – including existing nickel-cadmium; nickel-iron; nickel metal-hydride and flow batteries; as well as ultra-batteries, sodium and zinc (chemistries that are still in the R&D phase).

Compared with lithium, those alternative chemistries that are commercially available now:

- remain less efficient (with regards to charging); or
- have even higher upfront costs; or
- are unavailable in Australia; or
- are suited only to large format applications.

With regards to the emerging chemistries:

- the ultra-battery is essentially a lead-acid battery with capacitors added in to the electrolyte for enhanced performance. Like all lead-acids, ultra-batteries remain susceptible to corrosion and must be periodically charged to 100% to maintain their capacity (e.g. once per month). This requirement comes at an economic cost to the end user as the battery will not be available for normal use for a portion of the time.

  Ultra-batteries also have an effective limit on discharge rate in the range of a ‘C1’ rate. However according to the CSIRO, this is only achievable provided that the technology is only cycled between 50% and 80% state of charge (SoC) – effectively a significant limit on useable capacity. As yet, ultra-batteries are not widely commercially available.

- sodium batteries have relatively low discharge rates and low energy density - neither of which is necessarily a problem for suitably sized storage in a home renewable energy system. However this emerging technology still has high capital costs and high weight per battery.

- zinc-air storage is expected to become commercially available in 2016 – zinc-air batteries. Normally found as single use batteries in small devices such as hearing aids, this chemistry has been developed into rechargeable batteries in the US[50].

  Zinc-Air technology is rated as being capable of 10,000 cycles (DOD not specified) and a 30-year lifespan. Zinc-air chemistry, it is relatively non-toxic and low cost. Their first system is a 4 MWh battery storage system for grid stabilisation, but hopefully smaller systems for domestic use will be available in the near future.

  Other Air-based technology is in development including Aluminium-air technology, however none of these are approaching commercial viability at this time.

For all of the reasons outlined above, lithium-based storage is recommended as the chemistry for residential stationery energy storage for the foreseeable future.

10.2 Energy Storage Systems

It is also important to consider the different types of energy storage systems in the market.

Increasingly, energy storage is not provided by large battery banks that are assembled on-site. Complete, ready-to-use energy storage systems are available that include the battery, inverter (and/or inverter/charger), management and smart controls usually for adding storage to grid-connected homes.

These systems are available in a range of sizes. Because they are often designed to be modular, adding more storage is simply a matter of adding more units. Some newer systems include an inverter/charger, lithium ion battery and control system all in one enclosure. These units look much like any other large appliance and can be installed inside a home or garage[51].

Whilst such systems need to be suitably sized and therefore require considerable investment up-front, more modular systems are currently in development that allows the addition of new storage capacity[52]. These systems are also offering the benefit of reduced labour time associated with installation.

10.3 International Context & Electric Vehicles

Bearing in mind the above, the other major factor to consider in regards to which battery chemistry is likely to proliferate in Australia and globally over the coming decade is the influence of the car industry.

As of 2015, lithium storage technology is being used globally on a much larger scale in the automotive industry than in the home or business energy management sector – that is, in the development and manufacturing of plug-in hybrid (PHEV) and battery electric vehicles (BEV).

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[50] By EOS Energy Storage (www.eosenergystorage.com)
[51] For an example, see the 'Bosch BPT-S 5 Hybrid' (www.bosch-power-tec.com).
[52] An example of such a system is the AC battery from Enphase (still in development). This product consists of a lithium battery, Enphase micro-inverter and charger. In effect, this system is an AC battery which is simply connected to the mains grid in the home.

For a variety of reasons including those listed above, lithium is the preferred storage technology for the car industry and is the basis for the majority of research, development and commercialisation in relation to PHEVs and BEVs.

A strong indicator of this is that all of the price forecasts for storage for 2020 and beyond are presented specifically in regards to lithium-based chemistries – and most in the context of wholesale prices to the automotive industry.

According to the CSIRO, there is virtually no issue with global lithium supply for the foreseeable future – with many countries having significant deposits including Australia.

11.0 Appendix D – The Sunulator

The 'Sunulator' is currently the most capable economic analysis tool for grid-connected solar and grid-connected solar-battery systems, available in Australia. The strengths of the Sunulator simulation model are as follows:

- To accurately inform generation, ATA integrated 19 years (1994-2013) of solar insolation data from the Bureau of Meteorology (BoM) into Sunulator. The data exists across five-kilometre grids for all of Australia and is the basis for the generation calculations within the model.
- Regarding consumption, Sunulator has the capability to:
  - directly accommodate interval data files of any time period (as Sunulator averages both generation & consumption back to a typical meteorological year and typical consumption year). For most accurate results, at least 12 months of data is preferable;
  - alternatively, a detailed consumption profile can be built based on relevant input assumptions regarding load patterns, including daily, weekly and seasonal variations; and other variables such as public and private holidays, weekends and standby loads.
- Regarding storage, Sunulator has the ability to analyse the energy flows and economic outcomes of different storage chemistries (e.g. lead acid versus lithium) with the ability to input specific battery charge/discharge rates and efficiencies. Battery storage strategies such as export minimisation, peak shaving and tariff arbitrage can be modelled by setting limits for charge/discharge rates at any time of the day.

Economic and energy results are based on netting off generation versus consumption data, specific to that location and user profile, for each 30 minute interval over a full year.

This takes account of climate variability and gives the most accurate picture of how much solar generation will be consumed on-site (and when); versus how much will be stored and discharged from the batteries and when (if of relevance); versus exported. System design and configuration can then be optimised to maximise the value of solar generation and minimise the cost of consumption from the grid.

Sunulator calculates the impact on the consumer's electricity bill (annually) and projects the savings over a 30-year time frame. Financial results include simple and discounted payback, net present value and return on investment (project internal rate of return). The carbon impact of the project is also automatically calculated.

A results sheet from a Sunulator simulation is contained on the following page for reference.

Worksheet 5b: Results Statistics

Stats and financial measures for each scenario.

- Please see the notes on the results introduction page.

For each measure, the most attractive or equal-most attractive scenario is shaded green

Energy updated on:	13/Mar/15 12:03
Financials updated on:	13/Mar/15 12:04

	Scenario names					
Item	**BAU**	**10kW**	**15kW**	**20.8kW**	**25kW**	**30kW**
Key Simulation Inputs						
Financial discount Rate - Consumer	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Horizon (years)	10	10	10	10	10	10
Simulation Results - Environment						
Tonnes of carbon dioxide offset annually	-	13.0	19.4	26.9	32.4	38.9
Equivalent number of cars off the road	-	3.8	5.6	7.8	9.4	11.3
Simulation Results - Key Statistics						
Export as a % of solar generation	0%	9%	15%	21%	24%	28%
Consumer financial stats						
Up-Front solar investment		$ 15,516	$ 22,429	$ 29,952	$ 35,431	$ 41,850
Annual electricity cost (first year)	$ 20,626	$ 17,812	$ 16,594	$ 15,294	$ 14,408	$ 13,409
Annual cost for maintenance eg cleaning		$200	$200	$200	$200	$200
Annual cost - total (first year)	$ 20,626	$ 18,012	$ 16,794	$ 15,494	$ 14,608	$ 13,609
Consumer financial projections compared to Scenario 1						
Annual cost saving (first year)		$ 2,614	$ 3,832	$ 5,133	$ 6,018	$ 7,018
Net Present Value		$ 5,186	$ 7,876	$ 10,586	$ 12,062	$ 13,482
Simple payback period, years		6	6	6	6	6
Discounted payback period, years		8	7	7	8	8
Return on Investment (Int. Rate of Return)		11.4%	11.7%	11.7%	11.5%	11.2%
Levelised Cost of Energy (LCoE), c/kWh		15.9	15.3	14.8	14.5	14.3

