



Low Carbon Growth Plan for the **Macquarie Park Precinct**

November 2011



Preface

ClimateWorks Australia (ClimateWorks) was founded in 2009 through a partnership between the Myer Foundation and Monash University, with a mission to substantially reduce Australia's greenhouse gas emissions over the next five years. ClimateWorks believes the practical steps required to achieve these reductions are more likely to be undertaken if presented in an easy to understand, overarching and cohesive climate change strategy for Australia.

In March 2010 ClimateWorks released the Low Carbon Growth Plan for Australia, which presents a range of actions to reduce greenhouse gas emissions at lowest cost across the economy. In August 2010 the Low Carbon Growth Plan for Australia was the national winner of the Eureka Prize for Innovative Solutions to Climate Change, presented by the NSW Minister for Climate Change and the Environment.

This report, the Low Carbon Growth Plan for the Macquarie Park Precinct, identifies least cost opportunities to reduce greenhouse gas emissions within the buildings in the precinct of Macquarie Park in Sydney, New South Wales. It is based on the opportunities outlined in the Low Carbon Growth Plan for Australia.

Specifically, this report aims to highlight the energy and cost savings that can be achieved from the implementation of the technologies available to building owners and tenants.

ClimateWorks hopes readers find this a useful contribution in understanding the energy saving technologies available and the financial benefits these technologies can provide.

Acknowledgments

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In addition, ClimateWorks gratefully acknowledges the contribution of the following individuals in preparing this publication:

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Key Findings

Building owners and tenants in the Macquarie Park precinct can significantly reduce their energy use - and hence the amount of money spent on energy bills - between now and 2020 using a range of widely available technology solutions that can be implemented at relatively low cost.

FOR MACQUARIE PARK'S COMMERCIAL BUILDINGS:

- ▶ \$24.4 million could be saved per year by fully implementing the opportunities identified in this report¹. This would also reduce the precinct's greenhouse gas emissions from commercial buildings by 42% each year.
- ▶ Three quarters of all opportunities can save money, even after taking into account the upfront costs.
- ▶ While the largest overall energy savings can be found by retrofitting buildings in the Offices and Education sectors, all of Macquarie Park's existing buildings can benefit from substantial energy savings of between 21% and 42% through improved energy efficiency.
- ▶ Macquarie Park can also reduce its dependence on grid supplied electricity by 27,900 MWh each year through the installation of cogeneration and mid-scale solar PV.
- ▶ A carbon price associated with Australia's 5% emissions reduction target would increase the volume of profitable opportunities available to Macquarie Park's businesses by 28%.

FOR MACQUARIE PARK'S HOMES:

- ▶ Investing in more efficient appliances, electronics and lighting will pay for itself through energy savings in less than 2 years. This would reduce emissions from Macquarie Park's households by 26%.
- ▶ Substantial new housing development provides an opportunity for Macquarie Park to reduce the energy needs of its housing stock above those achieved through BASIX², but this comes at a cost premium of \$24 per square metre.
- ▶ While a carbon price will be hardest felt by low income households, the carbon price package offers substantial support to assist these households to capture energy efficiencies to offset this impact.

1 Assuming an electricity price of A\$189/MWh and a cost of capital of 12.7%

2 Introduced by the NSW Government, BASIX, the Building Sustainability Index, ensures homes are designed to use less potable water and be responsible for fewer greenhouse gas emissions by setting energy and water reduction targets for house and units.

Whilst most of the opportunities identified in the Macquarie Park precinct already offer financial savings, there are a number of barriers which prevent these opportunities from being implemented.

For example:

- ▶ **CAPITAL CONSTRAINTS** – while some improvements such as lighting come at a low additional cost, other opportunities such as improving insulation are capital intensive.
- ▶ **LONG PAYBACK PERIODS** – opportunities that have long payback periods, such as water heating, are often perceived as non-critical to business.
- ▶ **TRANSACTION COSTS** – the cost of pursuing energy efficiency (gathering information, setting up financing, etc) is often higher for smaller businesses and households in relation to the financial benefits that the opportunities will generate.
- ▶ **SPLIT INCENTIVES** – when buildings are occupied by tenants or short-term owners, the capital invested by the owner to improve energy efficiency will be recouped in part by the tenant or the next owner, acting as a disincentive to investment.
- ▶ **INFORMATION GAPS** – businesses may not closely follow how much energy they use and the savings that could be achieved through improved energy efficiency.
- ▶ **DECISION PROCESSES** – even when full information about energy efficiency opportunities is available, a company's decision processes may make it difficult or impossible for managers to act.

This report demonstrates that reducing greenhouse gas emissions can be profitable for Macquarie Park's businesses, while also reducing energy consumption and dependence on grid-supplied electricity. Some financial savings can also be captured by Macquarie Park's residents.

But to ensure the full energy savings potential can be captured by 2020, businesses and households will require clear information and improved access to financial solutions, indicating a clear role for government, energy service companies and financial institutions in the implementation of these opportunities.

ClimateWorks hopes this report will provide a useful tool to enable Macquarie Park to capture the substantial energy savings available to its businesses and residents through improved energy efficiency and local generation of cleaner energy.

Methodology

All of the findings detailed in this report are based on the low carbon growth plan methodology used by ClimateWorks Australia. This approach identifies commercially available technology solutions to reduce greenhouse gas emissions and excludes:

- ▶ actions expected to occur under current policies³. (as these are captured in the business-as-usual case);
- ▶ changes to lifestyles or behaviours (e.g. driving less, or switching off lights or appliances when not in use);
- ▶ the transaction costs associated with implementing these opportunities (e.g. the cost of management time, energy audits or building contractors engaged to undertake the work), as these vary with the precise approach chosen for each opportunity.

Many findings are averaged across a range of businesses within a building type, or across a range of building types that could implement a particular technology solution, and therefore the actual savings that could be achieved by any individual business could vary from these findings.

Project Background

Macquarie Park is set to experience unprecedented growth over the next 20 years from 77,000 to 210,000 residents and workers. The demand on resources and space will be significant. In 2010 the Office of Environment and Heritage (previously the Department of Environment, Climate Change and Water), Sydney Water, the City of Ryde and Macquarie University agreed to collaborate to streamline access to support programs and encourage uptake of programs that reduce resource consumption, with the aim of assisting Macquarie Park to become an exemplar Green Precinct.

3 'Current policies' includes all policies and programs in effect in March 2010 when the Low Carbon Growth Plan for Australia was released, as this forms the basis for analysis of the energy savings potential of the various opportunities identified in this report. It includes the Renewable Energy Target but excludes a carbon price, as this had not been legislated at the time of release of this report. A brief desktop analysis of changes to policies and programs between March 2010 and February 2011 reveals few changes that would make a substantive difference to the opportunities identified. The largest impact is likely to come from the abolition of the insulation scheme, although our estimate is that this would increase the opportunity available through the 'Building envelope (basic)' opportunity by an order of magnitude of ~5%. Note that while the Commercial Building Energy Efficiency Disclosure program is expected to stimulate market demand for offices with improved energy efficiency, it does not set targets or minimum standards and therefore its impact on the overall energy efficiency of Australia's commercial building stock is difficult to quantify. The program has therefore been excluded from ClimateWorks' analysis of 'business-as-usual'.

THE IMPACT OF LIFESTYLE AND BEHAVIOUR CHOICES

This report explores only those opportunities focused on technology solutions, rather than those that require changes in the lifestyle or behaviours of individuals, such as turning lights off when leaving a room. This deliberate design choice allows for analysis of how much energy can be saved without requiring individuals to change their patterns of behaviour, which can be difficult to quantify and to measure success.

However, behaviour change still offers a large and often financially attractive means of reducing energy use. There are a variety of adjustments that individuals and businesses can make to reduce energy use and therefore save money, such as:

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- ▶ Reducing heating set temperatures on thermostats in winter, and raising set temperatures for cooling in summer
 - ▶ Switching appliances from standby to off when not in use
 - ▶ Switching lights off when leaving a room (if sensor systems not already installed)
-

Behaviour change efforts in organisations are often most successful when senior management voice a strong commitment to change, and demonstrate this by ‘walking the talk’ themselves. Recognising and rewarding positive behaviours, and ensuring energy use and energy savings data is clearly available to staff (ideally in a format that is readily understood by non-technical personnel) are also important to the success of behaviour change programs. Ultimately, the amount of energy saved will depend on the uptake of energy savings behaviours by individuals.

CO-BENEFITS

Not only can the actions presented in this report result in significant financial savings and minimise ongoing operating costs, they can achieve a number of co-benefits including:

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- ▶ Reduced greenhouse gas emissions, which enables Macquarie Park’s businesses to be prepared for future policy constraints and to contribute to national and global efforts to limit global temperature rises.
 - ▶ Reduced exposure to the impact of a carbon price (see page 18 for further detail on anticipated impact of a carbon price on the financial savings available through reduced energy use).
 - ▶ Increased workplace comfort for employees e.g. through better controlled heating and cooling systems.
 - ▶ Improved productivity, as demonstrated by recent studies in the United States that show that green buildings can deliver up to 10% increase in productivity and 40% decrease in sick days compared to average buildings, numbers corroborated in Australia by observations following a major green refurbishment at 500 Collins Street, a 30 year old building in Melbourne.
 - ▶ Improved property attractiveness to potential buyers and sellers, as programs such as the Australian Government’s mandatory disclosure of commercial office building energy efficiency increase consumer demand for more energy efficient buildings.
 - ▶ Reduced need for costly electricity supply infrastructure upgrades, through reduced demand for electricity from improved energy efficiency and distributed energy solutions.
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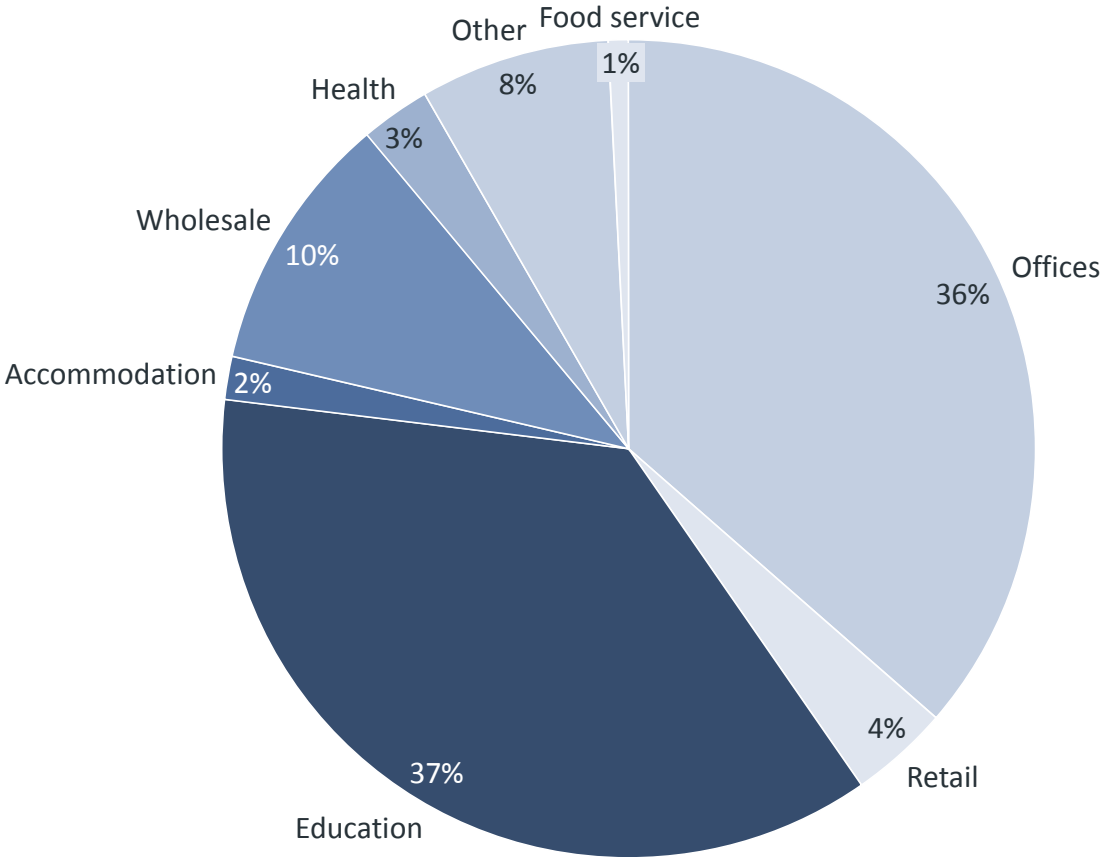


SECTION 1: Commercial Buildings

Business-as-usual energy use in Macquarie Park

The Macquarie Park business precinct is home to a range of businesses of various sizes. Exhibit 1 illustrates the broad cross section of activities that these businesses undertake, by comparing floor space by sector.

