Household Energy Report
West Belconnen

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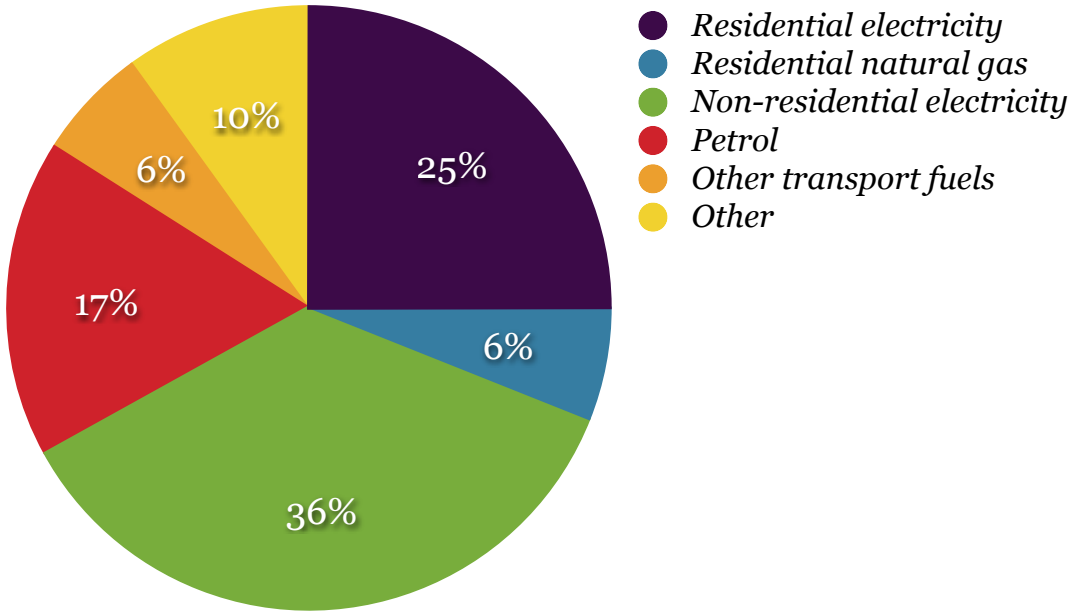
1. Introduction

There are significant energy efficiencies and greenhouse gas emission reductions achievable within the context of West Belconnen's residential sector.

In 2009-10 the residential sector in Australia accounted for 26% of total net energy use (ABS, 2012). This includes household energy usage and petrol for transport.

More recent data specifically for the ACT (Table.1) shows that greenhouse gas emissions arising from energy use (both gas and electricity) in the residential sector account for 31% of total emissions, with emissions from petrol contributing an additional 17% (ICRC, 2013).

Table 1. ACT Share of emissions by source, 2010-2011



Source: ICRC (2013)

The ACT Government has set ambitious reduction targets in line with the international scientific consensus on global warming. These include an overall zero emission target by 2060 as well as a 90% renewable energy target by 2020 (ACT, 2012).

In line with its vision to create a sustainable community of international significance, West Belconnen embraces these targets and will contribute towards them. The development intends to be accredited as a 6 Star Community by the Green Building Council of Australia's Green Star Communities Pilot scheme and aims to meet their residential energy criteria, which are highlighted in the relevant sections of this document. The development is also conscious of the benefits that would accrue if these criteria can be exceeded and will explore and every opportunity to do this. West Belconnen will develop a mix of on-site distributed generation including rooftop solar PV and building integrated solar (BiPV) at the household level and larger scale ground-mounted solar PV or 'solar farm' within the suburb. Other innovations may be incorporated and /or evolve over time based on various factors including community needs, technology and economics.

There is an extensive array of commercially viable building design and construction methods as well as energy saving and energy generating technologies and innovations that will be deployed. This report will outline the proposed housing construction methods for West Belconnen which are specifically designed to reduce energy usage and deliver on-site energy generation. It also identifies a range of end-use energy efficiency measures.