Simulation Results per installation - Energy

Avg. daily consumption exc. solar, kWh	237.50	237.50	237.50	237.50	237.50	237.50
Avg. Daily generation, kWh	-	35.48	53.22	73.80	88.71	106.45
Avg. Daily generation per kW of capacity		3.55	3.55	3.55	3.55	3.55
Avg. daily solar consumed on-site	-	32.16	45.22	58.58	67.35	76.91
Avg. net daily consumption, kWh	237.50	202.01	184.27	163.69	148.79	131.05
Avg. daily export to grid, kWh	-	3.32	8.00	15.23	21.36	29.54
Avg. daily import from grid, kWh	237.50	205.34	192.27	178.92	170.15	160.59
Self-consumption of solar generation, %	0%	91%	85%	79%	76%	72%

Simulation Results per installation - Maximum Demand

Overall maximum grid import, kW	53.96	51.49	51.34	51.17	51.04	50.90
Date of max. grid import	24/06/13	17/06/13	17/06/13	17/06/13	17/06/13	17/06/13
Time of max. grid import	10:00	10:00	10:00	10:00	10:00	10:00

Simulation Results per installation - Consumer Electricity Costs

Avg. daily electricity bill - energy charges	$ 55.41	$ 47.90	$ 44.86	$ 41.74	$ 39.70	$ 37.47
Avg. energy charge per kWh imported	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23
Avg. daily electricity bill - standing charges	$1.10	$1.10	$1.10	$1.10	$1.10	$1.10
Avg. daily grid bill excluding feed-in	$ 56.51	$ 49.01	$ 45.96	$ 42.84	$ 40.80	$ 38.57
Avg. daily bill per kWh imported, exc. feed-in	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
Avg. daily feed-in credit	$ -	$0.21	$0.50	$0.94	$1.32	$1.83
Avg. daily electricity costs exc. feed-in	$ 56.51	$ 49.01	$ 45.96	$ 42.84	$ 40.80	$ 38.57
Avg. daily electricity costs inc. feed-in	$ 56.51	$ 48.80	$ 45.46	$ 41.90	$ 39.47	$ 36.74

Appendix E - “Desktop review of community engagement practices”

(MEFL / Solar Suburbs, 13 November 2015)

Desktop review of community engagement practices

13 November 2015

Moreland Energy Foundation Limited (MEFL) and Solar Suburbs have undertaken a desktop review of community engagement practices in order to inform the development of the Solar Suburbs model.

Overview of Solar Suburbs community engagement outcomes

Solar Suburbs aims to encourage behavioural change within individuals that results in a verifiable impact within and across entire communities. In the Solar Suburbs context, the ultimate goal is to enable financial, social and environmental conditions that facilitate individuals (persons and/or households) to proactively implement rooftop solar PV.

The desktop review therefore includes consideration of:

- factors that lead to individuals changing their behaviour, and
- the role of and impact on community groups and organisations, ranging from the specific and organised (such as schools, daycare centres, churches, sporting and community clubs) to the unorganised (such as pub and cafe patrons, retail clientele, local Council constituents), to the nebulous (such as a local suburb or community)
- techniques and mechanisms, that can be utilised to create the desired change.

MEFL's expertise: Effective methods of community engagement

Engaging with the community (and activating an engaged community) are key focuses of MEFL's operation. Our mission is the creation of an active, inspired community tackling climate change with sustainable energy solutions.

Since 2000 MEFL has worked as a connector between the community and local government and the development industry. We have designed and delivered community based energy solutions and programmes, provided energy efficiency advice and education to the community and worked with residents to improve their energy practices and bills. From this on-ground experience we have gained a deep understanding of how to engage, inspire and enable communities on climate change issues.

Through the use of our knowledge and best practice research MEFL has become a leader on how best to deliver community based sustainable energy solutions and programs to households, community groups and businesses. We use up to date knowledge of technology, policy, behaviour change and communication to design tailored programs that work. Programs are developed to recognise social circumstances, address equity issues and build resilient communities whilst reducing emissions. Programs are also designed to be specific rather than generic to extend the reach of programs to a range of communities

Key projects have included:

- Moreland Solar City project – engaging all levels of the community to deliver community-based sustainable solutions
- Zero Carbon Moreland (ZCM)

- Positive Charge
- Darebin Solar $avers
- Implementation of Moreland City Council's Zero Carbon Evolution strategy

A selection of relevant case studies are included in Appendix 1.

We are continually refining our learning on each project of how to engage with community members to participate in our projects and in action on climate change. We are also looking to understand how we can capture the information needed whilst minimising disruption but maximizing benefit for participants.

Key areas we are learning from include:

- What are the best strategies for engagement?
- How do you engage across different stakeholders?
- How do you keep community informed and engaged?

<u>What are the best strategies for recruitment?</u>

The recruitment strategy required will depend upon who needs to be recruited. The project may require this to be:

a) Any households wishing to participate
b) Households with specific social attributes (ie pensioners, low-income households)
c) Households with specific housing types
d) Self-recruiting households: that is, households recruit themselves as a result of individual behavioural change having detected the change or opportunity occurring around them, and in order to be part of the wider movement towards a community-wide change
e) Households within a specific building.

These are discussed in more detail, below:

a) Any household wishing to participate

MEFL has consistently found that recruitment can be boosted – particularly to those beyond the typical green audience - by working with local trusted providers such as councils, neighbourhood houses, local Centrelink offices, Community Health Services, culturally and linguistically diverse (CALD) groups, rotary groups, mothers groups, men's sheds and other existing community groups.

MEFL has used a range of methods to get messages out, including outreach stalls at community events, newspaper columns, community talks, web advice, email updates, monthly pub nights and CALD materials and events.

With specific offers / calls to action the Positive Charge program has found the most successful broad brush engagement method is by delivering directly addressed mail through Australia Post. The response to this mail is even greater, when the letter comes from a trusted body, such as the local council. Councils can also assist by providing contact details, through their rates team.

Inviting people to attend a workshop or talk about a subject with which they are not already engaged or is too broad to really understand, for example 'Energy Efficiency', results in considerably lower uptake than speaking to community groups at their own regular meetings and/or providing specific message – e.g. 'Explaining Solar' or 'Heatwave Preparedness'.

Potential effectiveness for Solar Suburbs: **HIGH**

b) Households with specific social attributes

It can be useful to work with other organisations and community groups to assist in recruitment as this can provide access to specific audiences – such as low-income households, health card holders, school communities, culturally and linguistically diverse (CALD) groups, or pensioners.

This requires direct interaction with the identified organisations and/or community groups to identify and then approach the target households. In many cases communication channelled through the organisation or community group can cut through privacy issues, as well as increasing trust due to being through a known entity.

This may work well for the Solar Suburbs project if the project supports or underpins an existing program with similar objectives, such as increasing access of low-income households to residential solar PV.

Potential effectiveness for Solar Suburbs: **MEDIUM**

c) Households with specific house types

Where specific housing types have been required, such as free-standing dwellings with north facing roofs, MEFL has tended to undertake a general recruitment process then select the specific households from data provided through surveys or conversations. Where this is done it is important to make it clear that a selection process will be taking place to fit with the project needs, rather than recruitment being taken on a first come first served basis.