Exhibit 1 - Comparison of commercial building floor space by



Source: ClimateWorks team analysis, based on data inputs from Macquarie Park

Education and corporate activity (Offices) represent the largest share of activity in Macquarie Park in terms of floor space occupancy, followed by warehousing (Wholesale). Retail⁴, Health⁵, Food service⁶, and Accommodation⁷, also have a minor presence. Other buildings⁸ make up the remainder

4 Retail’ includes food retail (supermarkets, convenience stores and fresh food outlets) and non-food retail
 5 ‘Health’ includes GPs, hospitals, dentists, pathology/medical research facilities, and vet clinics
 6 ‘Food service’ includes restaurants, cafés, fast food outlets
 7 ‘Accommodation’ includes hotels, aged care, university student residential facilities
 8 ‘All other buildings’ includes community buildings, service stations, the train station, cinemas, Macquarie Park’s ice skating rink, non-tenanted areas in Macquarie Park Shopping Centre, the Energy Australia sub-station, and any other buildings that do not fit within one of the other classifications.

of the mix of business types in the MacQuarie Park precinct. A detailed breakdown of floor space by sector is included in Appendix 1: Key assumptions.

By 2020, it is expected that an additional 455,000 m2 of new build commercial floor space will be constructed across the range of building sectors.

Under business-as-usual, Macquarie Park’s commercial buildings are expected to consume 290,500 MWh and generate 615,000 tonnes of greenhouse gas emissions each year by 2020.

These emissions will be produced by energy (electricity and gas) consumed in heating and cooling, lighting, water heating, electronics and appliances.

The variety of different businesses and building types in Macquarie Park have a range of energy demands. Of the total energy expected to be consumed by Macquarie Park’s buildings in 2020, Offices are estimated to use the largest share (39%), followed by Education (28%) then the Health sector (12%).

Exhibit 2 - 2020 business-as-usual energy use in existing commercial buildings by sector and technology

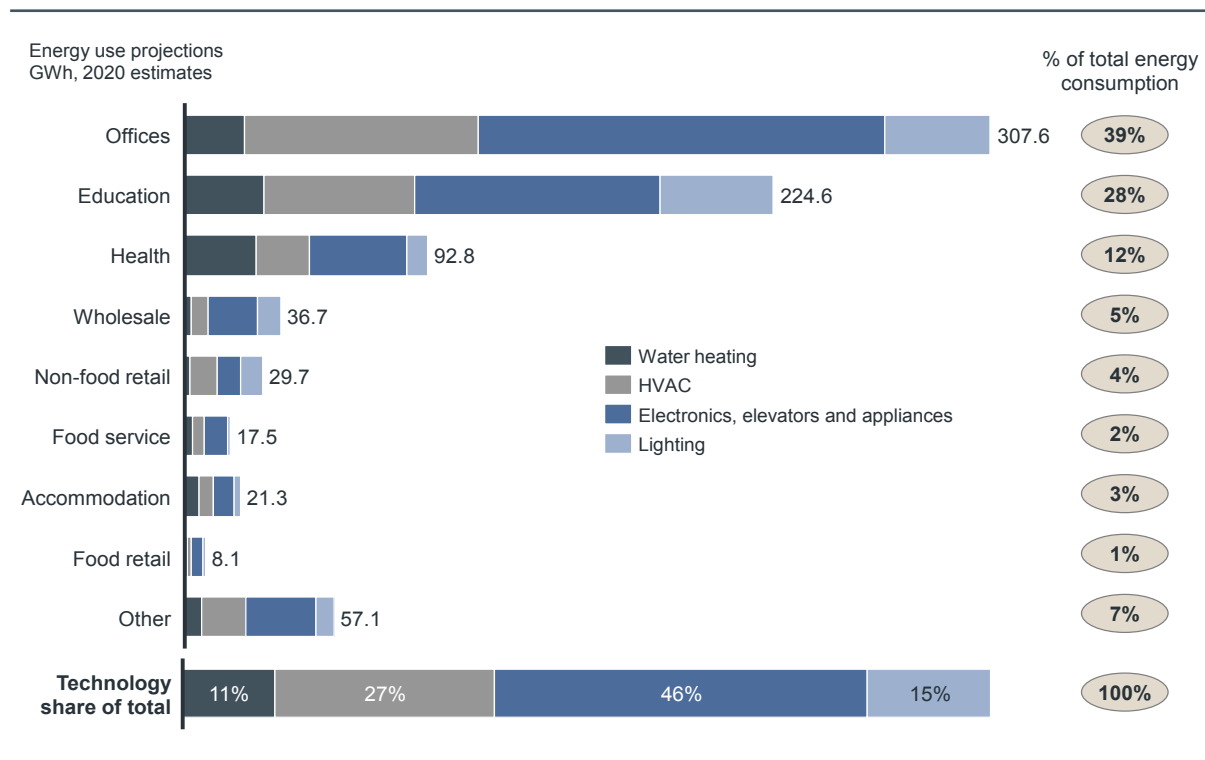


Exhibit 2 also demonstrates the expected 2020 business-as-usual energy use by technology type for each sector. A range of technology uses contribute to overall energy consumption, and this varies depending on the type of building and how it is used. Electronics and appliances (computers, printers, photocopiers, dishwashers, microwaves etc.) are expected to consume the largest overall share of energy (46%) across all sectors, followed by HVAC (heating, ventilation and air-conditioning) (27%), lighting (15%) and water heating (11%).

Australia has a relatively mild climate compared to other developed nations and this particularly true for the Sydney region. Buildings therefore require less energy for heating and cooling than other parts of the world, or even other parts of Australia. Coupled with comparatively cheap energy prices, this has led to a prevalence of poor efficiency equipment and inadequately thermally designed building shells. For Macquarie Park this means that significant energy savings can be achieved through adjustments to the built environment.



The Opportunity

Macquarie Park's commercial buildings have the opportunity to significantly reduce their demand for energy between now and 2020. In doing so, businesses generate combined financial savings of \$24.4 million each year. This would also reduce the precinct's greenhouse gas emissions from commercial buildings by 42% per year (259,300 tonnes). These savings can be achieved through a combination of energy efficiency measures and new distributed energy generation from lower emission sources.

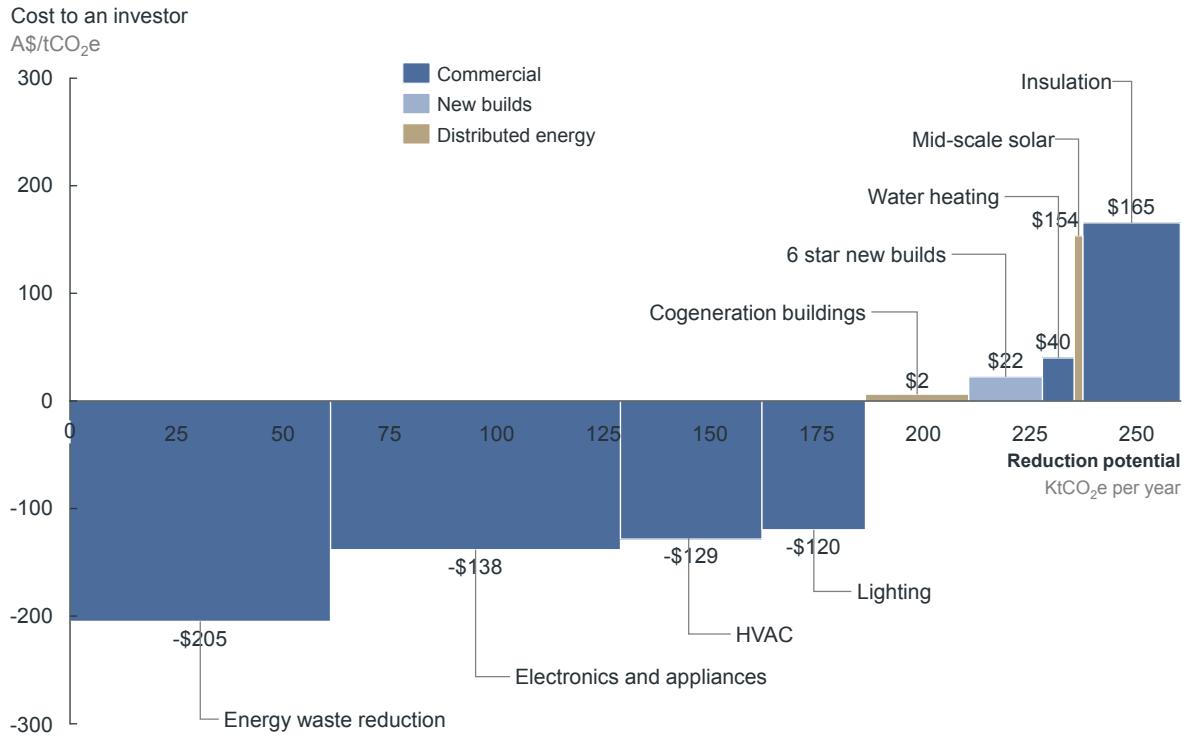
Macquarie Park's businesses could save \$24.4 million and reduce greenhouse gas emissions by 42% each year through energy efficiency and distributed energy.

Exhibit 3 illustrates the range of low cost abatement opportunities available to Macquarie Park's businesses and compares the annual net cost (in dollars per tonne of emissions reduced) of capturing these opportunities⁹. 72% of all opportunities – those that fall below the \$0 line in Exhibit 3 – can generate net financial savings for businesses and households in the precinct.

These opportunities are realistically achievable by 2020 using technologies that are already commercially available to reduce energy use or provide cleaner, less emissions intensive energy to Macquarie Park's buildings.

9 The net cost factors in the upfront capital investment which is annualised over the life of the asset, and deducts the financial savings earned each year.

Exhibit 3 - Macquarie Park commercial buildings 2020 greenhouse gas emissions reduction cost curve



Source: ClimateWorks team analysis, derived from the Low Carbon Growth Plan for Australia 2020 greenhouse gas emissions reduction cost curve with data inputs from Macquarie Park.

HOW TO READ THE GREENHOUSE GAS EMISSIONS REDUCTIONS COST CURVE

The greenhouse gas reduction cost curve summarises ClimateWorks’ estimate of the realistic volume and costs of opportunities to reduce Macquarie Park’s emissions. **The width of each box** represents the greenhouse gas reduction potential of an opportunity in kilotonnes (1 kilotonne = 1,000 tonnes) per year in 2020 compared to business-as-usual. **The height of each box** represents the average cost for that opportunity of abating one tonne of CO₂e (carbon dioxide equivalent) in 2020. All costs are expressed in 2010 real Australian dollars, and the graph is ordered left to right from the lowest cost to the highest cost opportunities.

The volume shown represents an assessment of realistic reduction potential (rather than the full technical potential for each opportunity) which takes account of labour and capital constraints.

However, we do assume that business and government are able to fully overcome the barriers to the capture of each opportunity.

Opportunities that appear below the horizontal axis offer the potential for financial savings even after the upfront costs of capturing them have been factored in. Opportunities that appear above the horizontal axis are expected to come at a net cost. All costs include the typical private cost of capital for each sector (8 to 14%), energy taxes and retail margins and subsidies, in order to illustrate the direct cost faced by a company or consumer to implement an emissions reduction opportunity.

However, project transaction costs (such as management time or consultancy fees) have not been included, as these can vary significantly depending on how the opportunity is captured.

ENERGY SAVING OPPORTUNITIES

Each opportunity illustrated in Exhibit 3 is outlined in detail in Appendix 1. Macquarie Park can save energy by improving the energy efficiency of existing buildings, and by constructing new buildings to a higher efficiency standard.