Together these measures will result in significant environmental benefits over time through reductions in greenhouse gas emissions as well as generating economic benefits for households through reducing household energy bills. According to ABS (2012) households in the ACT spend on average $109 per week on energy, of which $49 was for residential consumption and $60 was spent on transport. This represents the highest expenditure on residential energy of any state or territory (the average is $39) while transport energy spending by householders in the ACT is on par with the national average. It is anticipated that the West Belconnen residents will have minimal household energy bills and in time may be generating income from solar electricity generation.

Household energy usage and spending on fuel for transport purposes are both addressed. The report details a range of strategies designed to reduce the total volume of car journeys and encourage car sharing. And finally, West Belconnen positions itself as an early adopter and promoter of electric vehicle technologies.

2. Housing Construction

11,500 dwellings will be constructed in West Belconnen over 40 year period in line with cutting edge sustainable and green housing methods and technologies. A range of design strategies for energy-efficient buildings will be implemented. These will vary according to the site location, the approach taken by architects and builders and the availability and cost-efficiency of technologies over time. All dwellings will achieve a minimum 6 star energy efficiency EER rating with 7 stars being the objective.

20% of dwellings will be designated as affordable housing (in line with the ACT government's affordable housing policy). At this end of the market there is recognition of budget constraints and West Belconnen will look at ways of optimising energy performance and efficiency while simultaneously keeping costs down. The volume of dwellings being constructed and supply chain optimisations will both support economies of scale. The project also undertakes to educate the community about the whole of life costs of sustainable housing whose ongoing running costs are significantly reduced. This may extend to working with financial institutions to develop mortgage and financing arrangements that are geared accordingly.

A precinct code will enable West Belconnen to establish and supervise precinct-specific building construction and performance requirements. The code can provide guidance on affordable design and construction as well as end-use energy efficiencies.

2.1 Materials

Builders and developers at West Belconnen will be encouraged to source sustainable materials with low embodied energy wherever possible. Tools such as those provided by the Ecospecifier website will be used to preference products that carry sustainable certifications such as Greentag or Green Star ratings.

Professionals will be made aware that consideration needs to be given to distances that materials travel to the site, with a preference for regional sourcing to reduce transportation costs and related greenhouse gas emissions. Environmental and cost efficiency gains can also be expected through advanced supply chain management solutions to improve importation, storage and distribution processes for materials.

Opportunities for developing in-suburb eco businesses which manufacture sustainable housing materials and/or prefabricated homes will be actively encouraged. There is a strong economic incentive here given the captive market within the suburb over the next 40 years and the wider opportunity to supply the eastern Australian seaboard.

As the on-site solar farm becomes operational it will be able to provide locally generated zero emission electricity for housing construction needs.

2.2 Construction Methods

A range of sustainable and green housing methods will be encouraged and deployed. These may include solar orientation strategies for solar passive homes, and a range of building shell and ventilation strategies for 'Passivhaus' homes (see box below for more details). Experimentation will be encouraged, allowing for innovation and new sustainable housing construction methods to be explored, developed and implemented over time.

'Passivhaus' is a building approach, pioneered in the 1980's in Central Europe. Not to be mistaken for 'passive solar' design, Passivhaus refers to 'a building in which a comfortable interior climate can be maintained without active heating and cooling systems' (Weizsacker et al, 2009).

Passivhaus building performance is achieved through a set of four core design elements, with solar orientation not being one of them. Firstly Passivhaus buildings exceptionally air-tight to the tune of maximally 0.6 Air-Change-per-Hour (0.6 ACH50), tested with the help of a blower door at a pressure differential of 50 Pascal [Pa]. Secondly, Passivhaus buildings have a seamless thermal envelope, meaning that they are circumferentially insulated, have hence no thermal bridges such as from concrete or steel structures that penetrate the envelope, and feature mostly triple-glazed windows & doors. In addition Passivhaus buildings depend on external shading to prevent overheating. This is best achieved with adaptive blinds or screens. Passivhaus buildings also feature an energy recovery ventilation system to supply filtered fresh air during times of adverse climatic conditions when windows should not be opened. Finally Passivhaus buildings employ only very-high-efficiency lighting and appliances, including heat pump technology for hot water.