The effectiveness of the Solar Suburbs project may be improved if the most appropriate housing type is targeted. For example, select free-standing dwellings that have good solar radiation (exposure to direct sunlight) and north-facing roof orientation. Conversely, avoid actively targeting large apartment towers which may have rooftop access and safety difficulties for the installer, corresponding higher installation costs, and common area / strata complexities.

Potential effectiveness for Solar Suburbs: **MEDIUM**

d) Self-recruiting households

This is equivalent to an opt-in, however it may be less formalised than a traditional opt-in program, and in some circumstances it may not be apparent to the project manager/coordinator that the household(s) is a participant.

In the context of the Solar Suburbs project, which is aiming for a large number of individual participants to collectively result in and also bring about community-wide change, self-recruitment should be factored into the project design.

A common social norm to consider is the *spatial neighbour effect*, commonly known as “Keeping up with the Joneses”. This dictates that some households are prompted to act in a certain way because their neighbours have acted in a certain way - not because the action has a financial incentive for them or is good for the environment.

This requires:

- the desired action to be visible (such as the neighbour’s solar PV installation)
- the desired action to be reproducible by the household (such as the ability and enabling conditions to install on the their rooftop)
- the desired action to be desirable to the household (such as a call-to-action that the individual can identify and respond to)
- sufficient information for the individual to take necessary steps to act.

Therefore, the project will need to enable self-recruitment and as far as possible be able to identify households that have self-recruited.

Potential effectiveness for Solar Suburbs: **MEDIUM**

e) Households within a specific building

An effective method of engagement is through face to face community events – such as a residents’ BBQ.

Other effective face-to-face strategies might include a stall within each building that is staffed at the busiest times of building use, for example in the lobby / lift area when people are arriving home from work. For safety reasons it is important to have two staff on the stall at all times.

These face-to-face methods must however be supported by a wider engagement strategy so that residents gain trust in Solar Suburbs (through Department of Human Services or the property managers / body corporate), understand the purpose of the event and reach those who are unable to attend the event. This can be developed through letterbox drops (surveys, newsletters, event invitations) and posters on noticeboards. It is beneficial to co-brand materials with trusted partners, for example the Council or DHS.

There is also a need to allocate time to follow up the contacts made at face to face events in order to finalise the recruitment as often people do not have the details needed on them (such as billing information).

Although MEFL has had some success with doorknocking campaigns (for example on the Merlynston Village Green project) MEFL discontinued using doorknocking as a method of engagement on a late project - The Nicholson - over concern for resident privacy.

Potential effectiveness for Solar Suburbs: **LOW**

Summary of potential effectiveness of recruitment strategies

The table below summarises the potential effectiveness of the best recruitment strategies in the context of the Solar Suburbs project.

Strategy / Effectiveness	Effectiveness
(a) Any household wishing to participate	**HIGH**
(b) Households with specific social attributes	**MEDIUM**
(c) Households with specific house types	**MEDIUM**
(d) Self-recruiting households	**MEDIUM**
(e) Households within a specific building	**LOW**

The Solar Suburbs project should therefore include, among others, the following:

- Direct partnership and support from local Council
- Direct mail-out by local Council to qualifying households via Australia Post
- Co-operation between local Council, Solar Suburbs project team and organisations representing relevant targeted social groups
- Development of a visible and desirable call-to-action mechanism such as the one proposed by Solar Suburbs, below, to allow households to self-recruit and also serve as evidence of the effectiveness of the project.

How to keep a community informed and engaged?

MEFL has found that having existing and ongoing channels of communication can improve take up of specific programs. It is therefore important to understand which methods are effective in terms of informing and engaging communities.

From experiences with Moreland Solar City, MEFL found that:

- People can be overwhelmed by too much information. The most effective way to avoid this is providing opportunities for people to ask questions. In addition where possible messages should be targeted to specific audiences to ensure that they are relevant.
- If we want to attract a wider audience we should layer messages on all drivers that might be appropriate – financial benefits, home comfort, health, community connection, environment and keeping up with the Joneses. The focus should be on personal benefits – to stop wasting money and increase comfort and health rather than climate change. The messaging should be reviewed to reflect public opinion.

- Similarly, any sustainability / climate change / environmental messaging should be framed positively to encourage participation (for example, "Join the team!"), instead of negatively (for example, "What are *you* doing to reduce your emissions?").
- It is important for those dealing with the community to have strong interpersonal skills as well as solid local and technical knowledge.
- Most people want practical help and inspiration to act. MEFL has found people are most interested in case studies so often embeds actions into real stories rather than producing endless facts sheets.
- Locally produced information provides effective motivation on actions.

During the Concession Assist program households were provided with ongoing support through the ZCM household programme. This meant they received a monthly update (post or email) with advice, special offers and details of local events. This was a successful delivery model.

The Concession Assist scheme also highlighted the need to develop targeted engagement strategies for sections of the population that require specific strategies such as CALD and indigenous communities.

<u>Proposed Solar Suburbs model call-to-action mechanism</u>

Drawing on the principles outlined above, MEFL understands the Solar Suburb community engagement model consists broadly of the following, with Streams 1 and 2 designed to underpin each other:

(1) Individual Household Stream

- Households with solar installed can apply for a plaque to go on letterbox or door
- Plaque includes recognisable and simple symbol for the Solar Suburbs project (eg panels against a blue sky) and simple "where to find more information" trigger, such as facebook symbol + "SolarSuburbs" or solarsuburbs.org.au
- Council or Solar Suburbs organisation manages plaque requests to allow M&V
- Council may consider providing a once-off or per-plaque fee to Solar Suburbs, as each installation (may) contribute to the LGA's renewable energy / climate change objectives

(2) Community Groups Stream

- Community groups within target suburbs / LGAs that own or pay for the electricity of the buildings they use (e.g. schools, churches, sporting clubs, childcare centres) are recruited ahead of the promotion of the Individual Household Stream (above) by Council.
- Community group leaders (e.g. school principal, club captain) are encouraged to exhort their members to participate in the campaign. If minimum number of participants from the respective group subscribe (e.g. 20+) the group may be incentivised by a free solar PV system, thereby reducing their energy costs.
- "Town Hall" sessions may be delivered to further promote the campaign in line with the group's core messaging and business.

(3) Other

- Solar Suburbs manages website / Facebook page, including:

- link to (for example) Our Solar Future website for households to get a quote
- application form to request a plaque
- maps function showing individual “Solar Suburbs” installations
- “upload a photo” function for households and their new installations
- details on incentive programs for community groups (etc) wishing to enlist their own customers.

By offering a program incorporating the above strategies Solar Suburbs can support the efforts of local Councils to support their community in installing solar and feeling part of a broader movement.

The use of plaques and social media is intended to assist in measuring the effectiveness of the Solar Suburbs messaging and reach.

MEFL understands that people respond well to visually represented information, so the use of maps and plaques increases visibility and adds to the “Keeping up with the Joneses” effect.

Council assistance and support, along with community trust is vital to the success of the community engagement of the Solar Suburbs program.

Appendix F - “The Solar Suburbs Model With application of the Switch framework”

(Solar Suburbs, 15 November 2015)

The Solar Suburbs Model
With application of the Switch[1] framework

(1) SOLAR SUBURBS OVERVIEW

The objectives of the Solar Suburbs project are, broadly:

(1) Eliminate or manage, as far as is practically possible, barriers to implementing residential solar PV such as cost, access to capital, information gaps/saturation, trusted suppliers, split incentive between landlord and tenant, and

(2) Encourage households in targeted suburbs or Local Government Areas (LGAs) to take up residential solar PV.

As this project requires many individual and often unrelated actors to take similar actions, unique mechanisms that influence or take advantage of social norms may be required.