EXISTING BUILDINGS

Reducing energy consumption by retrofitting existing commercial buildings can be achieved through two key measures:

- 1. Improving energy efficiency through technology** – when current technology is due for replacement, choosing electronics and appliances, HVAC systems, lighting and water heating technology with a higher efficiency rating (compared to the existing) can reduce energy consumption, even without factoring in a change in how the technology is used. For example, switching to high efficient light bulbs reduces energy use without changing the number of lights or hours the lights are turned on for.
- 2. Reducing energy waste** – experience shows that significant savings can be achieved with minimal capital investment by getting rid of or downsizing unnecessary equipment. For example, downsizing a boiler or water heater, reducing the number of photocopiers or printers servicing an office space, or removing some light fixtures and redirecting those that are left to ensure equivalent light quality in a retail space. Energy waste reduction offers an average of 10% savings across all commercial building types. Improving a building’s insulation can also achieve substantial energy savings, reducing the energy required for heating and cooling by up to 20%.



NEW BUILDINGS

When new buildings are constructed – or existing buildings fully refurbished – to an equivalent of 6 stars in the GreenStar rating system, energy used for heating and cooling can be reduced by up to 40% (averaged across all building types).

Applying these energy saving measures could reduce Macquarie Park’s energy consumption by 40% (21,700 MWh) each year.

DISTRIBUTED ENERGY GENERATION

Distributed energy systems are small-scale power generation technologies used to provide an alternative to or an enhancement of the traditional centralised electricity supply. Installation of distributed energy systems within the precinct can help to reduce greenhouse gas emissions, reduce overall energy consumption (through cogeneration), reduce demand the need for costly grid infrastructure upgrades and increase long-term energy security for the precinct.

This report identifies two key opportunities for distributed energy in the Macquarie Park business precinct which together could reduce Macquarie Park's energy demand from the grid by 27,900 MWh each year.

COGENERATION

Cogeneration, also called combined heat and power or CHP, generates both electricity and heat in a gas-fired plant located close to or within the building(s) that will consume the energy generated. This reduces total energy consumed (as heat from the cogeneration plant can be used to heat buildings and hot water) and also provides a cleaner source of energy (as electricity produced from natural gas produces less emissions than electricity generated at coal fired power stations that supply the grid). In addition, cogeneration is more energy efficient than centralised power generation, where energy is lost in distribution networks, and heat produced through the process of generating electricity is not captured. A cogeneration plant can be set up to provide the main source of energy for a building.

To date, the uptake of cogeneration potential for buildings has been low, primarily due to market and regulatory barriers that make its deployment difficult.

Yet cogeneration remains a realistic opportunity for buildings by 2020, and has therefore been included for consideration.

SOLAR PHOTO-VOLTAIC (PV)

Solar PV generates electricity onsite by converting solar radiation into electricity via solar panels typically installed on the roof or walls of a building. Depending on the scale and orientation of the system, a solar PV system may have a generating capacity of up to 100 kilowatts (kW) for a small-scale system¹⁰ suitable for small-medium sized businesses, to between 100 kW and 500 kW for a medium-scale system¹¹ suitable for a larger office building, shopping centre, warehouse or other large building.

The primary barrier to the uptake of solar PV remains its high cost. Even though the price of solar systems has come down considerably in recent years, and a number of state and federal government programs exist to encourage the uptake of solar PV, upfront out of pocket costs and relatively long payback periods have discouraged significant investment in solar PV systems, particularly at a commercial scale.

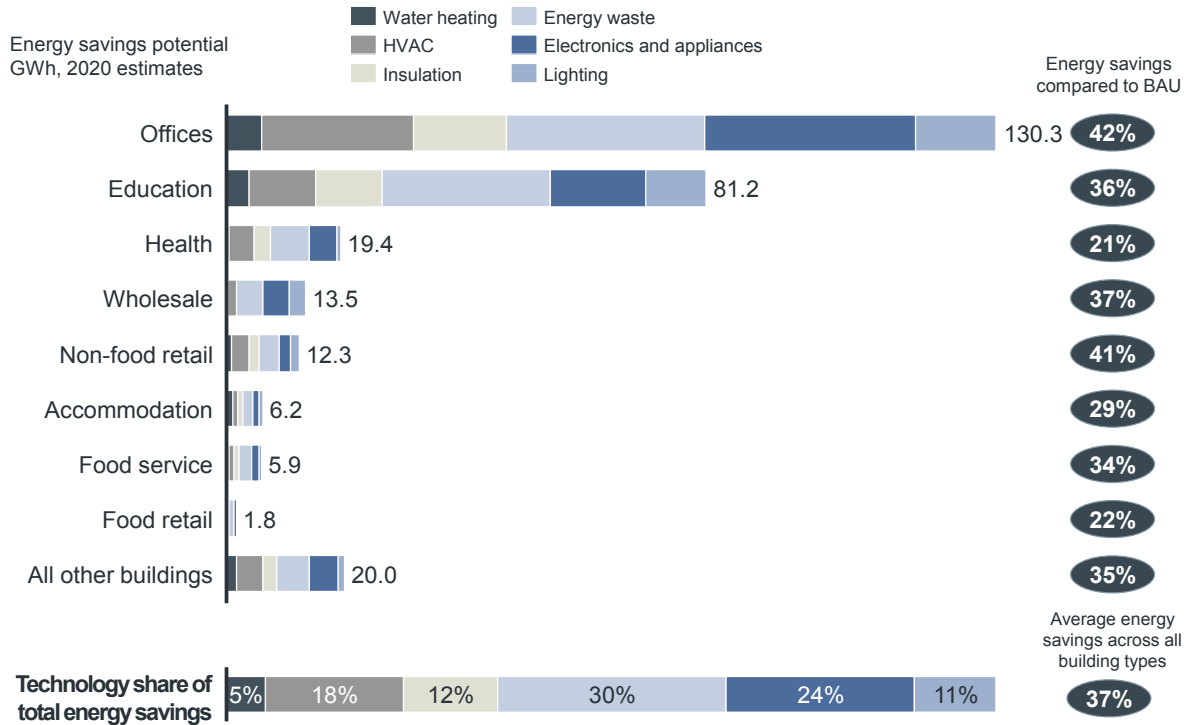
10 The Office of Renewable Energy Regulator classifies a small generation solar photovoltaic system as no more than 100 kW. However, there are no definitive definitions for 'small scale' and 'medium scale' solar PV, and these groupings are indicative only.

11 Larger systems can be installed, but are typically too large for rooftop installation and therefore require the use of additional adjacent land.

Energy Savings By Sector

All commercial buildings are not the same, and the energy savings that can be captured will depend on how the building is used. Looking at the energy savings compared to business-as-usual in Exhibit 4, it is clear that all of Macquarie Park’s buildings can benefit from substantial energy savings of between 21% and 42%.

Exhibit 4 - Commercial building retrofits energy savings by technology



Source: ClimateWorks team analysis, derived from Macquarie Park commercial buildings 2020 GHG emissions reduction cost curve

While the largest overall energy savings can be found in Offices and Education (211 gigawatt hours (GWh) per year), it can be seen that all sectors can benefit from quite substantial energy savings through improved energy efficiency. For most sectors, the key opportunities to reduce energy consumption (and therefore greenhouse gas emissions) come from replacing electronics and appliances with high efficiency electronics and appliances; reducing energy waste by downsizing or getting rid of oversized or unnecessary equipment; and upgrading HVAC systems to high efficiency when current systems expire, coupled with improving HVAC control systems to adjust for building occupancy and minimise re-cooling of air. Full descriptions of all opportunities can be found in Appendix 1.

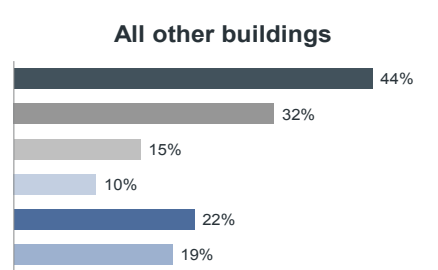
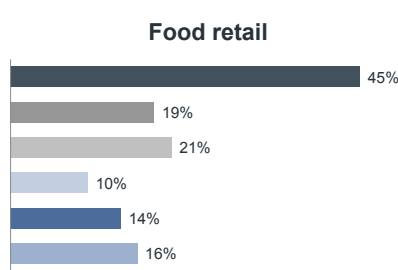
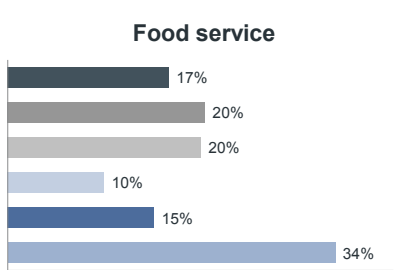
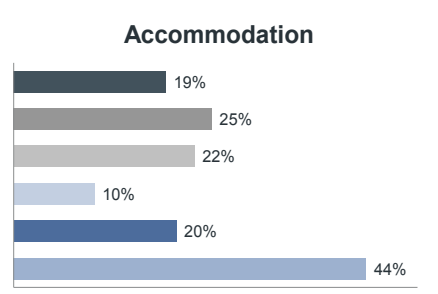
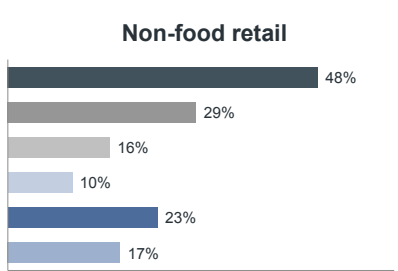
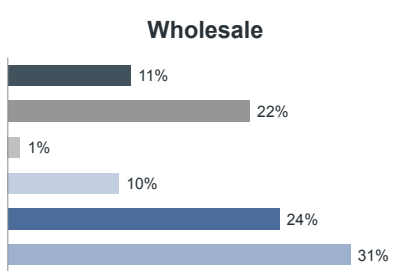
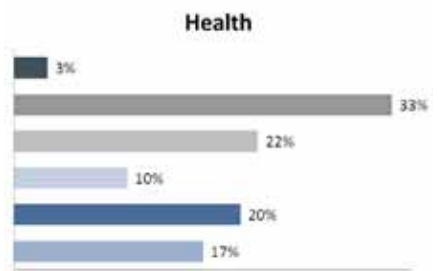
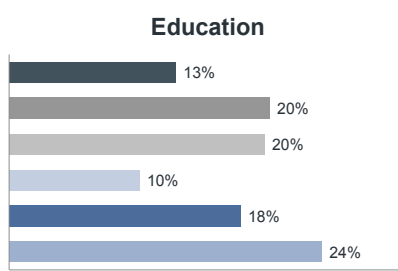
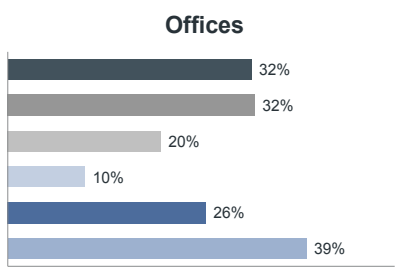
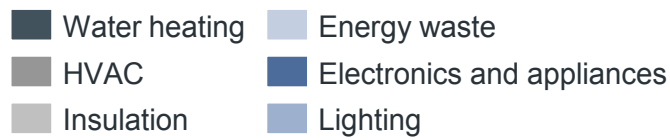
Exhibit 5 on page 16 expands on the information provided in Exhibit 4 to provide a breakdown of energy savings by technology against business-as-usual for each sector. It can be seen that, depending on how a building is used, the energy savings potential that each technology solution offers varies substantially, depending on the sector, illustrating that a 'one-size-fits-all' approach to capturing energy savings will not achieve the best outcomes for all sectors. It also highlights where each sector can achieve the most benefit, in terms of overall energy savings.

For Offices, it is worth noting that from 1 November 2011, all commercial office buildings over 2000 m² are required to disclose a Building Energy Efficiency Certificate (BEEC)¹² at time of lease or sale. The BEEC will provide guidance to businesses looking to rent or buy an office space about the property's energy performance. More energy efficient buildings are more attractive to buyers and tenants and offer greater investment performance. It therefore creates a strong market-based incentive for owners to improve the energy efficiency of their properties in order to increase their return on investment.



