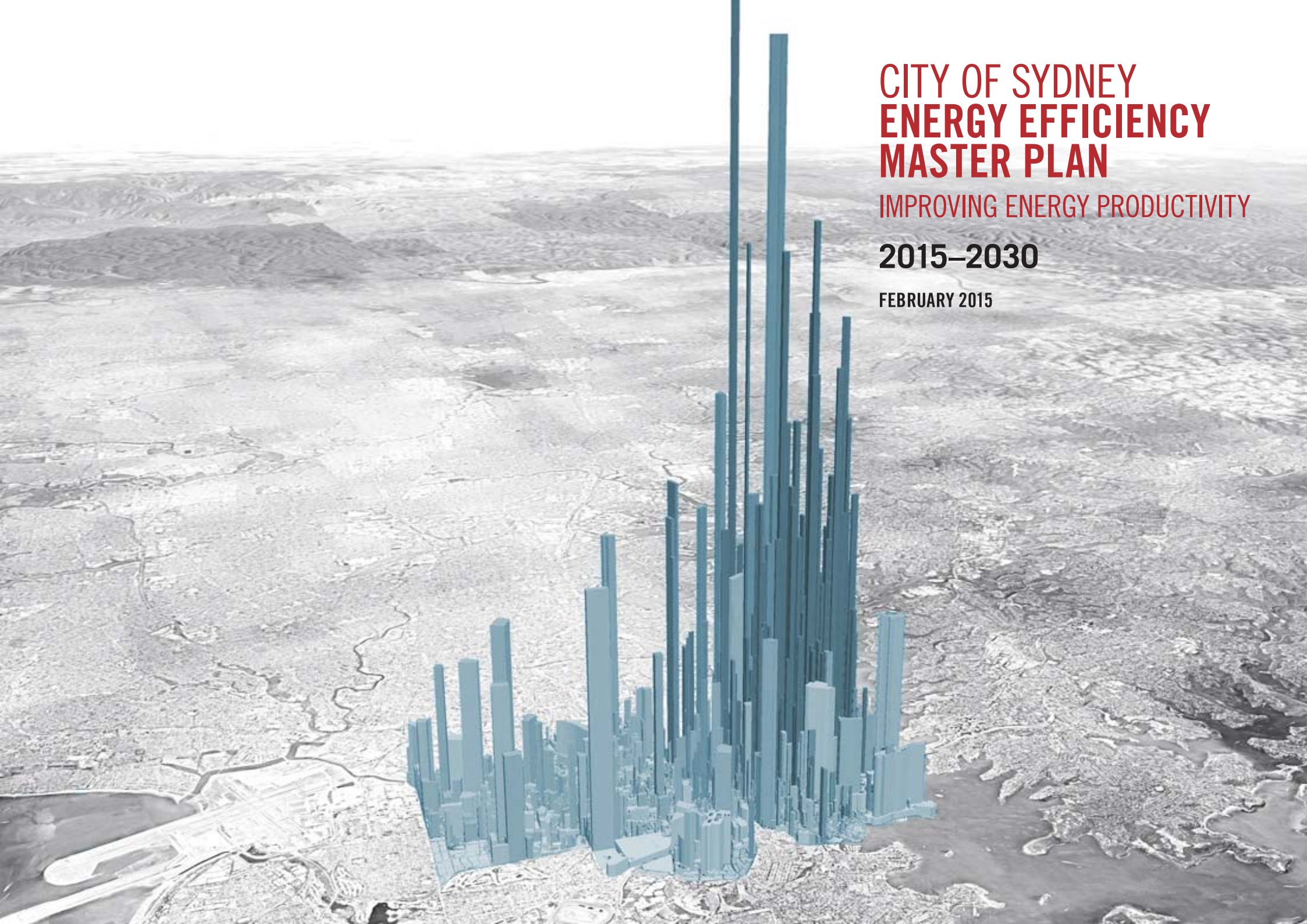
ATTACHMENT A

DRAFT ENERGY EFFICIENCY MASTER PLAN



CITY OF SYDNEY
ENERGY EFFICIENCY MASTER PLAN

IMPROVING ENERGY PRODUCTIVITY

2015–2030

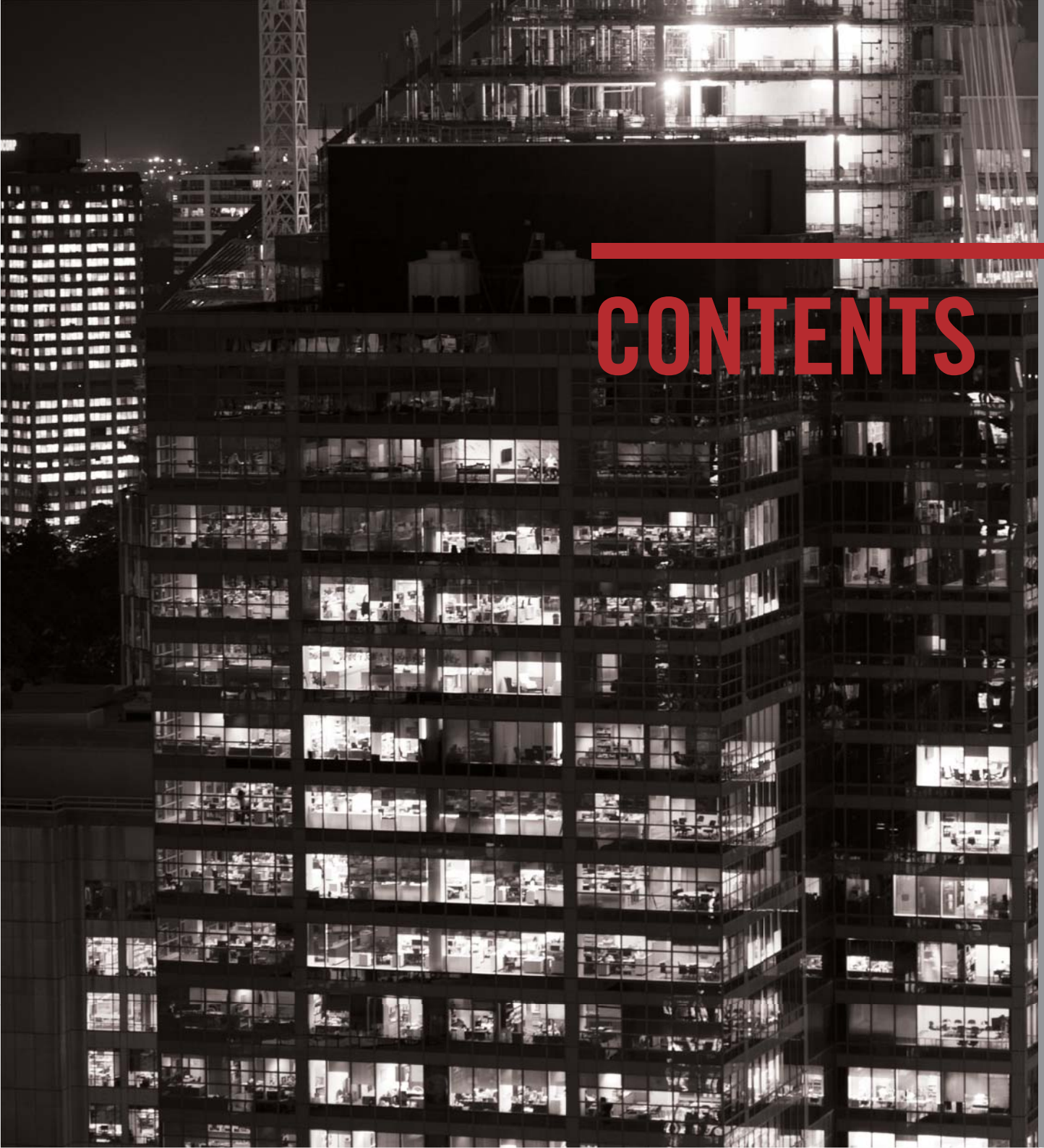
FEBRUARY 2015

ACKNOWLEDGEMENTS

The City wishes to acknowledge and thank **pitt&sherry** and **Exergy** (acquired by Energy Action in 2014) for undertaking the energy efficiency technical analysis required for the Master Plan.