(2) SOLAR SUBURBS CONCEPT PLAN

This project aims to shorten the distance to the desired change outcome as much as possible. In contrast to a proposed centralised renewable energy project, such as a local wind farm that may only require a comparatively smaller number of community investors to initiate the project and therefore benefit from an organised town hall event, potential participants in this project number in the thousands for individual suburbs or LGAs.

Therefore, the role of Council is important as are the role of local identity and the phenomenon of Keeping Up With the Joneses, as follows.

(3) PROPOSED FEATURES

A. Mail-out #1 – with sticker for house window

This is sent by Council. It includes:

- letter from the Mayor recognising that many constituents desire a future where energy is 100% renewable/clean and that Council would like to enable residents to publicly but modestly show their support for a clean energy future. There is no reference to the Solar Suburbs project.
- Small sticker which can be placed on a dwelling's front window, including those who rent or live in apartments.

  Suggested copy could be "I support 100% renewable energy for [*suburb*]". This enables all residents to now be part of a movement.

  The theory underpinning this is the 'foot-in-the-door technique' (Freedman & Fraser, (1966)) which suggests that, once a homeowner has agreed to a small, token action, there is more likelihood of success when it comes to asking for a larger, related commitment.

  It also helps to build or rebuild local identity as the sticker signifies other constituents with similar community-minded identities.

B. Mail-out #2 – offer for letterbox plaque

[x] weeks after the initial mail-out, a second mail-out from Council includes:

- letter which 'points to the destination' – a solar suburb complete with before and after aerial shots (ie both shots are of the target suburb and therefore recognisable to

[1] Heath & Heath, *Switch; How to Change Things when Change is Hard* (2010), Random House: London

constituents and the 'after' shot has solar PV arrays superimposed over all north-facing structures with good thermal coverage

- application form for a Solar Suburbs plaque (see below) for houses already with solar PV installed (this provides a baseline), OR
- a simple flyer with one link to Our Solar Future (or similar) web-based platform for obtaining 3 quotes, and statement that we will write again in 3 months with plaque application for New solar PV installations. Application would ask household to also indicate which installer did the work, which could enable an incentive-based arrangement between Solar Suburbs and the installers.
- *possible* modeled scenarios eg pensioners in small dwelling at home during the day, large family with high usage but mostly out during the day.
- *possible* offer to apply for rates-based finance offered by Council
- *possible* letter for tenants to request landlord to install and pass on incremental increase via rent.

Solar Suburbs Letterbox Plaque

(a) Rationale

The letterbox plaque is the trigger for the spatial neighbour effect which is commonly known as Keeping Up with the Joneses.

The rationale is that residents or households are more likely to act in a certain way, by installing solar PV, if their neighbours have taken the desired action – more so than if there were a financial or environmental benefit for doing so such as lower bills or helping to save the environment (see Graziano, M., and Gillingham, K., 'Spatial patterns of solar photovoltaic system adoption: the influence of neighbors and the built environment', *J Econ Geogr* (2014).

The letterbox plaque is a visual tool which has the effect of signaling to neighbours that the household has taken socially-desirable action, similar to households volunteering for the Safety House and/or Neighbourhood Watch schemes which were also symbolised by letterbox plaques (see sample photos 1 and 2, below).

The premise for the Solar Suburbs plaque is twofold:

(i) It draws attention from street-level to the roofspace where solar PV installations are less obvious to neighbours or passersby, and

(ii) It encourages the spatial neighbour effect, coupled with a strong sense of local identity, by signaling that the household has undertaken positive action befitting a good constituent of [*suburb*].

The copy and image(s) of the proposed plaque are therefore crucial, as follows.

(b) Copy and images

The plaque should not only indicate that the household has installed solar PV but it should also be a positive call-to-action for others.
XXXXX suggest that positive instead of negative language should be used in order to generate interest and then participation in sustainability initiatives.

For example, it is better to say "Join the team in the fight against ABC" instead of "What are *you* doing to fight against ABC?" Therefore, suggested copy include:

"*Powering a clean future today"*

"I've gone solar"

"Free, clean energy in use" (ie a play on the "bore water in use")

"We've joined the solar generation"

Suggested image could be an array of rooftop solar PV panels set against a clear blue sky.

There should also be enough graphical information for the observer to find out more about the program, such as both Council and Solar Suburbs logos and/or a weblink.

See below for Sample Solar Suburbs Letterbox Plaque.

C. Send letterbox plaques – existing solar PV installations

D. Mail-out #3 – offer for letterbox plaques for new installations

Sent 3 months after Mail-out #2 to prompt renewed action to either investigate quotes or applying for plaque if installation complete.

E. Ongoing reinforcement

It is important for not only program managers to see early and ongoing results but also participants and potential participants.
Therefore, it is proposed to set up and maintain a Facebook page where residents can "add your house to the map" and "send us your photos".
Program managers could also take photos of random solar PV installations in the target suburb and ask FB group users to identify whose it is (etc).

(4) KEY STRUCTURES

In order to implement an effective Solar Suburbs program, the following actors and structures are required:

(1) **State Government:**

Selection and/or certification of suppliers (eg via tender).

QA support, such as 5% random inspection of each supplier's installations (NZ program)

Funding for ongoing program management.

(2) **Local Government:**

Agreement to implement Solar Suburbs model/package.

Must have clearly defined target for community-derived RE which translates into goal of X new solar installations.

Mayoral support, at minimum to use letterhead for at least one mail-out.

Local signage.

Sponsorship package.

Support for targeted community groups component, below.

(3) **Community Groups**

In addition to participation of individual households, local demographic-based groups such as schools/ clubs/ religious/ sporting/ CALD communities should be actively targeted and incentivised to participate via two means:

(i) Financial incentive by installer, eg free solar PV system for the club/school (etc) if X participants sign up.

(ii) Carefully tailored language relevant to the group in question that aligns participation in the scheme with the common identity of the group. For example:

- for a surf life saving club group, “We work and play under the sun. We should also get our power from the sun”.
- for a school group, ”We want the best for our kids. If we sign up, we get clean energy, the school gets a free solar PV system, we all save money and our kids get a hands-on lesson in renewable energy. We should do this because we are [*suburb*]”.

(4) **Online quote platform**

Similar to SSROC’s Our Solar Future, an easy, click-through process to obtain a quote for limited suppliers.

This is crucial, as it assists to shorten the distance.

(5) **Financial sustainability**

Achievable if suppliers are selected/approved and they agree to a $ portion of each installation towards the Solar Suburbs project.

Graphic 1, below, is a conceptual outline of the key Solar Suburbs components.

(5) INTRODUCTION TO THE SWITCH FRAMEWORK

The following table sets out the framework proposed by Dan and Chip Heath (*Switch: How to Change Things When Change is Hard*) to create switches in behaviour that lead to measurable impacts or change.