12 A BEEC is a required under the Building Energy Efficiency Disclosure Act 2010 (BEED Act). BEECs have three components: a NABERS Energy for offices rating (exclusive of GreenPower) for the building; a CBD lighting assessment for the area of the building that is being sold or leased; general energy efficiency guidance. Applications for a BEEC can only be submitted by a CBD Accredited Assessor.

Exhibit 5 - Energy savings potential against BAU by technology type and sector¹³



Source: ClimateWorks team analysis, based on Macquarie Park 2020 commercial buildings GHG emissions reduction cost curve

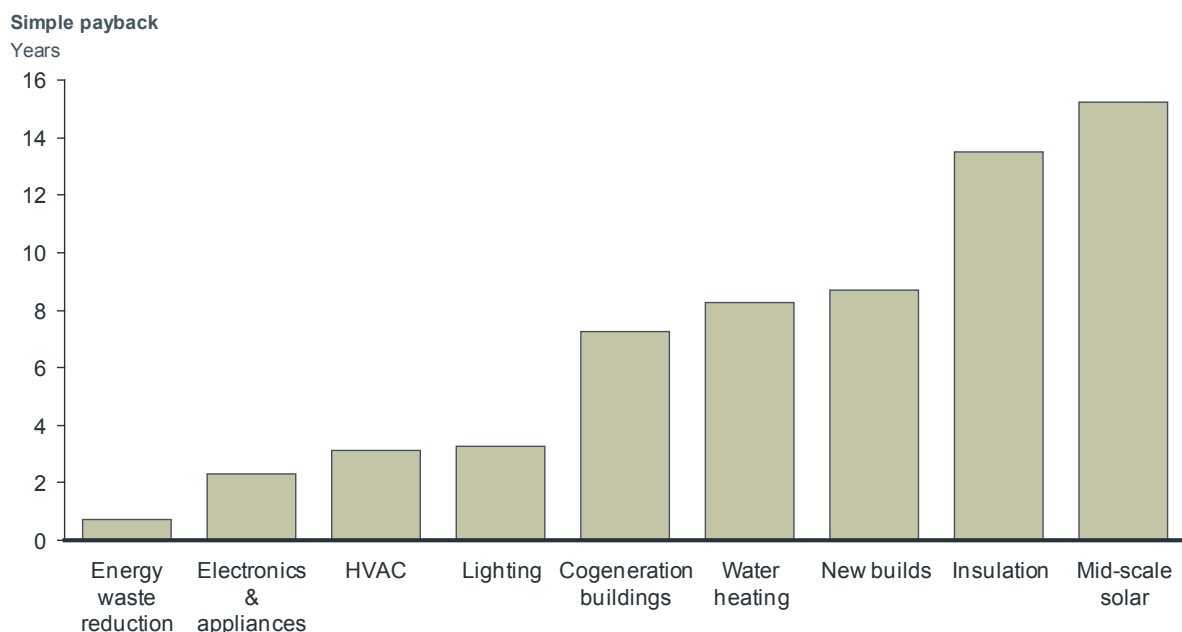
13 Although energy savings against BAU for water heating appear large, water heating makes up just 2% of total energy use in Non-Food Retail which means that it is rarely a priority for energy efficiency investments.

The Cost

Capturing the energy savings and cleaner energy solutions identified in this report will require an upfront investment of capital. Yet even factoring in the upfront capital costs¹⁴, and annualising them over the life of the relevant asset, the majority of opportunities identified in this report will save businesses money over their lifetime.

Understanding how long it will take to recoup the upfront capital investment is often crucial to decision-making for businesses. Exhibit 6 details the estimated payback associated with each technology solution.¹⁵

Exhibit 6 - Comparison of payback across technology opportunities



It can be seen that four of the nine opportunities offer a payback of less than 4 years. Energy waste reduction, the relatively easy task of removing or downsizing unnecessary equipment (e.g. de-lamping, reducing the number of printers or photocopiers to service an office space, downsizing a water heater to fit the requirements of the business it services), has a payback of eight months. Opportunities with a higher capital investment will take longer to recoup, such as cogeneration, more efficient new builds and improving the thermal insulation of existing buildings may require financial incentives to ensure they are captured by 2020.

¹⁴ Capital costs include the incremental capital investment required to capture each opportunity, as well as the cost of capital.

¹⁵ Using simple payback (which excludes interest paid on capital costs).

The Impact of the Carbon Price

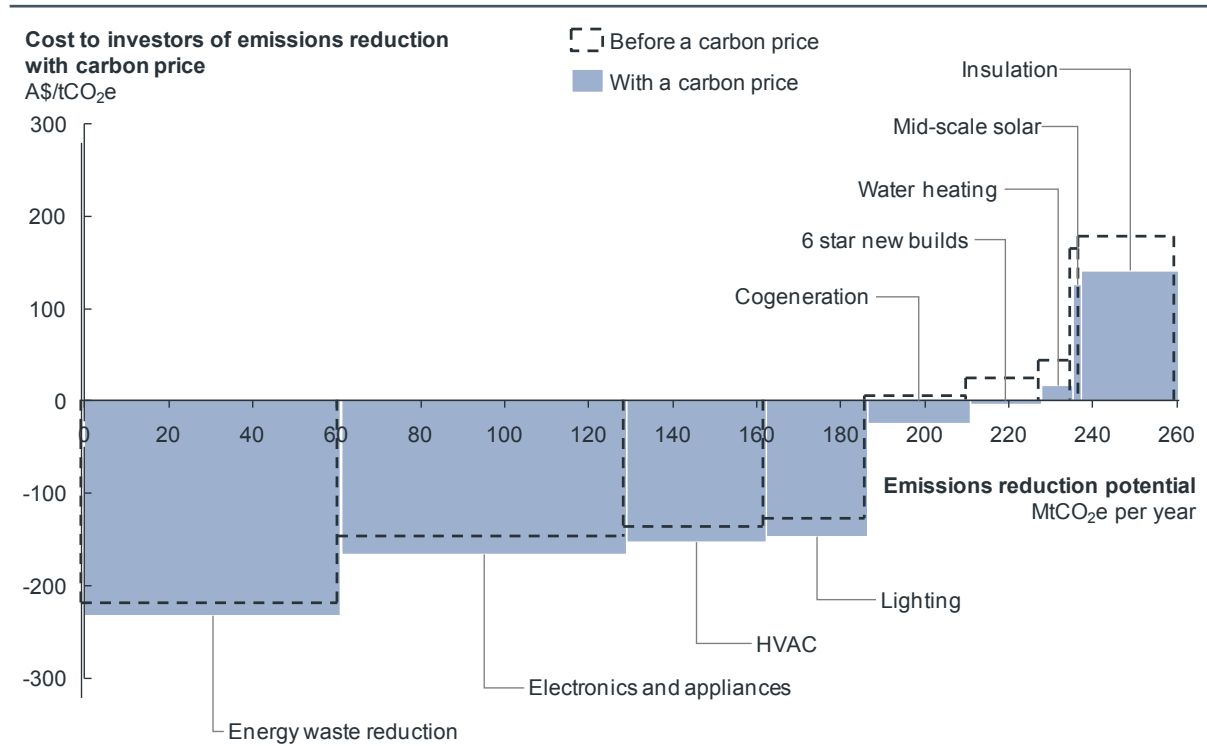
By increasing the cost of activities that produce greenhouse gas emissions, a carbon price amplifies the operational savings available from capturing opportunities to reduce those emissions.

Placing a price on carbon will see some opportunities that currently come at a net cost become profitable. For opportunities that are already profitable, it can reduce payback time as well as helping to make these opportunities more visible to businesses.

The Australian Government has outlined its proposed carbon price package – Securing a clean energy future – and ClimateWorks has undertaken a detailed analysis of this package and its impact on the cost of capturing emissions reduction opportunities¹⁶.

For most of Macquarie Park’s businesses, the most significant impact of the carbon price will be felt through an increase in electricity prices, as power generators pass on the cost of carbon permits that they will be required to purchase. This increase in electricity prices also increases the profitability of energy efficiency opportunities. This can be seen in Exhibit 7, which illustrates the change in cost of capturing the opportunities identified for Macquarie Park’s commercial buildings with a carbon price associated with a national 5% emissions reduction target below 2000 levels by 2020, which has bipartisan political support.

Exhibit 7 – The impact of a carbon price in 2020¹⁷ on the cost of emissions reductions



16 Low Carbon Growth Plan for Australia – Impact of the carbon price package is available on the ClimateWorks Australia website www.climateworksaustralia.org

17 Using a carbon price of \$29 in 2010 real dollars, based on modelling by the Australian Treasury (5% target in 2020 scenario)

The carbon price increases the proportion of opportunities that are profitable for Macquarie Park's businesses by 28%.

The Australian Treasury¹⁸ has modelled that 85% of the carbon price will be passed through to the electricity price. Other expected electricity price increases, associated with infrastructure upgrades to the poles and wires that transmit and distribute our electricity have already been factored into the electricity price used in our modelling for 2020.

Other inputs are also expected to increase in price, as the impact of the carbon price is passed through by other businesses. However, as illustrated in Exhibit 3 and Exhibit 7, many businesses are sitting on substantial financial savings that are not being captured, but which help to mitigate the impact of a carbon price.

In effect, the carbon price increases the financial savings that Macquarie Park's businesses can capture from implementing all opportunities on the cost curve by 41% - from \$24.4 million to \$34.5 million per year. These savings can help to offset the rising costs of business inputs that businesses will experience under a carbon price.

For a carbon price mechanism to be effective, especially for longer term investment decisions, policy certainty is important. If investors are unsure of policy outcomes, the risk of acting or investing based on the price signal increases, thus reducing policy traction.

THE CARBON PRICE PACKAGE IS NOT JUST A CARBON PRICE



The carbon price package also includes a range of complementary measures that will provide information, financial assistance, regulatory adjustments and other assistance to help Australians reduce their exposure to a carbon price. Programs such as the Tax Breaks for Green Buildings, Small Business Instant Asset Write-Off and Low Carbon Communities are targeted specifically at commercial buildings and can help in reducing capital availability issues and improving project payback. The Clean Energy Finance Corporation may also provide capital in the form of low interest loans for cogeneration and medium-scale solar projects in commercial buildings. The financial impact of these funding mechanisms has not been factored into the modelling in Exhibit 7, however they can help to reduce upfront capital costs, thereby improving the overall profitability and reducing the payback of capturing energy efficiency opportunities.

18 Australian Treasury, Strong growth, low pollution. Modelling a carbon price (2011)

The Challenges

Most of the opportunities that this report identifies are already profitable, yet are not being captured by Macquarie Park's businesses indicating that a range of barriers are preventing the capture of these energy savings and their associated emissions reductions and financial savings. These barriers can be split into three categories:

1. Capital constraints and investment priorities
2. Market structure and supply constraints
3. Information gaps and decision process

The discussion below examines these barriers in more detail.

CAPITAL CONSTRAINTS AND INVESTMENT PRIORITIES

Some energy efficiency improvements such as insulation are capital intensive, offer long payback periods and are usually perceived as non-critical to business.

ACCESS TO CAPITAL

As businesses only have access to a finite amount of capital, they typically take a strategic view of how best to deploy it. For example, start-ups and small businesses generally do not have the resources to invest in more expensive energy efficient appliances even though the investment will pay for itself in energy savings. Access to capital can also be restricted by the perceived risk profile of the project manager, even with positive project fundamentals. This is usually based on the credit history or amount of funds already committed to the company or industry.

As much of the capital spent on energy efficiency projects is not transferable once invested (e.g. windows, insulation or tailored machine parts cannot be easily removed and reused), there is little collateral if a borrower defaults. As such, lending standards for non-recourse projects can restrict access to capital. For cogeneration projects, businesses are often unwilling to invest due to the high up-front capital cost and uncertainty around future gas and electricity prices.

LONG PAY-BACK PERIODS

Even where decision-makers can access sufficient capital to undertake profitable energy saving projects, investments may not be pursued because they have lengthy payback periods. Investors with a short term profit focus are unlikely to view such opportunities as attractive.

- ▶ **POTENTIAL SOLUTION:** Factoring the impact of a future carbon price into project costings can improve the attractiveness of energy efficiency projects and reduce payback projections.