Front cover designed by Kinesis.

This Master Plan has been prepared by the City of Sydney



CONTENTS

FOREWORD

Sydney can be one of the world's most energy efficient cities by 2030. This Energy Efficiency Master Plan maps the way; using knowledge gained in just the past few years and robust modelling.

Energy consumption from buildings in the local government area could fall by 31 per cent by 2030 compared to 2006 levels. That is equal to almost two million tonnes $CO_{2\text{-}e}$ saving, making it the single largest contribution toward meeting the City of Sydney's goal to reduce greenhouse gas emissions by 70 per cent by 2030.

Climate change is the most important issue facing our city, nation and planet. Scientists agree we've reached a critical decade, and we must take action now to reduce our emissions and adapt to a changing climate.

Energy efficiency is the cheapest way of cutting greenhouse gas emissions, which is why the City of Sydney has developed this Energy Efficiency Master Plan. The Plan complements the range of other climate and environment initiatives in our world recognised *Sustainable Sydney 2030* Plan.

Sydney can be one of the world's most energy efficient cities by 2030, and the City of Sydney's Energy Efficiency Master Plan provides a roadmap for how it can be achieved.

Improving the energy efficiency of our buildings not only contributes to efforts to address climate change, it makes sound business sense. In fact, it is vital to future economic competitiveness.

As our Plan demonstrates, businesses and residents can make substantial cost savings by upgrading equipment, improving building design and making behavioural changes.

Using cutting-edge research and robust economic modelling, the Master Plan demonstrates that by implementing measures which pay themselves off within three years, energy consumption by the city's buildings could be reduced 31 per cent by 2030 on 2006 levels.

That is equal to almost two million tonnes of greenhouse gases, making it the single largest contribution toward meeting the City of Sydney's target to reduce greenhouse gas emissions by 70 per cent by 2030 – and it would reduce energy bills for businesses and residents by $604 million.

The good news is that Sydney is already improving its energy efficiency. Since 2006, energy use in buildings has fallen 5 per cent whilst employment grew by 17 per cent, businesses by 13 per cent and population by 12 per cent.

The City has pioneered a series of successful initiatives, such as the Better Building Partnership with the owners of 60 per cent of Sydney's office space. Last year, the Better Building Partnership collaboration resulted in a cost saving of $25 million and greenhouse emissions savings of 31 per cent for its members.

The City's initiatives have been recognised by the C40 (an international collaboration of global cities) by being selected as the co-chair of the C40 Private Buildings Efficiency Network.

However, the Energy Efficiency Master Plan illustrates enormous potential for greater energy efficiency exists across our building stock – the non-premium offices, car parks, apartments, shopping centres, and accommodation buildings.

There are significant barriers to improving energy efficiency, such as low awareness or understanding, split incentives between the building owners who must make the investments and the tenants who benefit from the energy savings, and access to finance and the upfront cost.

The Energy Efficiency Master Plan proposes eleven actions to address these barriers, including measures to improve the efficiency of our own buildings, education and training, building retrofits and tune-ups, and improving access to finance.

It will require collaboration between different levels of Government, but also the many different people and organisations who influence the efficiency of our buildings – the building owners, managers and occupiers, the technicians, the product suppliers.

I look forward to working with as many people as possible to make Sydney a global leader in energy efficiency.

Clover Moore
Lord Mayor
City of Sydney


UTS

UNLOCKING THE MASTER PLAN

THIS MASTER PLAN DRAWS ON LEADING ANALYSIS ABOUT THE IMPACT FROM EXISTING AND NEW ENERGY EFFICIENCY POLICIES AND PROGRAMS FOR BUILDINGS IN THE CITY OF SYDNEY. THE RESULTS ARE COMPELLING.