It broadly has three components:

(1) Rational or logical elements that enable a change participant’s to make logical decisions in the direction of the desired change (“Direct the Rider”)

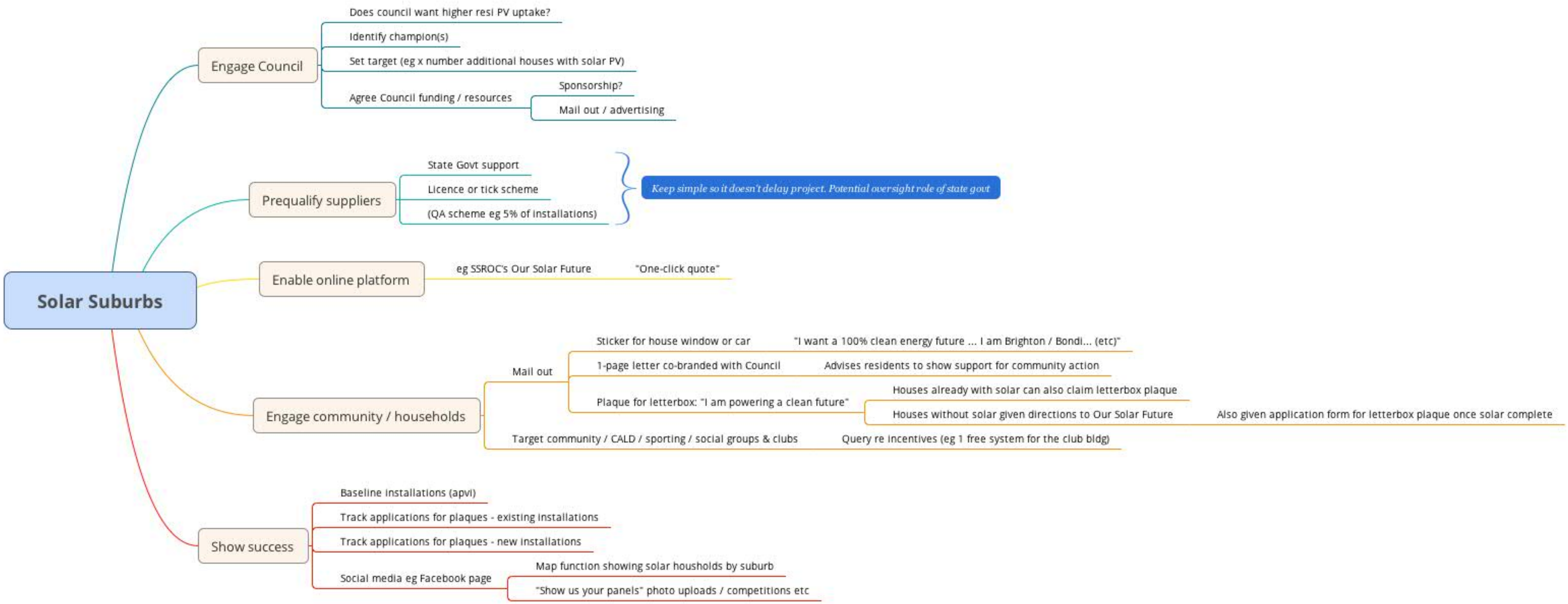
(2) Emotional elements that appeal to the change participant’s heart, emotions or identity. It is argued by the Heath brothers that emotional elements are key in order to effectively create desired behavioural change (“Motivate the Elephant”).

(3) Clearly defined steps or processes to achieve the desired outcome. This is more than a “project plan”, and requires shortening the distance as much as possible between the status quo and the desired outcome (“Shape the Path”).

Proposed applications of the framework to the Solar Suburbs project are listed in the last column. Note that the Application column corresponds to the Switch framework components, and is not sequentially aligned to the proposed Solar Suburbs concept plan outlined above.

Solar Suburbs

Graphic 1: Conceptual outline of the key Solar Suburbs components



Solar Suburbs

Table 1: Switch Framework – Application to Solar Suburbs

Framework Component	Explanation	Example	Application to Solar Suburbs
(1) Direct the Rider (rational side)			
Follow the bright spots	Investigate what's working and clone it.	Jerry Sternin in Vietnam, solutions-focused therapy	Melb Council, Wilmot St Marrickville – *positive deviants*
Script the critical moves	Don't think big picture, think in terms of specific behaviours.	1% milk, four rules at the Brazilian railroad	"Get a quote from xxxxxx website"
Point to the destination	Change is easier when you know where you're going and why it's worth it.	"You'll be third graders soon," "No dry holes" at BP	"Create a Solar Suburb" via every viable individual households implementing solar PV
(2) Motivate the Elephant (Emotional side)			
Find the feeling	Knowing something isn't enough to cause change. Make people feel something.	Piling gloves on the table, the chemotherapy video game, Robyn Waters's demos at Target	• Before vs after aerial shots by suburb (ie with PV overlay). • Nominate a free system for the club / school / church for every X systems installed. • Signs at bus stops / café strip / train station
Shrink the change	Break down the change until it no longer spooks the Elephant.	The 5-Minute Room Rescue, procurement reform	One house at a time. "It only takes one house to power the future. It could be yours". - graphic visualisation tool?
Grow your people	Cultivate a sense of identity and instill the growth mindset.	Brasilata's "inventors," junior-high math kids' turnaround	"We are [*suburb*]. We are all creating the future now".
(3) Shape the Path (clear the way to enable success / shorten the distance)			
Tweak the environment	When the situation changes, the behavior changes. So change the situation.	Throwing out the phone system at Rackspace, 1-Click ordering, simplifying the online time sheet	(1) Letter # 1 with Sticker to place in house window (2) Letter #2 with either Solar Suburbs plaque for existing PV installations or further info for interested households. (3) Send Plaque to houses with solar PV installed (4) Letter #3 to houses without solar PV, with Plaque application form and weblink reminder.
Build habits	When behavior is habitual, it's "free"—it doesn't tax the Rider. Look for ways to encourage habits.	Setting "action triggers," eating two bowls of soup while dieting, using checklists	3-point plan in local paper / online
Rally the herd	Behavior is contagious. Help it spread.	"Fataki" in Tanzania, "free spaces" in hospitals, seeding the tip jar.	"XX% of houses in [*suburb*] have already taken action. We are already on the way to the future".

Sample Solar Suburbs window sticker

Sample Solar Suburbs window sticker

Solar Suburbs

Sample photo 1: Safety House letterbox sign

Sample photo 2: Neighbourhood Watch letterbox sign

Appendix G - “Internal briefing note: proposed Solar Suburbs model”

(Solar Suburbs, 29 March 2016)

Solar Suburbs

INTERNAL BRIEFING NOTE: PROPOSED SOLAR SUBURBS MODEL

Campaign name: Solar Suburbs

Campaign purpose: To increase the diffusion of solar PV systems across residential rooftops in target areas (such as suburbs or postcodes) by simultaneously targeting both individual households (**Stream 1**) and members of community groups (such as schools, churches, sporting clubs – **Stream 2**) in the same target area.

Short description: There are two main streams, with the key purpose (*italics*) and activities of each being:

Stream 1: Individual households

To apply social norm-based instead of rational-based mechanisms that positively influence large numbers of individual households to proactively install solar PV on their rooftops.

In a two-stage process, households are invited by a "small ask" to make a small public display of their interest in a clean energy future (such as placing a sticker in their window or signing an online and public petition). Households are then given information on how to procure a solar PV system and invited via a "bigger ask" to install a system via a straightforward process and easily accessible tools.

Then, once the system is installed, the household may apply for a plaque to place on their letterbox, signifying that a proportion of their electricity is generated via solar power.

Stream 2: Community groups

To apply community-based social marketing techniques within community groups to encourage group members to take the desired action under Stream 1 as a result of peer dynamics that operate within community groups.

Prior to Stream 1 commencing, the Solar Suburbs program manager has identified and recruited community groups in the area that own or operate a building, such as schools, childcare facilities, churches, sporting and other clubs.

The leader or champion within each group is briefed and given collateral that refers to Stream 1, and exhorts their members to participate in order for the group and its building to receive a free solar PV if X number of members sign up to Stream 1 and reference their preferred community group.

It is anticipated that the campaign is implemented by the Solar Suburbs program manager and will have either active or passive support from the relevant local government authority (Council) as required, as well as policy, legislative and/or other support as required from the State government.