INVESTMENT PRIORITIES

A profitable emissions reduction project may also be hampered when its rate of return is less than alternative investments, or where the emissions reduction activity is not considered core business. E.g. in high growth industries where increased market share may be prioritised over cost reduction opportunities.

- ▶ **POTENTIAL SOLUTION:** The NSW Government has recently amended the Local Government Act 1993 to enable environmental upgrade loans to be attached directly to a property, and be recovered by local councils through a charge linked to rates collecting, which helps to increase the attractiveness of financing retrofits to both building owners and finance institutions.

Low Carbon Australia is offering tailor-made financing solutions for businesses looking to invest in energy efficiency upgrades to existing non-residential buildings. These may include direct loans or co-financing with service providers. For more detail, see page 26.

MARKET STRUCTURE AND SUPPLY CONSTRAINTS

Market barriers include high transaction costs, split incentives, contract structures and regulatory constraints.

TRANSACTION COSTS

Transaction costs are the indirect costs associated with implementing projects including the time involved in researching and choosing the most appropriate actions, e.g. energy audits, price negotiations, the cost of gathering information to choose a product, and developing new project-specific skills in staff. This is a particular problem for small to medium-sized businesses, where the cost of this decision-making in proportion to the anticipated savings can be high. For example, it may require a significant investment of time for a small business to acquire information, set up financing and find the right equipment and contractors to install it.

- ▶ **POTENTIAL SOLUTION:** Some energy service companies (ESCOs) have made a business of aggregating small scale projects on behalf of commercial building owners or city councils, therefore lowering the cost of assessment, planning and implementation of energy efficiency retrofits. For further detail see the Government programs section on page 26.

SPLIT INCENTIVES

Split incentives arise when buildings are occupied by tenants or short-term owners: any capital investment made by the owner to improve energy efficiency will be recouped in part by the tenant or the next owner.

- ▶ **POTENTIAL SOLUTION:** Some large commercial real estate companies have begun to subsidise energy efficiency upgrades of their tenants' buildings, even though the immediate financial benefit is enjoyed by the tenant rather than them. These companies have recognised that demand for energy efficient buildings will increase in the future (particularly as energy prices rise and climate change awareness increases) and are positioning themselves as leaders in the market.

In addition, the NSW Government's recent amendment to the Local Government Act 1993 also enables a portion of retrofit costs that directly benefit tenants to be passed on by building owners, increasing the incentive to invest in retrofits that will bring greatest immediate financial benefit to tenants.

The amendment to the Local Government Act will enable local councils to enter into voluntary environmental upgrade agreements with building owners and finance providers to upgrade a building's environmental performance. Under the agreement, the lender provides funds directly to the building owner to undertake environmental upgrades to the building. The loan is repaid through the local council in the form of a special charge as part of council rate payments. The building owner is also able to pass through some of the cost of the retrofit to tenants, who can agree to pay an increase in rent to offset the energy savings experienced as a direct result of the building upgrade.

CONTRACT STRUCTURES

Some long term or less variable contract structures diminish the positive impact of short term action, or of changed price signals. The profitability of energy efficiency opportunities can be strongly impacted by the energy price that businesses negotiate or the rate at which their energy costs vary with usage. For example, retail businesses may have little incentive to reduce their energy consumption when energy use is included in rental payments rather than paid separately.

- ▶ **POTENTIAL SOLUTION:** Large businesses can negotiate Power Purchasing Agreements that stipulate a percentage of energy that is supplied from gas or renewable sources.

REGULATORY CONSTRAINTS

Cogeneration in particular faces a range of regulatory barriers to its implementation. Existing regulations favour large centralised power plants, and hinder cogenerators from using the distribution network to move energy between sites at a cost that reflects the actual cost of using the network to move energy such short distances. Current regulations also prevent cogenerators from selling electricity to all tenanted spaces on a single site as regulated monopolies, which limits the ability for cogenerators to have a secure market for their power and reduces the financial viability of installing a cogeneration facility.

- ▶ **POTENTIAL SOLUTION:** While building stand-alone cogeneration plants to meet the energy needs of a single building is typically how this issue is overcome, greater efficiencies are achieved through larger cogeneration plants that service a number of buildings. However, the widespread implementation of networked cogeneration will require regulatory change. ClimateWorks is currently working with a number of stakeholders and the energy regulator to develop a proposal for regulatory changes that would enable increased cogeneration opportunities.

INFORMATION GAPS AND DECISION PROCESSES

Access to adequate and accurate information is vital to achieving the emissions reduction potential outlined in Exhibit 3. Even when an opportunity is profitable, it will not be captured if decision-makers are not aware of it, or are not convinced of its impact.

INFORMATION GAPS

Information gaps arise in a number of circumstances. Decision-makers may have a concern about energy consumption or greenhouse gas emissions but be unaware of the potential solutions, or may dismiss known energy saving activities because they do not have the knowledge to determine their effectiveness. Many businesses - in particular those with low energy bills as a proportion of outgoings - may not closely follow how much energy they use, and the savings which could be achieved through improved energy efficiency. Moreover, the equipment needed to estimate and verify energy savings is not readily available and comes at a cost for business, making it difficult to build traction on energy efficiency measures. Even when energy efficiency measures are pursued, savings are often undermined by a lack of understanding of the proper use of new equipment, or inadequate investment in the skills of auditors and contractors.

- ▶ **POTENTIAL SOLUTION:** Role modelling has been shown to be an effective means of raising awareness and commitment, and has the additional benefit of helping to build community cohesiveness around efforts to reduce emissions. This can be achieved by tapping into existing trusted networks such as industry or business groups to encourage sharing of information and stories of success. See government programs page 26.
- ▶ **POTENTIAL SOLUTION:** Awareness campaigns can stimulate demand for energy efficient equipment and spaces, as can promoting the secondary benefits such as increased property value or improved productivity and health for office workers.

DECISION MAKING PROCESS

Even where full information about energy saving opportunities is available, a company's decision process may make it difficult or impossible for managers to act. This can occur in large companies or departments where capital investment and operating expense budgets are separate, sometimes resulting in the net effect of limiting upfront capital at the expense of higher total life-cycle costs.

Other criteria may also take priority over the profitable use of energy efficient equipment. For example, procurement policies within businesses may give preference to locally produced but inefficient appliances.

Even the decision processes of smaller businesses may reduce uptake of energy savings opportunities, as they delegate these decisions to their suppliers, who can be motivated by competing incentives. For example, plumbers or building contractors play a decisive role in the choice of small business water heaters, but may not choose the most energy efficient option, prioritising instead the equipment with which they are most familiar or on which they achieve the highest return (which is usually the lowest upfront cost, but not most efficient option).

- ▶ **POTENTIAL SOLUTION:** Working with local trade organisations to ensure their members are familiar with energy efficient equipment and its benefits to end users is critical to ensure broad uptake of these technologies.



Next Steps

The previous chapters of this report identify the energy savings and cleaner energy opportunities that are available to Macquarie Park at relatively low cost and the key challenges to capturing those opportunities. This chapter will focus on the next steps to capturing these opportunities, including consideration of the ease with which each opportunity can be implemented, and important factors to consider when planning for implementation.

EASE OF IMPLEMENTATION

Implementing each of the actions identified in this report requires different types of effort, and as such, each opportunity has been categorised by the level of difficulty associated with its implementation:

- ▶ **Relatively easy to implement** – opportunities that do not have significant costs or other barriers and can be implemented now.
- ▶ **More difficult to implement** – generally requires some level of planning and can be implemented in the short to medium term (i.e. within a couple of years).
- ▶ **Most effort to implement** – requires advanced planning, is difficult to secure funding and approval and therefore takes the longest time to implement (i.e. within five to ten years).

Relatively easy to implement	More difficult to implement	Most effort to implement
<ul style="list-style-type: none">▶ Commercial energy waste reductions▶ Commercial lighting▶ Commercial new build elevators, appliances, electronics, refrigeration and cooking▶ Commercial retrofit elevators, appliances and electronics	<ul style="list-style-type: none">▶ Commercial HVAC▶ Commercial insulations▶ Commercial water heating▶ Commercial refrigeration and cooking▶ Cogeneration	<ul style="list-style-type: none">▶ Construction of new builds to a 6-star (NABERS) equivalent▶ Solar PV

For all opportunities, there is work to be done now – not just those that are relatively easy to implement. For those that require additional effort, work should be done to address the barriers they face, to ensure they can be captured by 2020.

IMPORTANT FACTORS TO CONSIDER WHEN PLANNING FOR IMPLEMENTATION

Whilst the opportunities identified in this report can be implemented individually and at any point in time, it should be highlighted that including energy efficiency improvements in a building's refurbishment is a cost-effective way of capturing the financial and energy savings available. Where a building is not due for refurbishment, it is often more economical to implement a range of opportunities at one time rather than individual opportunities. Doing so will minimise the disruption associated with implementation and save in contractor's fees. There are a range of programs offering funding and assistance for low carbon and energy efficient projects within the building sector. These include:

NSW GOVERNMENT PROGRAMS

NSW Office of Environment and Heritage:

- ▶ **The Sustainability Advantage Program** is for organisations of 40+ staff. The program assists members to identify and implement sustainability projects including those that will lower costs through resource efficiency, behaviour change and carbon management. The program provides practical, tailored support in the form of workshops and training, technical assistance and networking to help with the planning and implementation of environmental projects.
- ▶ **The Energy Saver Program** provides subsidised energy audits for as little as 20-50% of the original cost. Highly qualified energy auditors will identify opportunities for your organisation to save energy and provide business cases with payback periods.
- ▶ **The Energy Efficiency Training Program** builds the knowledge and skills of tradespeople and professionals to support improved energy efficiency practices, products and services. The program supports industry partnership projects that develop and deliver energy efficiency training; supports university projects that develop and deliver energy efficiency education for the Higher Education sector; provides subsidies for Registered Training Organisations to deliver accredited short courses in energy efficiency skills; and develops courses to update

the energy efficiency knowledge of educators and trainers.

- ▶ **The Energy Efficiency for Small Business Program** is available to businesses that consume up to \$20,000 in electricity a year or have up to 10 fulltime employees. The program offers subsidised energy assessments and tailored energy action plans to small businesses, as well as providing discounts on installation costs, and coordinated assistance to install energy saving improvements.

NSW Office of Environment and Heritage with IPART:

- ▶ **The Energy Savings Scheme** is designed to increase opportunities to improve energy efficiency by rewarding companies who undertake eligible projects that either reduce electricity consumption or improve the efficiency of energy use. The scheme assists the payback of projects by generating approximately \$20 per tonne of CO₂-e saved, in addition to the energy savings that are made as part of the project.

Amendment to the NSW Local Government Act:

- ▶ This will enable local councils to enter into voluntary environmental upgrade agreements with building owners and finance providers to upgrade a building's environmental performance, and provide access to finance for building owners to undertake the upgrades.
-

NSW Department of Trade and Investment,
Regional Infrastructure and Services (NSW Trade &
Investment):

- ▶ Support innovative, sustainable and globally competitive businesses, industries and sectors. Provide business assistance and advice, strong technical knowledge and scientific capabilities.