Buildings in West Belconnen will be designed and constructed to take advantage of building-applied (BAPV) as well as building-integrated (BIPV) solar photovoltaic technologies. While BAPV technologies are typically added to a conventionally constructed building, BIPV form an integrated part of the building envelope (e.g. as facades, roofing tiles or shingles, shading devices, glazing on windows or skylights), therefore displacing some conventional building materials. BIPV has the potential to enhance the design values of the buildings and can offset the initial cost of conventional BAPV by reducing the amount needed on regular building materials and associated labour.

Close attention will be paid to advances in solar technologies and efficiencies and each development stage will incorporate next generation technologies as they become commercially viable.

2.3 Continuous Improvement

Residential housing construction will roll out in stages, with Stage 1 involving the construction of 300 dwellings proposed to commence in 2016, followed by Stage 2 and so on. Overall a total of 11,500 dwellings are planned for West Belconnen over a 40 year period.

Each stage will build upon lessons learnt in previous stages as well as incorporating new advances in construction methods and technological and product innovations. Where possible, consideration will be given to ensuring early stage homes can be retrofitted with new advances in technology as they become viable.

Initial stages will incorporate demonstration homes and a builder display village to showcase construction methods and to facilitate training and up-skilling of tradespeople in areas such as ‘Passivhaus’, BiPV and BAPV. There will be significant local employment opportunities as well as a range of proactive strategies to engage local people in the Belconnen area who are currently unemployed or underemployed.

It is intended that methods used will be replicable in other parts of the territory and country, increasing the sustainable housing knowledge base and capacity.

3. Household Energy Generation

West Belconnen is aiming to meet the Green Star Communities criteria which proposes that at least 30% of the annual household electricity needs are met through on site power generation systems.

3.1 Home Solar

Buildings will be fitted with solar power generation capacity as part of their original building design, either as building integrated solar PV (BIPV) or else as conventional building applied solar (BAPV) as discussed in Section 2.2. It is expected that site orientation and architectural design considerations will decide the appropriate technology on a project-by-project basis.

Over-production of solar power will be exported to the local electricity grid, particularly with Stage-1 buildings when in-home battery storage might not yet be the norm.

3.2 Home Solar Storage

In line with ACT government's Next Generation Solar strategy, West Belconnen proposes to install solar energy storage systems into homes as they become viable. Grid connected battery storage systems located within homes can achieve higher levels of energy self sufficiency.

This is another area of rapid technology development which will be monitored closely as the stages of development progress with next generation technology being introduced as it becomes commercially viable.

3.3 Solar Farm

Land has been allocated within the West Belconnen suburb for the early stage development of a solar farm, with a potential capacity of around 1-2 MW. Connected to the main grid this will provide solar power generation for the suburb early on and

may contribute renewable energy for construction purposes. Additional solar farms are planned to follow as the development rolls out.

The solar farm will operate under a community investment and ownership model that is currently being developed.

Through these measures West Belconnen will contribute to ACT's 90% renewable energy target by 2020 and support the positioning of the ACT as Australia's Solar Capital. Over time it is anticipated that the suburb will make a significant contribution to the volume of in-territory renewable energy generation.

3.4 Grid Electricity

Green Star Communities credit criteria reward reductions in the greenhouse gas emissions intensity of the energy supply against a business as usual baseline.

For all household energy consumption that derives from the grid (net of any grid-connected solar farm production) the project commits to funding the cost of the 100% renewable energy option under Actew AGL's Greenchoice scheme for at least the first ten years.

In this way and through the investment in solar energy generation outlined above, West Belconnen will ensure 100% renewable energy and zero greenhouse gas emissions for residential energy consumption from the outset.