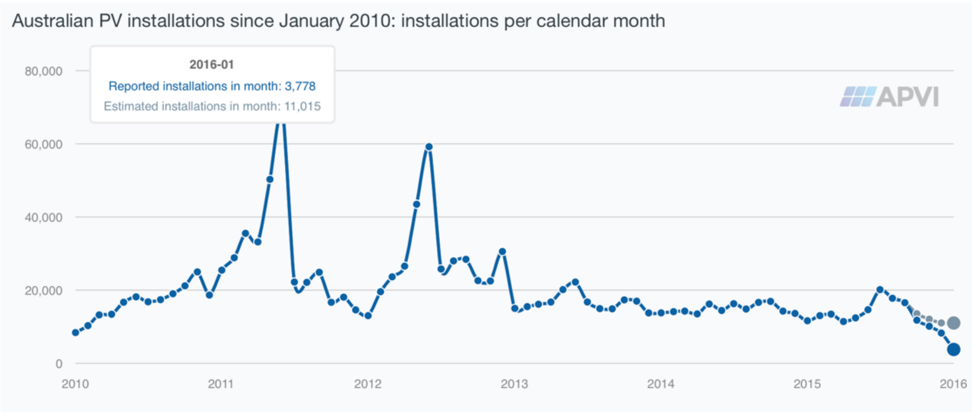
Background:

Solar PV is proven technology and commercially viable, with the cost to implement and corresponding return on investment improving continuously.

Diffusion rates – also known as penetration, density or take-up – range between 8.7% (in Northern Territory) and 29.6% (in Western Australia. Source: APVI, available from: http://pv-map.apvi.org.au. Accessed: 20/03/16) across Australian States, driven by a number of factors including state-based feed-in-tariffs (FiTs) which have allowed participating households to derive an income stream from feeding solar power generated by their own solar PV system to the electricity grid.

It could be argued that, following initial take-up by "early adopters" a large proportion of solar PV systems have been installed by those motivated by the financial incentives provided by the FiTs.

A number of states have either reduced or rolled back FiTs completely, sending a message to Australian households that solar PV is less economically viable than previously. Whilst there may be a number of factors that influence a household's decision to install solar PV, the rate of installation growth has slowed since the twin peaks of 2011 and 2012 (see graphic, below), reflecting the closures of the Solar Bonus Schemes in NSW and QLD, respectively.



Our research indicates that the return on investment for implementing household solar is continually improving as technology becomes more efficient and the capital cost of solar PV systems reduces, even in the absence of FiT shemes.

There is therefore an opportunity to "activate" qualifying households (those that may legally and practically install solar PV on their rooftop) that have not installed solar PV so that they are motivated by reasons other than a FiT to install solar PV.

Therefore, in the absence of strong FiT schemes which entice households via financial incentives, and in order to maximise the potential take-up via a co-ordinated campaign, there is an opportunity to introduce innovative social norm-based mechanisms that could further encourage households to decide to install solar PV.

Activities: Stream 1

Activities: Stream 1			
Item no.	**Activity**	**By whom**	**Details**
1	Engage Local Council	Solar Suburbs Program Manager (SSPM)	n/a
2	Identify campaign boundary	SSPM / Council	Agree target suburb(s) and/or postcode(s) Agree methodology for measuring boundary (eg postcode search by Google maps or Council-issued map).
3	Agree baseline and set target	SSPM / Council	Identify number of existing solar PV installations. Identify any existing Council-led solar PV targets for residential households. Set target with Council.
4	Prepare campaign collateral	SSPM / Council	Tailor template documentation, including window sticker and letter to households.
5	Distribute collateral	SSPM	Tailored to local area, if required

Rationale: Stream 1

The activities undertaken in relation to individual households are designed to have the following outcomes:

- ***Result in large concentrations of individual households affixing a small sticker to one of their front windows with a neutral message indicating their support for a clean energy future.***

  The theory underpinning this is the 'foot-in-the-door technique' (Freedman & Fraser, (1966)) which suggests that, once a homeowner has agreed to a small, token action, there is more likelihood of success when it comes to asking for a larger, related commitment. It also helps to build or rebuild local identity as the sticker signifies other constituents with similar community-minded identities.

- ***Result in high uptake of solar PV installations through the deployment of letterbox plaques that signify that a household has installed solar PV.***

  The letterbox plaque is the trigger for the 'spatial neighbour effect'. The rationale is that residents or households are more likely to act in a certain way, by installing solar PV (the "bigger ask"), if their neighbours had taken the desired action – more so than if there were a financial or environmental benefit for doing so such as lower bills or helping to save the environment (see Graziano, M., and Gillingham, K., 'Spatial patterns of solar photovoltaic system adoption: the influence of neighbors and the built environment', J Econ Geogr (2014).

  The letterbox plaque is a visual tool which has the effect of signaling to neighbours that the household has taken socially-desirable action, similar to households volunteering for the Safety House and/or Neighbourhood Watch schemes which were also symbolised by letterbox plaques.

  The premise for the Solar Suburbs plaque is therefore twofold:
  (i) It draws attention from street-level to the roofspace where solar PV installations may be less obvious to neighbours or passers-by, and

(ii) It encourages the spatial neighbour effect, coupled with a strong sense of local identity, by signaling that the household has undertaken positive action befitting a good constituent of [suburb].

Activities: Stream 2

Activities: Stream 2			
Item no.	**Activity**	**By whom**	**Details**
1	Identify target community groups	SSPM	E.g. school, church, sports club.
2	Recruit groups via leader or champion	SSPM	The leader or champion is either the person legally responsible for the operations of the entity (e.g. Principal, Minister or church Council, club Captain)
3	Initial solar PV design	SSPM / supplier	The preferred supplier will do an actual and/or desktop design of solar PV system for the community group's building in order to inform capital cost and required number of group participants to activate the "free" offer.
4	Issue collateral to community group(s) and assist with coordination of communication timings.	SSPM	It is imperative that the individual group(s) are in a position to communicate to their membership immediately following the communication by Council in Stream 1.
5	Presentation to group	SSPM / Council	As required, in order to inform members and increase legitimacy of campaign.

Rationale: Stream 2 The activities undertaken in relation to members of community groups are designed to have the following outcomes:

- ***Result in a large proportion of group members publicly indicating their support for the group to "go solar" and/or carbon neutral if it could be implemented on a cost-neutral basis.***

  Group members are invited by the champion (e.g. school principal, minister, club captain) to sign a petition which is then distributed publicly around the group. The effect of the petition is that individual group members publicly declare that they will actively support the group to achieve solar / carbon neutral status where possible. No details about the Solar Suburbs scheme are given at this stage.

- ***Result in a large proportion of group members installing solar PV under stream 1 as a result of peer effects that require members to follow-through with their public commitments***

  The champion, in co-ordination with the Solar Suburbs program manager and following the communications to individual households under Stream 1, refers to the Stream 1 communications (which the members would have received) and exhorts members to participate in the Solar Suburbs campaign.

  Explicitly, members are motivated to do so on the basis that the group's building will receive a free solar PV system if X members subscribe to the Solar

Suburbs campaign (and indicate their membership of the group in question).

Implicitly, however, members are more likely to act because it is consistent with their earlier, publicly declared commitment to the group. It is therefore the role of the champion to incorporate the petition in communications with the group as appropriate to the dynamics of the group in question.