NATIONAL PROGRAMS

- ▶ **Low Carbon Australia – Energy Efficiency Trust:** The Australian Carbon Trust will invest up to \$23.7 million over the next 3 years through innovative energy efficiency financing programs in commercial buildings across Australia. These programs will leverage private sector funding to make available over \$300 million in new financing for Australian businesses, large and small to improve energy efficiency in commercial buildings. Financial solutions are tailor-made to suit the needs of the borrower, and may offer the opportunity for up-front costs to be covered by a service provider and recouped through energy bills.
- ▶ **The Green Building Fund:** aims to reduce the impact of Australia’s built environment on greenhouse gas emissions. During the 2010 election campaign, the Federal Government announced its intention to provide an additional \$30 million to expand the Green Building Fund, broadening its scope to include hotels and shopping centres as well as commercial office buildings.
- ▶ **CitySwitch Green Office program:** works with tenants to improve office energy efficiency, recognising that tenants directly account for almost half the electricity consumed in office buildings. This helps to reduce transaction costs that an individual business would face in identifying these opportunities and implementing them on their own. Companies that join the CitySwitch program CitySwitch commit to achieve and maintain an accredited 4 stars or higher NABERS Energy tenancy rating.
- ▶ **Tax Breaks for Green Buildings:** From 1 July 2012, eligible businesses that invest in improving the energy efficiency of their existing buildings will be able to apply for a Tax Break. The Tax Break will cover specified expenditure which is incurred as part of a qualifying retrofit of an existing office building, hotel or shopping centre. The retrofit must be assessed by an accredited National Australian Built Environment Rating System (NABERS) assessor before and after the project. To be eligible for the Tax Break, the building must achieve a significant improvement in energy efficiency. The Government will consider legislation establishing the Tax Breaks for Green Buildings program in the second half of 2011.
- ▶ **Office of the Renewable Energy Regulator:** Renewable energy certificates can be earned through the Small-scale Renewable Energy Scheme (SRES) for solar PV systems up to 100kW and through the Large-scale Renewable Energy Target for projects over 100kW. Small-scale certificates can be sold for a fixed price of \$40 per certificate (equivalent to 1 MWh of energy produced over the lifetime of the solar PV system), and additional certificates can be earned for the first 1.5kW of installed capacity. The price for large-scale renewable energy certificates is set by the market, and typically fluctuates between \$30-\$40 per certificate
- ▶ **Commercial Building Disclosure Program:** Mandatory disclosure of energy efficiency for all commercial office spaces over 2,000m² will improve the performance of larger office spaces, by increasing transparency and tenant awareness of the value of energy efficient offices.

▶ **National Australian Built Environment Rating System (NABERS)** is a performance-based rating system for existing buildings. NABERS is currently looking to extend its rating system to include 6 and 7 stars, in recognition of the fact that new buildings are becoming more efficient and some are already achieving higher than 5 stars.

▶ **Enterprise Connect.** Workshops, Industry Intelligence & Networking (WIIN) is a competitive small grants element of the Enterprise Connect initiative. WIIN offers grants of up to \$50,000 for eligible organisations to deliver activities to Australian small and medium businesses which help them to improve their performance through better access to new innovations, technologies, expertise, business networks and best practice.

In addition, the United Nations Environment Program is developing a Common Carbon Metric to provide businesses with a tool to measure, report, and verify greenhouse gas emissions reductions in buildings in a consistent and comparable way. The tool is still under development, and businesses can sign up to participate in the Phase 2 pilot program.



ADDITIONAL FUNDING INCLUDED IN THE CARBON PRICE PACKAGE

In the carbon price package – Securing a clean energy future – additional funding has been announced that can assist with energy efficiency and low emissions energy generation. These include:

- ▶ **Small business instant asset write off** – \$130 million for commercial buildings.
- ▶ **Low Carbon Communities** - \$200 million in grants for energy efficiency upgrades of public buildings, facilities and lighting.
- ▶ **Energy Efficiency Information Grants** – \$40 million in grants for industry associations & NGOs to establish relationships with SME and community organisations to deliver information about the implications of the carbon price and practical steps to manage its impact.
- ▶ **Tax Breaks for Green Buildings** (see detail above)
- ▶ **Clean Energy Finance Corporation** – \$10 billion Clean Energy Finance Corp to fund commercialisation and deployment of renewable and low emissions energy.
- ▶ **National Energy Savings Initiative (NESI)** – National ‘white certificate’ scheme (NESI) proposed to oblige energy companies to undertake energy efficiency improvements for residential, commercial and industrial energy users

Many of these programs are yet to be developed, and further details can be found at www.cleanenergyfuture.gov.au.

MACQUARIE PARK’S BUSINESSES HAVE BEFORE THEM A SUBSTANTIAL OPPORTUNITY to improve energy efficiency and energy security, capture financial savings, and reduce their exposure to the impact of a carbon price. Capturing these opportunities will require action to address the range of barriers that currently block effective action.

Some of these barriers can be overcome by actions that businesses can take themselves. Others will require the intervention of Government – local, state or federal, depending on the barrier.

ClimateWorks hopes this report (and the substantive fact base that underpins it) will be a useful prompt and guide the actions required from government and business to achieve the low cost actions to reduce energy consumption and increase local generation of low emissions distributed energy.





SECTION 2: Residential Buildings

Business-as-usual: residential buildings

The Macquarie Park precinct also includes a small proportion of residential buildings (1.5% of total floorspace). By 2020, this will have grown to approximately 600 households¹⁹, with an average of 2.4 people per household living predominately in flats, apartments or townhouses. The breakdown by residential building type is illustrated in Exhibit 8.

41% of total residential floor space is classified as social housing²⁰, which indicates a high proportion of tenanted properties in the precinct.

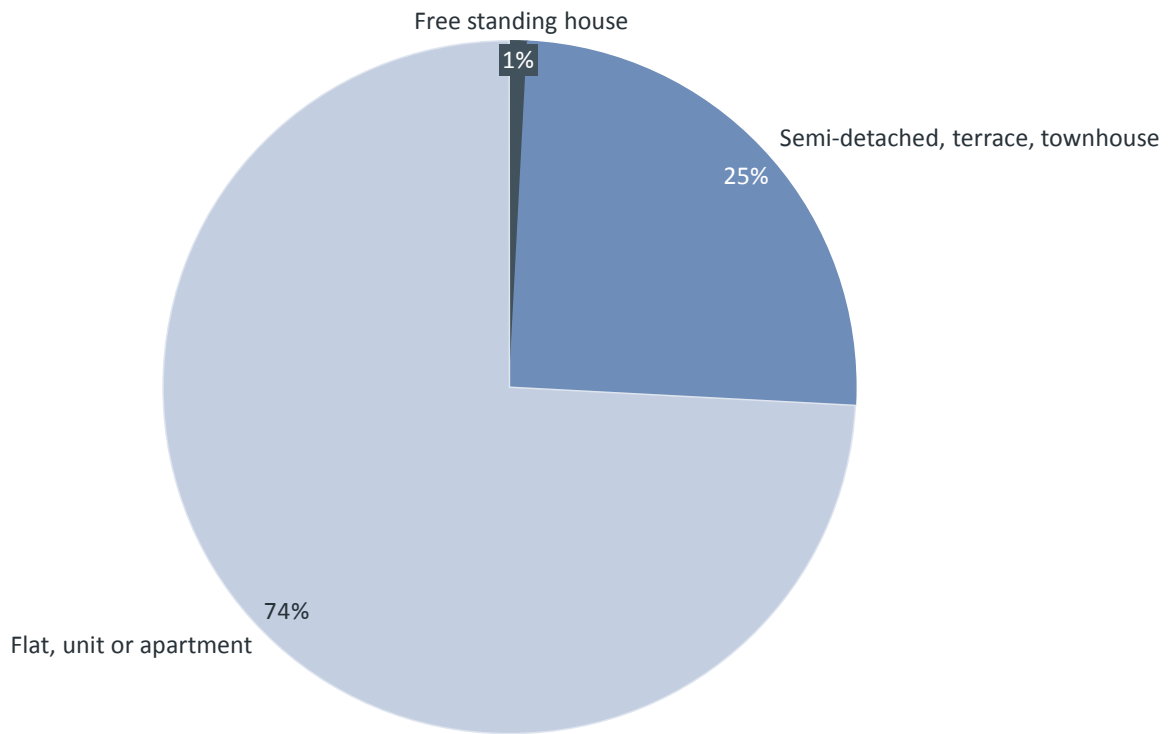


Although residential buildings make up less than 1% of overall energy usage in Macquarie Park's buildings, energy bills often represent a higher proportion of expenditure for households than for businesses, particularly low income households. For the average household, electronics and appliances are the largest user of energy under business-as-usual, representing 62% of total stationary energy consumption for households. Lighting consumes a further 26% and HVAC the final 12% under business-as-usual.

19 Based on data provided by City of Ryde

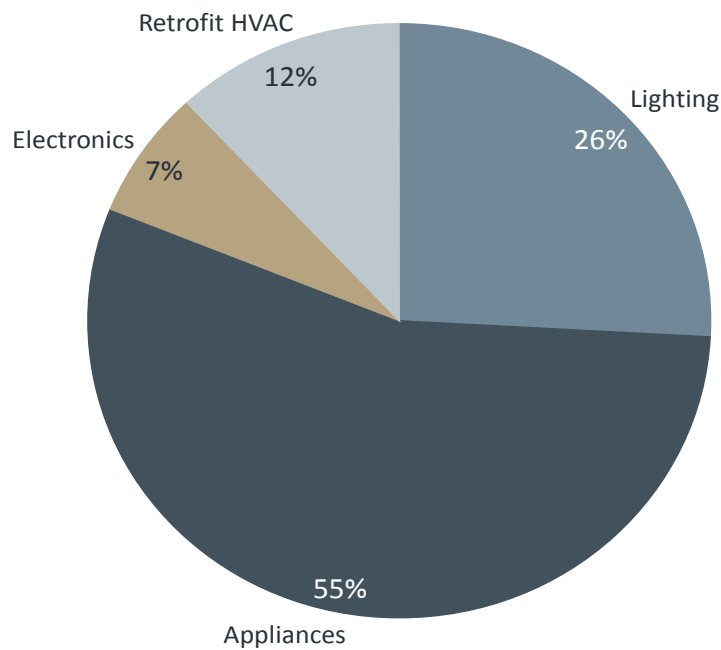
20 Based on data provided by NSW Office of Environment and Heritage

Exhibit 8 - Residential buildings by building type



Source: ClimateWorks team analysis, based on data inputs from Macquarie Park

Exhibit 9 – Business-as-usual energy consumption in existing residential buildings by technology in 2020



Source: ClimateWorks team analysis, based on data inputs from Macquarie Park

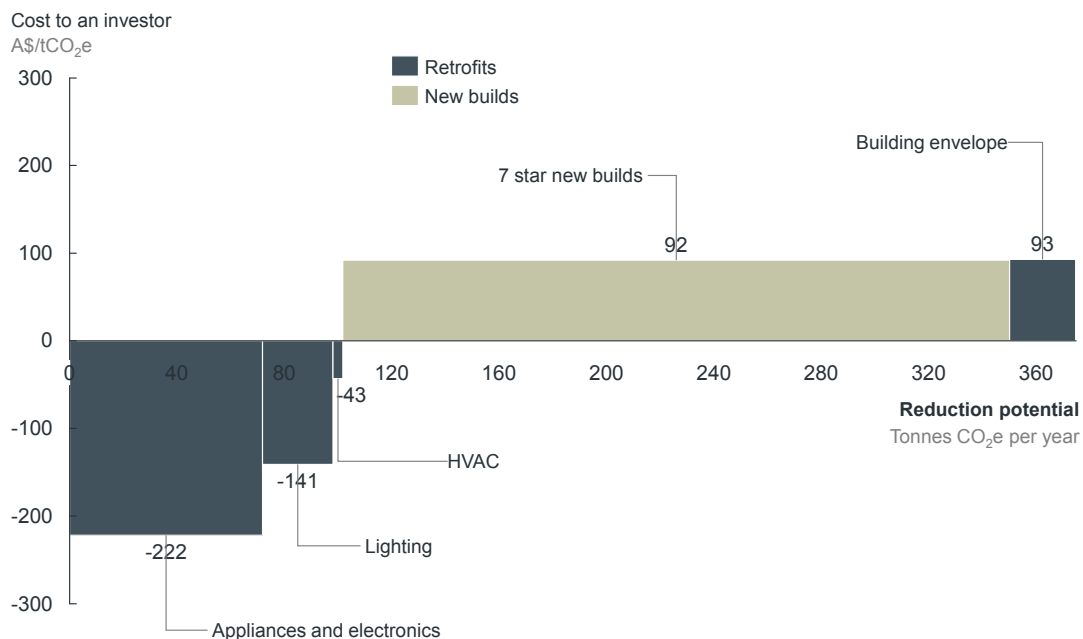
The Opportunity for Macquarie Park's Homes

A range of opportunities are available to Macquarie Park's households to reduce energy consumption and capture the associated financial savings. Exhibit 10 highlights these opportunities, which are focused on improving the energy efficiency of homes, either by reducing the energy consumed by electronics, appliances, heating and cooling, or by reducing the need for heating and cooling through improving the thermal efficiency of houses. Capturing all of these opportunities has the potential to reduce total energy consumption by 34%, which would result in greenhouse gas emissions reductions of 375 tonnes per year.