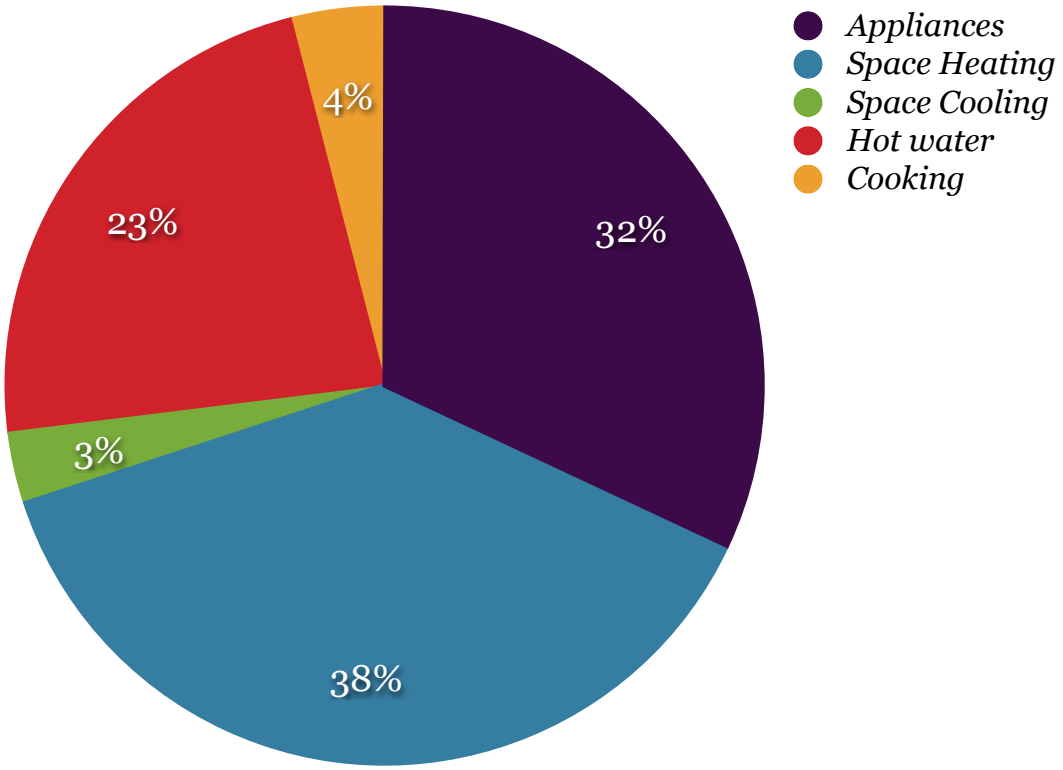
3.5 Gas

At this stage the need for gas piped to each home is questionable and would have consequences for greenhouse gas emissions which would need to be considered and mitigated. Therefore the option is there not to connect gas into the suburb if it does not prove necessary.

4. Household Energy Usage

Alongside sustainable housing construction and on-site energy generation, efficiencies in household energy usage represent the third plank of West Belconnen's ambitious household energy equation. Attention will be paid to reducing consumption levels in each area of residential energy usage and the development intends to satisfy the Green Star Communities criteria which recognises reductions in peak electricity demand of 25% compared with business as usual baselines.

Table 2. Australian residential energy in 2007 by major end uses



Source: DEWHA (2008)

4.1 Space Conditioning

Space heating and cooling represent the largest proportion of residential energy use in Australia. In 2007 they accounted for 41% of total energy consumption. Space heating accounts for the bulk of this, with space cooling only comprising 3% of energy consumption, as indicated in Table 2.

West Belconnen's sustainable housing construction methods are intended to dramatically reduce the need for active space conditioning. Each home will achieve a minimum 6 star energy efficiency rating (EER) for thermal performance, with the objective of reaching 7 stars, in accordance with the ACT House Energy Rating Scheme (ACTHERS). The maximum thermal loads for each star rating are detailed in Table 3.

Residences may still feature a small reverse-cycle air-conditioning unit as back-up for prolonged extreme weather conditions or to make up for sub-optimal building designs on over-shadowed blocks of land.

Table 3. EER Star Criteria for Canberra (showing maximum thermal energy loads in MJ/m2)

	6	6.5	7	7.5	8	8.5	9	9.5	10
Canberra	165	142	120	99	77	56	35	17	2

Source: NatHERS (2014)

4.2 Hot Water

Hot water may be generated in a range of ways; using electricity from on-site solar, direct solar thermal or advanced heat pump technology (see the box below for one example).