Activities: Program level

Activities: Program Level			
Item no.	**Activity**	**By whom**	**Details**
1	Nominate preferred suppliers	SSPM / Consultant	Intended to nominate up to 2 preferred suppliers based on quality, experience and after-care in order to ensure quality, reliability and a marginal revenue stream derived from individual installations in the form of commission (also known as an origination fee). Households must nominate one of the two suppliers on the application form for letterbox plaque in order to qualify.
2	Develop online platform	SSPM	Similar to Our Solar Future, the online platform is designed to be easily accessed, navigated and used by individual households to obtain a direct quote from one of the preferred suppliers.
3	Quality Assurance	SSPM / Consultant	Inspect minimum 10% of each supplier's installations
4	Monitor performance against targets	SSPM / Council	Track effectiveness of campaign in each target area using the applications for letterbox plaque as evidence of participation rates.

Rationale: Program

The Program level activities are undertaken primarily by the Project Manager and ensure that relationships with key stakeholders (e.g. Local government, State government, suppliers, community groups) are created and maintained effectively.

The Program level activities ensure that the outputs of Stream 1 and Stream 2 underpin and contribute to the achievement of the overall program or campaign goals, and that the organisational entity undertaking Program activities is continuously viable.

Appendix H - “FAQ Booklet” and “Promotions and Communications Strategy”

(MEFL, 2015)

Solar Power

What size do I need?

Finding the system that best suits your needs will depend on:

+ How much electricity you use (daily usage)
+ Your roof size, its orientation and shade
+ How many people live in your home and when they are home
+ Your budget

The table below provides estimates to help you consider what size system will work for you. For best value, aim for a system size which covers a third to half your daily electricity usage.

Rough Guide

System size	Solar starter	Solar couple	Family starter	Solar for 4	Serious solar
	1.5kW	2kW	3kW	4kW	5kW
Recommended for	Singles or energy smart couples	Couples and retirees	Energy-smart family	Average family with two kids	Big family
Daily solar power produced*	5.5kWh	7kWh	11kWh	14.5kWh	18kWh

* Average solar power generated each day, based on 3.6 solar hours. (You can compare this to your daily usage as a quick way of estimating how much of the electricity you use could be covered by solar power).

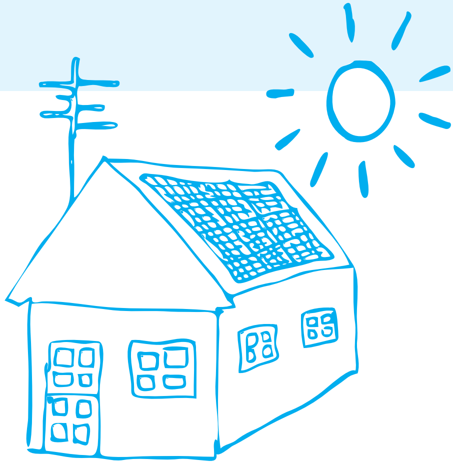
Installing Solar

Solar panels on your roof convert energy in the form of sunlight into direct current (DC) electricity. The DC power is then transformed by the inverter into 240V alternating power (AC) that is then is used in the house or exported to the grid. Your smart meter records both the energy consumed from the grid and also the electricity that is exported back into the grid for which the customer is eligible for a feed-in-tariff (FiT). The feed-in-tariff is reviewed annually. For up to date information visit: http://bit.ly/1JRFqGx

The best financial benefits of solar are achieved when most of the electricity generated is consumed at the site, as you then avoid paying your retailer your current electricity rate per kWh. Following the installation of a solar system, less electricity will need to be purchased from your electricity retailer, therefore decreasing your electricity bills. Any electricity generated but not consumed is sold back to the grid under a feed-in tariff (FiT) agreement.

The Process

1. Contact Positive Charge to arrange a quote from a tried and tested supplier



Call 9385 8555 or visit www.positivecharge.com.au

- Assess whether your switchboard and meter require upgrades
- Investigate tariff prices with your retailer

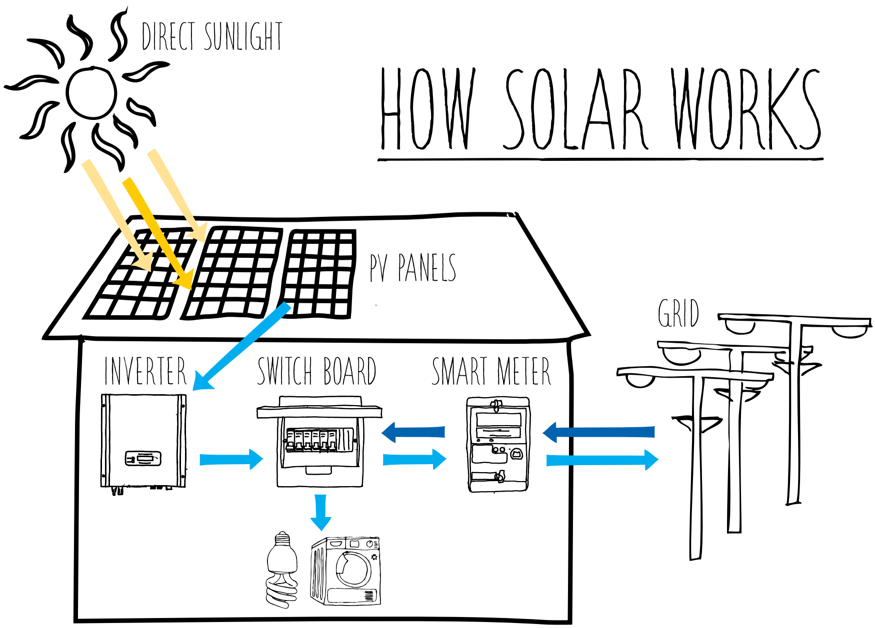
2. Accept quote & book installation day

3. Solar PV system is installed

Once finished the system installer will initiate paper work with your retailer and distributor.

4. Distributor changes over or reprograms smart meter (process initiated by your retailer) system is now fully installed

Note: any charges related to the upgrade of switchboard; meter changeover or meter reprogramming is additional to the cost of the solar PV system. It is recommended to get in touch with your distributor to determine what additional costs will apply.



Council and Positive Charge Solar Bulk Buy Program

Promotions and Communications strategy

Communications Objectives + Ensure that the community is aware that this is a council run program and Positive Charge is partnering with the council + Build on public trust of their council + Ensure that the community feels safe and informed about the process + Let the community know the benefits of installing solar – saving money and reducing pollution + Give the community a clear call to action of requesting a quote + Goal of 300+ households contact Positive Charge (with 20% conversion rate to installation) + Let people know that they can request a quote OR call Positive Charge with any questions or concerns about the program and the selected supplier
Target audience Due to the added complications of installing solar for renters, apartment owners and households with heritage overlay the initial target audience is home owners who do not fall under any of these categories. i.e. Home owners of houses with no heritage overlay. Households who are already curious about or have been considering installing solar will be the most receptive, so geographical areas where there is already some solar uptake are desirable – building on social norms.
Strategic approach The focus of the program communications is to drive a very particular call to action: for people to obtain a quote for solar from the Positive Charge selected supplier.
Key messages All the hard work has been done for you: + Positive Charge is trusted by the council + Positive Charge has conducted a rigorous procurement process + The components are of a high quality at a good price + The warrantees are valid + The selected supplier has a proven track record and is anticipated to be around for the long haul + Independent advice and support is on hand + Positive Charge can support you through the process should you need it + Solar is still worth considering – even with the low feed in tariff + Solar is not for everyone and the supplier will not pressure you into a purchase if it doesn't make financial sense for you
Media strategy This bulk buy presents a special offer for the community. It is important to get as much exposure of the offer out, so that people feel confident that it is legitimate and the program is normalised locally. Reinforcing council's involvement in the program will encourage trust in Positive Charge and in turn the selected supplier. Wherever possible we hope to promote the program multiple times in the below ways: + Council magazine / newsletter + Council website + Council email lists + Council offices and libraries (e.g. with digital slides on displays and flyers) + Council on-hold messages + Council stalls at local community events + Council social media sites