More than half of the opportunities (those that fall below the \$0 line in Exhibit 10) offer net financial savings, even after the upfront capital costs of implementing the opportunity are taken into account. These profitable opportunities are focused on ensuring new electronic equipment and household appliances are highest efficiency; choosing energy efficient lighting; improving the thermal efficiency of homes through basic improvements such as sealing areas of air leakage, weather stripping doors and windows, insulating attic and wall cavities; and selecting new air conditioners and space heaters that are the most energy efficient in their category, while also improving maintenance of HVAC systems.

Some additional opportunities come at a net cost. These focus on improving the standard of new houses to 7 stars to reduce heating and cooling requirements over the life of the house; and 'advanced' building envelope adjustments to existing houses which are typically implemented at the time of major renovation, such as installing high efficiency windows and doors, increasing insulation, mechanical ventilation with heat recovery, and basic passive solar principles.

Exhibit 10 - Macquarie Park 2020 residential buildings GHG emissions reduction cost curve



Source: ClimateWorks team analysis, derived from the Low Carbon Growth Plan for Australia 2020 GHG emissions reduction cost curve with data inputs from Macquarie Park

Investing in more efficient appliances, electronics and lighting offer substantial financial savings, even factoring in upfront costs. All of these opportunities will pay for themselves in energy savings in less than 2 years.

While improving the basic building envelope and upgrading HVAC systems also offers net financial savings to households, these longer life assets also take longer to recoup.

This highlights one of the key barriers to the uptake of many energy efficiency opportunities in residential buildings – the split incentive, where the person responsible for making the investment in energy efficiency is not the person who reaps the financial benefits. For example, in tenanted properties the landlord is responsible for structural upgrades such as insulation or heating systems, yet the tenant benefits from reduced energy bills.



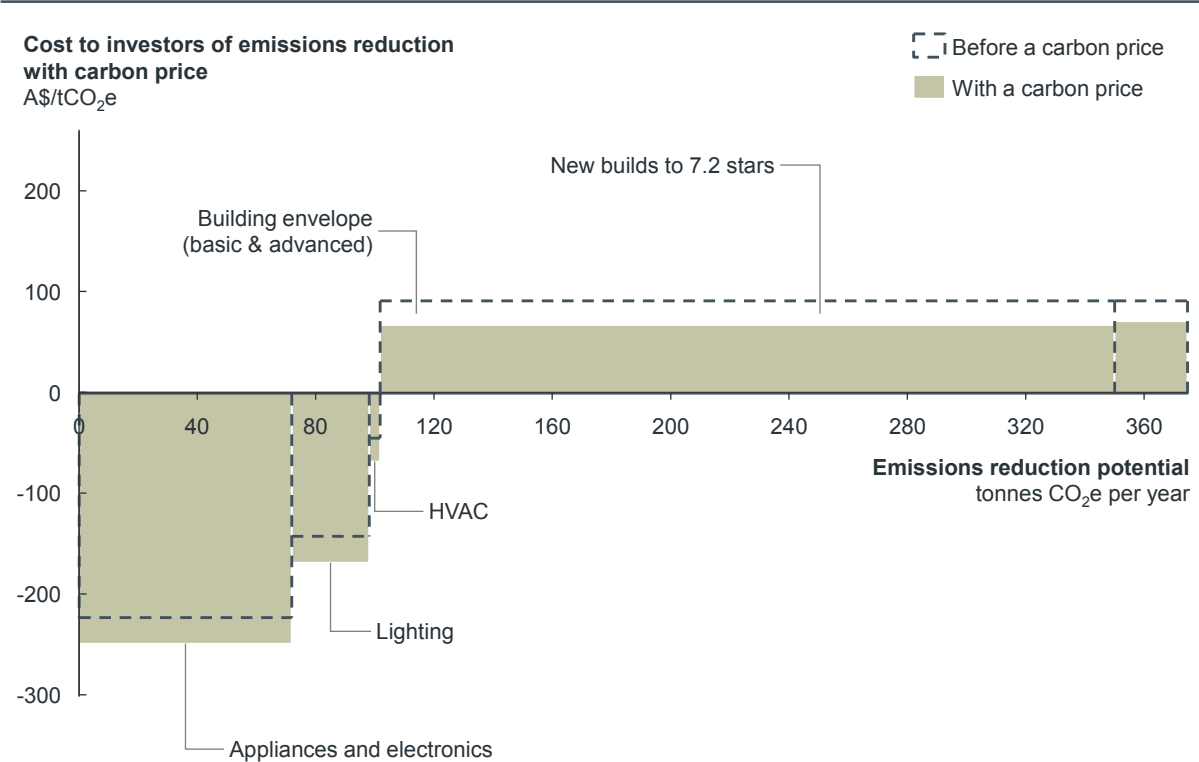
The largest opportunity on the curve is improving the energy efficiency of residential new builds from 4 stars to 7 stars according to House Energy Rating Schemes such as NatHERS. These improvements are in addition to those achieved through the current design requirements of BASIX. As the number of homes is expected to double over the next ten years²¹, this offers significant potential to ensure long term lower operating costs for households in the face of rising electricity prices. Residential buildings have an average life of 50 years; a failure to capture this opportunity in the short term will mean households will be ‘locked in’ to higher energy consumption over the lifetime of those homes.

21 Based on data provided by Ryde City Council

The Impact of a Carbon Price on Opportunities in Residential Buildings

In 2020, a carbon price is expected to increase the cost of electricity for households by approximately 15%. This increase in electricity prices will make those opportunities that are already profitable more so. It will also improve the economics of higher cost opportunities such as building new homes to a higher star rating, but will not be sufficient to make these opportunities profitable without additional assistance. Exhibit 11 below illustrates this impact.

Exhibit 11 – The impact of a carbon price in 2020 on the cost of emissions reductions in residential buildings



Low income households are most vulnerable to increasing electricity prices, and the proposed carbon price package will address this impact by direct compensating these households in line with the increase to the consumer price index. In addition, a number of complementary measures in the carbon price package are aimed at assisting households with the costs associated with capturing energy efficiency upgrades, such as the National Energy Savings Initiative, Low Income Energy Efficiency Program and the Household Energy and Financial Sustainability Scheme.

ADJUSTING BEHAVIOUR TO SAVE ENERGY AT HOME

While this report focuses on technology solutions to reduce energy consumption - and therefore greenhouse gas emissions - in Macquarie Park's homes, simple changes in behaviour can also be effective at saving energy.

- ▶ Reducing heating set temperatures on thermostats in winter, and raising set temperatures for cooling in summer
- ▶ Switching appliances and electronic equipment from standby to off when not in use

- ▶ Switching lights off when leaving a room
- ▶ Reducing shower time to reduce hot water consumption
- ▶ Air-drying clothes rather than using a clothes dryer

These and other simple energy-saving behaviour shifts cost nothing to implement but will reduce energy consumption and therefore money.

Next Steps

EASE OF IMPLEMENTATION

As with the opportunities for commercial buildings, implementing each of the actions identified for Macquarie Park's residential buildings requires different types of effort. Opportunities are categorised by the level of difficulty associated with their implementation:

- ▶ **Relatively easy to implement** – opportunities that do not have significant costs or other barriers and can be implemented now.
- ▶ **More difficult to implement** – generally requires some level of planning and can be implemented in the short to medium term (i.e. within a couple of years).
- ▶ **Most effort to implement** – requires advanced planning, is difficult to secure funding and approval and therefore takes the longest time to implement (i.e. within five to ten years).

Relatively easy to implement	More difficult to implement	Most effort to implement
<ul style="list-style-type: none">▶ Residential lighting▶ Residential appliances and electronics	<ul style="list-style-type: none">▶ Residential HVAC	<ul style="list-style-type: none">▶ Residential building envelope▶ Residential new builds to 7.2 stars

IMPORTANT FACTORS TO CONSIDER WHEN PLANNING FOR IMPLEMENTATION

Funding and assistance is available to households to assist them to capture energy efficiency opportunities, including:

- ▶ **NSW Office of Environment and Heritage – The Home Power Savings Program:** provides free help, a power savings kit and energy assessment to eligible low income households to save up to 20% a year on their power use.
- ▶ **NSW Office of Environment and Heritage – The Low Income Household Retrofit Program:** aims to help the most vulnerable households save power and money to buffer them against rising energy prices.
- ▶ **Department of Climate Change and Energy Efficiency – Solar Hot Water Rebate:** Eligible households can claim a rebate of \$1,000 for a solar hot water system or \$600 for a heat pump hot water system through the rebate.

In addition, the carbon price package includes the following programs to assist households to capture energy savings:

- ▶ **Low Income Energy Efficiency Program:** \$100 million in grants to trial energy efficiency approaches in low income households.
- ▶ **Household Energy and Financial Sustainability Scheme:** \$30 million in grants to assist low-income households find more sustainable ways to manage their energy consumption.
- ▶ **National Energy Savings Initiative (NESI):** Assistance provided through electricity retailers to reduce energy consumption by businesses and households, focusing on least costly and capital intensive abatement opportunities. Designed to achieve around 5% reduction in electricity and gas emissions by 2020.

There are many actions that households can take to reduce energy consumption and therefore reduce exposure to rising electricity prices. Many of these opportunities are low cost, and will pay themselves back in a relatively short timeframe. In addition, programs and funding are available to assist those households that are most capital constrained, and therefore most vulnerable to increases in electricity pricing.

ClimateWorks hopes this chapter on Residential buildings will assist government and community groups to work with households in the Macquarie Park precinct, by highlighting some of the most cost-effective ways to reduce energy consumption in the home.

Appendix 1: Key Assumptions

A range of assumptions underpin the modelling that ClimateWorks has undertaken for this report. These assumptions are detailed in the following pages.

General Assumptions

Measure	Action and Key Assumptions
Electricity price in 2020	<ul style="list-style-type: none"> ▶ Commercial buildings: \$189/MWh ▶ Residential buildings: \$238/MWh ▶ Based on electricity forecast modelling by the Australian Treasury
Abatement electricity intensity in 2020	<ul style="list-style-type: none"> ▶ 0.82 tCO₂e/MWh
Cost of capital	<ul style="list-style-type: none"> ▶ 12.7% interest across commercial and residential buildings
Carbon price in 2020	<ul style="list-style-type: none"> ▶ \$29 (in 2010 real dollars) per tonne CO₂e associated with Australia's 5% emissions reduction target
Other key assumptions underpinning modelling)	<ul style="list-style-type: none"> ▶ All emissions reduction cost curves are for 2020 and represent the opportunity that can be captured from 2012 to 2020 ▶ All costs are calculated using the investor perspective (see the Low Carbon Growth Plan for Australia for methodology) and expressed in 2010 real dollars ▶ All carbon price values are shown in 2010 real dollars in order to be consistent with all cost curve data

Commercial buildings opportunity assumptions

Existing commercial building floor space	<ul style="list-style-type: none"> ▶ Education – 1,083,026 m² ▶ Offices – 1,072,879 m² ▶ Wholesale – 299,854 m² ▶ Non-food retail – 106,757 m² ▶ Health – 84,404 m² ▶ Food service – 21,035 m² ▶ Accommodation – 51,748 m² ▶ Food retail – 8,548 m² ▶ All Other buildings – 109,359 m²
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Measure	Action and Key Assumptions
IMPROVED ENERGY EFFICIENCY THROUGH TECHNOLOGY	
HVAC (heating, ventilation and air-conditioning)	<p>When current HVAC system expires, install premium-efficiency system or variable speed motors.</p> <p>Improve HVAC control systems to adjust for building occupancy and minimise re-cooling of air. This system, often referred to as a Building Management System, acts to interact directly with other building systems to monitor and control the environment to optimise efficiency. HVAC positive interaction - In addition, experience shows that most energy efficiency improvements can also deliver secondary benefits in terms of reduced need for HVAC. This means that potential exists to downsize a HVAC system once other equipment improvements have been made (e.g. lighting, cooking, and refrigeration). For example, putting doors on refrigeration systems reduces the heating load of supermarkets and improving the insulation of large ovens or installing more efficient light bulbs decreases the cooling load of bakeries or buildings.</p> <p>Potential HVAC energy savings:</p> <ul style="list-style-type: none"> ▶ Offices – 32% ▶ Non-food retail – 29% ▶ Education – 20%²³ ▶ Wholesale – 22% ▶ Community – 28% ▶ Accommodation – 25% ▶ Food retail – 19% ▶ Health – 33% ▶ Food service – 20% ▶ Other – 32% <p>Water heating fuel mix assumed to be:</p> <ul style="list-style-type: none"> ▶ Offices – 73% electricity; 27% ▶ Non-food retail – 75% electricity; 25% gas ▶ Education – 52% electricity; 48% gas²⁴ ▶ Wholesale – 75% electricity; 25% gas ▶ Community – 81% electricity; 19% gas ▶ Accommodation – 73% gas; 27% gas ▶ Food retail – 75% electricity; 25% gas ▶ Health – 75% electricity; 25% gas ▶ Food service – 73% electricity; 27% gas ▶ Other – 70% electricity; 30% gas <p>Lifespan of HVAC equipment estimated to be 20 years; Average capital cost of implementation estimated to be \$9/m²; A further 20% savings can be achieved across all subsectors with no capital cost through HVAC positive interaction.</p>

23 The potential for HVAC energy efficiency improvements for the Education sector has been reduced to reflect upgrades already undertaken to Macquarie University's HVAC system.