Installation of water efficient appliances such as front-loading washing machines, efficient dishwashers & low flow shower heads will reduce the overall volume of hot water being used.

CO_2 Heat Pump - Hot Water System

This is an electrical high-pressure heat-pump system which operates using super-critical carbon dioxide (CO_2). These innovative CO_2 heat-pump hot water systems operate when temperatures are as low as -10°C and outperform solar thermal hot water systems energetically as well as economically. In addition, they operate using solar PV electricity and provide bacterially safe water at 65°C at all times.

4.3 Appliances

Household appliances are responsible for an increasing proportion of energy consumption in residential homes. It is forecast that by 2020 energy used by electrical appliances will almost match space heating as the largest single end use in the Australian household (DEWHA, 2008). In many sustainable homes the need for space-heating is virtually nonexistent, hence hot water and appliance energy consumption will dominate.

Compared to a decade ago, the energy consumption of appliances can be reduced by more than 50% by implementing best available appliance technologies (Weizsacker et al, 2009). All homes will be fitted with energy efficient appliances available at the time of fit out, as indicated by the Australian Government's Energy Rating Labelling Scheme. Energy efficient, highly responsive induction stovetops will enable electricity to be used for all cooking needs.

4.4 Lighting

The IPCC's 2007 report highlighted that 'lighting energy use can be reduced by 75 to 90% compared to conventional practice through (i) use of daylighting with occupancy and daylight sensors to dim and switch off electric lighting; (ii) use of the most efficient lighting devices available; and (iii) use of such measures as ambient/task lighting.

Natural light within West Belconnen homes will be maximised through orientation of the buildings as well as careful placement of windows and skylights.

Daylight and occupancy sensors will be deployed in public building spaces and energy efficient lightbulbs such as light emitting diodes (LED's) will be installed throughout all buildings. LED's use significantly less power per unit of light generated and need replacing less often. The average LED lifespan is 50,000 hours compared with compact fluorescent (CFL) lifespan of 8,000 hours. LED technology is an evolving area of innovation which will be monitored to ensure household lighting efficiency gains continue to keep pace with advances in technology.

Within the outdoor areas and gardens of residential homes, solar garden lighting will be installed.

4.5 Smart Meters

Each house will be installed with a smart meter for monitoring energy consumption in real time, enabling home-owners to locate areas to target for energy efficiency.

Next generation wireless-interactive smart meter technology will be rolled out as it becomes available and commercially viable. This may include smart meters which :-

- track energy generation by source
- monitor energy usage by individual appliances
- enable residents to manage energy use (at home and away from home) via a tablet or smart phone
- enable residents to turn off all appliances at once (except those programmed to stay on) when they leave their homes in order to reduce standby and lower power mode energy usage

5. Household Transport Energy

5.1 Reducing Car Trips

As part of creating a sustainable community in West Belconnen there is a commitment to generating a thriving local economy with significant levels of local employment. It is envisioned that this will reduce the total number of people needing to commute out of the suburb for work. In addition a digital business hub and co-working space will be established in order to encourage tele-working options.

Developers will fund early stage implementation of public transport into the suburb to stimulate usage patterns. Urban planning within the suburb will create paths to encourage walking as well as an integrated cycle network for local trips and commuting.

5.2 Car Sharing

Collaborative consumption models of car sharing will be developed and implemented within the suburb to enable residents to car pool, car share or rent cars by the hour, thereby reducing the overall number of journeys and vehicles required. These may be formal car sharing schemes (e.g. Go Get) or informal ones (such as the one implemented by pioneering UK sustainable development BedZed). Smart phone app technology will facilitate the process of car sharing between neighbours and local residents. Consideration will also be given to a similar scheme for removal vans for people moving into and out of the suburb.

5.3 Electric Vehicles

Electric vehicle fueling capabilities will be rolled out in the suburb as they become commercially viable, ensuring that residents and visitors can take advantage of this option. Standard and rapid charger stations as well as battery swapping stations would be powered by locally produced solar farm electricity. Solar energy storage systems in homes are also expected to serve as in-house vehicle refueling stations.

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