+ Council page in the local newspaper + Internal council communications to staff (offer is available to staff even if they live outside of the council area) + Editorial/ case studies in local media + Positive Charge e-news and EDMs + Positive Charge social media We also recommend at least one of each of the below: + Direct addressed letter from council to households, utilising council's database, explaining the offer + An information session about solar and energy efficiency
Councillor Spokesperson Mayor or other counsellor to be signatory on the letter and speak publically/to the media about the program whenever possible/appropriate
Evaluation + The effectiveness of the campaign will be initially measured by the number of households that contact Positive Charge + Households that purchase solar through the selected supplier will be measured in emissions reductions based on the installed system size + Follow up with households that did not purchase through the selected supplier will be conducted to ascertain whether or not they installed solar through a different supplier, allowing emissions reductions to be calculated where necessary

Council and Positive Charge Solar Bulk Buy Program

Promotion activities and timelines

Timeline	Activity	Communications tools/channel	Responsibility
Prior to launch	Email announcing program and offer to households	Council database, Council Staff and PC database in LGA	Content – PC Publication - council
Launch	Article/Case Study in Council Magazine	Council Magazine	Content – PC Publication - council
Week 1 (ongoing)	Online information and link to PC sign up page	Council website – in as many places as possible	Content – PC Publication - council
ASAP and throughout program duration	On-hold message	Council on-hold telephone message	Content – PC Implementation - council
ASAP and throughout program duration	Digital slides	Digital slides at council offices and in any council buildings, eg libraries	Content – PC Publication - council
ASAP and throughout program duration	Flyers	Flyers in council offices and council buildings. Where possible sent to local schools and sporting clubs	Content – PC Publication and distribution- council
Week 1	Online	Information on positivecharge.com.au projects and drop down on sign-up page Latest News on PC website	Positive Charge
Week 1 (Ongoing at least weekly)	Social media	Council and PC Facebook and Twitter – share/retweet/'like' reciprocally	Content – PC Publication – council and PC
As scheduled and whenever possible throughout the program	EDM	Internal and external email (or content within email) through council channels	Content – PC Publication – council and PC
As appropriate	Flyers at community events	Council to ensure flyers for program are available at council stalls at community events	Content – PC Publication – council and PC
Week 2	Email to PC mailing list in council area	EDM announcing offer and link to sign up page	Positive Charge
Week 2	Direct addressed mail to select suburbs (approx. 10,000 owner-occupiers)	Letter signed by Councillor/Mayor Written and designed by Positive Charge including case study and reply paid envelope with slip to send back. NB: Council comms to approve	Content and costs – PC Distribution – council to provide data or manage through mail

			house
Week 2 and then fortnightly	City News or similar council page in local paper	Sentence or two about offer and details to contact PC or sign up	Content – PC Publication - council
Week 2 and ongoing	Promo slides	Council offices, Libraries	Content – PC Publication - council
Week 3	Info session (optional)	Solar bulk buy Information Session run by PC	Content and delivery – PC Promotion, booking venue and any catering - council
Week 4	Direct mail to select Suburb (approx. 10,000 owner-occupiers)	Letter signed by Councillor Flyer designed and supplied by Positive Charge including case study and reply paid envelope with slip to send back	Content and covering costs – PC Distribution – council to provide data or manage through mailhouse
As scheduled	Article/Case Study in Council Magazine	Council Magazine	Content – PC Publication - council
Week 10	Email reminder	Reminder email to Council Staff	Content – PC Publication - council
Monthly	E bulletin	Offer launch Follow-up: case study – closing soon	Content – PC Publication - council
Week 12 (or next publication)	Article in Council Magazine (with case study)	Council magazine	Content – PC Publication - council

Appendix I - Business Model Canvas for Solar Suburbs

Business Model Canvas & Sections of a Business Plan

KEY PARTNERS / PEOPLE & OPERATIONS

Who are our Key Partners?

Govt, Council, CE Groups (eg schools, clubs, churches)

Who are our key suppliers?

Which Key Resources are we acquiring from partners?

Funding, a market, media & comms

Which Key Activities do partners perform?

Publicity, lead

KEY ACTIVITIES / OPERATIONS

What Key Activities do Value Props require?

Run campaigns increase uptake of PV. Streams

- Council (liaise / recruit)
- Supplier (procure)
- Community
- implementation
- mgmt.
- training / franchise

Distribute info / stickers / plaques. Recruit Group, leaders & champions. Agmt w PV suppliers.

Our Distribution Channels? Council & Groups

Customer Relationships? Web / P2P or Group

Revenue streams? Per-plaque commission from supplier(s), council fee, govt funding, startup prizes.

KEY RESOURCES / OPERATIONS

What Key Resources do our Value Propositions require? Stickers, Plaques, web, customer interface

Our Distribution Channels? Council, Groups, Installers, web.

Revenue Streams? Application form for plaque as evidence of program. Invoice supplier accordingly.

VALUE PROPORSITION / MARKET & SOCIAL IMPACT

What value do we deliver to customer? Satisfy social norm (desirability of PV & letterbox plaque), facilitate 3rd p. transaction, free RE for community grps, access to customers for PV suppliers.

Which customer problems are we helping to solve? Access PV solutions, make easy & fun to do right thing, overcome barriers, help councils/govt achieve targets.

What bundles of products and services offering to each Customer Segment? Product-based commodity (plaque)

Free PV system for Group.

Cohesion for community.

Which customer needs are we satisfying? Social status, conformity with social norm. Desire for clean energy (?), energy security, reduced energy bills.

CUSTOMER RELATIONSHIPS / MARKET

What type of relationship does each of our Customer Segments expect us to establish and maintain with them? Supplier-Rep (PV suppliers), Program partner (Councils), Desired brand (indiv houses), Expert enabler (Groups).

Which ones have we established?

How are they integrated with the rest of our business model? Group-facing relationships / activities most time- and resource-demanding.

How costly are they?

CUSTOMER SEGMENTS / MARKET & SOCIAL IMPACT

For whom are we creating value?

State, Councils, Community (macro), Groups (micro), PV suppliers.

Who are our most important customers?

Individual households

KEY ACTIVITIES / SOCIAL IMPACT, FINANCE & MARKET

Through which Channels do our Customer Segments ***want (??)*** to be reached? Council mailout, P2P (Group-based), street graphics.

How are we reaching them now?

How are our Channels integrated?

Which ones work best?

Which ones are most cost-efficient?

How are we integrating them with customer routines?

COST STRUCTURE / FINANCE

What are the most important costs inherent in our business model? HR (time/expertise/admin), Cost of Sales (travel, pitching, recruiting), IT (CRM database, web page, software), product materials (stickers/plaques).

Which Key Resources are most expensive? HR, Product, Sales function.

Which Key Activities are most expensive? Sales.

REVENUE STREAMS / FINANCE & MARKET

For what value are our customers really willing to pay? PV suppliers pass on benefit derived from lead generation (origination or BD fee) and scale (benefit to household). PV supplier becomes the customer.

For what do they currently pay? Willing to pass on benefit derived from lead generation (origination or BD fee) and scale (benefit to household) but this is currently being retained by suppliers through lack of sales.

How are they currently paying? n/a

How would they prefer to pay? As above