24 The emissions intensity of electricity for the Education sector has been reduced in order to take account of Macquarie University's cogeneration plant and solar PV array.

Measure	Action and Key Assumptions
Electronics and appliances	<p>Ensure new electronic purchases (computer systems, lap tops, conferencing equipment) are in the top performers of their category in relation to energy usage. Ensure appliance purchases (cash registers, electrical fans, non-commercial kitchen appliances), as well as new elevators/escalators, are in the top performers of their category on energy usage/efficiency. Replace open refrigeration spaces with closed ones. For example, placing refrigerated products such as meats and cheeses in freezer style displays (i.e. behind closed doors) in supermarkets and delis. This also involves ensuring new purchases are top performers in their category in energy usage. Ensure commercial ovens (such as those used in bakeries) are properly insulated, and new purchases are top performers in their category in energy usage.</p> <p>Energy savings in 2020 estimated to be:</p> <ul style="list-style-type: none"> ▶ Offices – 26% ▶ Non-food retail – 23% ▶ Education – 18% ▶ Wholesale – 24% ▶ Community – 21% ▶ Accommodation – 20% ▶ Food retail – 14% ▶ Health – 20% ▶ Food service – 15% ▶ Other – 22% <p>Elevators and appliances fuel mix assumed to be²⁵:</p> <ul style="list-style-type: none"> ▶ Offices – 100% electricity ▶ Non-food retail – 94% electricity; 6% gas ▶ Education – 98% electricity; 2% gas²⁶ ▶ Wholesale – 99% electricity; 1% gas ▶ Community – 96% electricity; 4% gas ▶ Accommodation – 95% gas; 5% gas ▶ Food retail – 97% electricity; 3% gas ▶ Health – 92% electricity; 8% gas ▶ Food service – 46% electricity; 54% gas ▶ Other – 99% electricity; 1% gas <p>Average lifespan estimated to be 18 years. Average capital costs of implementation estimated to be \$11.7/m²In new builds, energy savings in 2020 estimated to be 28%. In new builds, energy savings in 2020 estimated to be 28%. Equipment run on electricity and gas/oil estimated to be 92% and 8% respectively. Equipment run on electricity and gas/oil estimated to be 92% and 8% respectively. Average lifespan of appliances etc estimated to be 15 years. Capital costs of implementation is \$15.7/m²</p>

25 It is assumed that consumption of other fuels is negligible in Macquarie Park's commercial buildings

26 The emissions intensity of electricity for the Education sector has been reduced in order to take account of Macquarie University's cogeneration plant and solar PV array

Measure	Action and Key Assumptions
Lighting	<p>Replace inefficient T12 or T8 fluorescent bulbs with new super T8 and T5 fluorescent bulbs; replace CFLs (compact fluorescent lamps) with LEDs (light emitting diodes).</p> <p>Install lighting control systems such as dimmable ballasts or photo-sensors to optimise light for occupants in a room. For example, installing master switches that are timed to turn off electricity overnight or occupancy sensors that switch off artificial lighting when no one is present. This is particularly effective in transient or intermittent spaces such as bathrooms, parking garages and storage areas etc.</p> <p>Retrofitting lighting offers the potential to reduce lighting energy consumption by:</p> <ul style="list-style-type: none"> ▶ Offices – 39% ▶ Non-food retail – 17% ▶ Education – 24%²⁷ ▶ Wholesale – 31% ▶ Community – 33% ▶ Accommodation – 44% ▶ Food retail – 16% ▶ Health – 17% ▶ Food service – 34% ▶ Other – 19% <p>Lifespan of lighting fixtures estimated to be 24 years. Capital costs of implementation estimated to be \$6.4/m²</p>
Water heating	<p>Replace standard gas water heaters with tankless gas, condensing gas, or solar water heater. Replace electric water heaters with heat pump or solar water heaters.</p> <p>Potential energy savings:</p> <ul style="list-style-type: none"> ▶ Offices – 32% ▶ Non-food retail – 48% ▶ Education – 13% ▶ Wholesale – 11%

²⁷ The potential for energy efficiency improvements from lighting for the Education sector has been reduced to reflect lighting upgrades already undertaken at Macquarie University.

Measure	Action and Key Assumptions
REDUCING ENERGY WASTE	
Energy waste reduction	<p>Remove or downsize unnecessary equipment such as lights or boilers. For example, lights can be positioned such that specific work areas or parts of a store can be illuminated, which can allow reductions in overhead lighting density. Similarly, many boilers used for hot water systems are larger than required, meaning that it takes more energy to heat water for which only a small portion of hot water is consumed. Energy savings in 2020 estimated to be 10% across all end uses. Capital costs of implementation is \$3.6/m²</p>
Insulation	<p>Improve the air-tightness of a building by sealing areas of potential air leakage, weather stripping doors and windows through wall/roof insulations, installing external shading (such as overhangs, shading devices and light coloured exteriors), or utilising standard sealants or caulking. This can reduce heat loss in winter (therefore reducing the need for heating) and keep buildings cooler in summer. Retrofitting insulation has potential to reduce HVAC energy consumption by:</p> <ul style="list-style-type: none"> ▶ Offices – 20% ▶ Non-food retail – 16% ▶ Education – 20% ▶ Wholesale – 1% ▶ Community – 19% ▶ Accommodation – 22% ▶ Food retail – 21% ▶ Health – 22% ▶ Food service – 20% ▶ Other – 15% <p>Lifespan of insulation estimated to be 56 years Capital costs of implementation estimated to be \$26.2/m²</p>

Measure	Action and Key Assumptions
CONSTRUCTION OF NEW BUILDINGS	
6 star new builds	<p>Achieving a 6 star rating in the GreenStar system (or NABERS equivalent when finalised)²⁸ for commercial new builds or refurbishments. These improvements could be achieved through a range of technical adjustments to the building’s design such as orientation, use of materials that improve thermal efficiency, improved natural ventilation and access to daylight, and use of recycled materials.</p> <ul style="list-style-type: none"> ▶ Office buildings are taken as a reference as they correspond to the average energy consumption per m2 in the building fleet ▶ New average energy consumption for central services is 68KWh/m2 ▶ Energy savings estimated to be 40% across all sectors. ▶ Assume average fuel mix across all sectors is electricity 80% and gas 20%. ▶ Lifespan of new build estimated to be 67 years. ▶ Capital costs of implementation is \$88.7/m2
DISTRIBUTED ENERGY GENERATION	
Cogeneration	<p>Install 12 MW of cogeneration plants to supply electricity and heat to Macquarie Park’s commercial buildings.</p> <ul style="list-style-type: none"> ▶ Assumes 26,800 MWh of electricity can be offset by the use of cogeneration by 2020. ▶ Capacity factor of 25%. ▶ Capital cost of \$3,000 per kW ▶ Opex of \$10/MWh ▶ Lifespan of each plant is 20 years.
Solar PV	<p>Install 800 kW of capacity on Macquarie Park’s commercial building rooftops, with excess energy fed back into the grid.</p> <ul style="list-style-type: none"> ▶ Assumes installation of 800 kW of solar PV by 2020. ▶ Generating capacity 1,140 MWh/year. ▶ Solar generating capacity in Sydney is 3.9 (i.e. 1 kW generates 3.9 kWh per day) ▶ Assumes network connection cost of \$10/MWh ▶ Fixed costs \$26/kW. ▶ Variable costs \$2.50/MWh. ▶ Capex per capacity is \$3.0/kW. ▶ Lifespan of solar PVs is 25 years.

²⁸ NABERS (National Australian Built Environment Rating System) is a performance-based rating system for existing buildings. NABERS is currently looking to extend its rating system to include 6 and 7 stars, in recognition of the fact that new buildings are becoming more efficient and some are already achieving higher than 5 stars. The key difference between the NABERS and GreenStar rating systems is that GreenStar awards ratings based on the technical environmental potential of a building, whereas NABERS awards ratings based on the actual performance of the building once occupied.

Measure**Action and Key Assumptions**

Residential buildings opportunity assumptions

IMPROVED ENERGY EFFICIENCY THROUGH TECHNOLOGY

Appliances and electronics

New appliances and electronics purchased are in the top performers of their category (named high-efficiency).

- ▶ Energy savings of 25% on appliance energy consumption and 25% on electronic energy consumption can be achieved.
- ▶ Capital costs of implementation is \$217/MWh of energy saved for appliances and \$60/MWh of energy saved for electronics.
- ▶ Lifespan for electronics is assumed to be 10 years for both electronics and appliances.

Lighting

Replace standard quartz halogen bulbs and CFLs (compact florescent lamps) with LEDs (light emitting diodes).

- ▶ Retrofitting residential homes by switching quartz halogen to LEDs and switching CFLs to LEDs to achieve energy savings of 47% and 30% respectively.
- ▶ Capital cost of implementation is \$331/MWh of energy saved for quartz halogen to LED; and \$447/MWh of energy saved for CFL to LED.

Building envelope (basic)

Basic retrofit including sealing areas of air leakage, weather stripping doors and windows, insulating attic and wall cavities.

- ▶ Average of 15% HVAC energy savings
- ▶ Capital costs of implementation is \$8/m²
- ▶ Lifespan of insulating assets is assumed to be 25 years.

HVAC (heating, ventilation and air-conditioning)

New air conditioners and space heaters purchased are in the top performers of their category (named high-efficiency).

Improved maintenance: improved duct insulation, correct level of refrigerant and new air filters.

- ▶ Energy savings potential of 6% on gas heating; 16% on electric heating; and 12% on air-conditioning.
 - ▶ Improved maintenance of HVAC systems can achieve an average further savings of 8%.
 - ▶ Incremental capital cost of implementation for gas heating system upgrade is \$2/m²; electric is \$10/m²; air-conditioning is \$0.40/m²; and improved maintenance is \$2/m².
 - ▶ Lifespan for all HVAC technologies is assumed to be 20 years.
-

Measure	Action and Key Assumptions
Building envelope (advanced)	<p>Retrofit to 'passive' standard, in conjunction with regular building renovations. Includes installing high efficiency windows and doors; increasing outer wall, roof, and basement ceiling insulation; mechanical ventilation with heat recovery, basic passive solar principles.</p> <ul style="list-style-type: none"> ▶ Retrofitting residential houses to 'passive standard with advanced insulation offers HVAC energy savings of 70% on average. ▶ Capital costs of implementation is \$64/m² ▶ Lifespan of insulating assets is assumed to be 30 years.
CONSTRUCTION OF NEW BUILDINGS	
7 star new builds	<p>New houses are built to 7 stars according to House Energy Rating Schemes (HERS) such as NatHERS.</p> <p>Improvements above those achieved through BASIX could be attained through improved building design and orientation, use of materials that improve thermal efficiency, etc.</p> <ul style="list-style-type: none"> ▶ Energy savings of 11kWh/m² can be achieved by increasing efficiency from 4 to 7 stars ▶ Incremental capital costs of \$24/m² ▶ Lifespan of new houses assumed to be 50 years.



This report, as well as the Low Carbon Growth Plan for Australia and ClimateWorks' other reports can be accessed at www.climateworksaustralia.org.

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