1. Total energy use in buildings has fallen five per cent in the City of Sydney from 2006 to 2012 and continues to decline.
2. Over this period employment grew by 17 per cent, new businesses by 13 per cent, population 12 per cent, new dwellings seven per cent, and total floor space four per cent.
3. Sydney's economy is one of the strongest in Australia and there is now a clear decoupling of energy from economic growth.
4. This Master Plan can double energy productivity – the economic output per unit of energy input – across the local government area by 2030.
5. Intervention is needed to realise the full potential for energy efficiency to benefit society.

This Master Plan shows the huge potential to reduce energy use and boost productivity in the City of Sydney.

By 2030, total energy and greenhouse gas emissions could be one-third lower than they were in 2006 levels – all while Sydney enjoys significant economic growth, new buildings, increasing population, new jobs and major redevelopments.

Since 2006, energy used by buildings has already dropped by five per cent – at the same time as Sydney experienced one of the fastest economic growth rates in the country. This trend is measured as improved "energy productivity" – the amount of economic output per unit of energy input. It demonstrates clearly how economic growth no longer requires more energy consumption in a modern economy.

Our residents and businesses are increasingly informed and are taking action to stop wasting energy and money. They are acting to avoid higher bills, counteracting the impact of rising energy prices.

With technology, automation and control, energy efficiency will make the biggest contribution to reducing greenhouse gas emissions and improving productivity. At the same time, every dollar not spent unnecessarily on energy can be used for other priorities that improve daily life in the City.

As technologies improve and people become more engaged, energy efficiency will make the most significant contribution to reducing greenhouse gas emissions and improving productivity. Every dollar spent unnecessarily on energy can be used for higher order purpose.

Energy efficiency pays for itself – the actions recommended in this Master Plan would reduce energy by 31 per cent and be paid back within three years in reduced energy bills. With such a strong economic case we must ask ourselves why many more actions have not already been taken up by our residents and businesses. Despite the multiple benefits of energy efficiency, intervention is required.

This Master Plan identifies how we can collectively make it possible to realise the benefits of an energy efficient society. Simply waiting for the market to deliver may delay cost-effective efficiency improvements and lock energy users into higher than necessary energy costs.

Modelling for this Master Plan was undertaken by pitt&sherry based on extensive audits of buildings in the Sydney local government area undertaken by Exergy. The pitt&sherry report forms the technical appendix to this Master Plan.

The term 'cost-effective' in this Master Plan is used where the future benefits of an investment, program or policy exceed the associated costs (based on present value discounted at the rate of seven per cent real per annum). This means a benefit cost ratio of one or more.

WHAT IS THIS MASTER PLAN PROPOSING?

While there are many compelling reasons for energy efficiency, intervention is required to realise the full potential of energy efficiency. This Master Plan makes the case that it is imperative to keep existing successful policies and programs in place which are already improving the energy efficiency of buildings, then to build on progress with new initiatives that engage our community, raise minimum standards, and ensure buildings perform as designed.

TABLE 1. SUMMARY OF KEY ENERGY SAVINGS IN THE BUILDING SECTOR (TJ)

2006 baseline	Terajoules (TJ)	2030 forecast	2030 saving p.a.	2006–2030 change
18,473	**FUTURE WITHOUT ENERGY EFFICIENCY**			
	@ 2006 efficiency levels	23,305	–4,833	+26%
	ENERGY SAVINGS PROPOSED BY THIS MASTER PLAN			
	Existing policies and programs	16,585	6,720	–36%
	New policies and programs	19,364	3,941	–21%
	NET RESULT	**12,644**	**5,829**	**–31%**

TABLE 2. SUMMARY OF KEY GREENHOUSE GAS EMISSIONS SAVINGS IN THE BUILDING SECTOR (T)

2006 baseline	Million tonnes ($MtCO_{2\text{-}e}$)	2030 forecast	2030 saving p.a.	2006–2030 change
4.75	**FUTURE WITHOUT ENERGY EFFICIENCY**			
	@ 2006 efficiency levels	5.26	–0.51	+11%
	EMISSIONS SAVINGS PROPOSED BY THIS MASTER PLAN			
	Existing policies and programs	3.65	1.61	–34%
	New policies and programs	4.38	0.88	–19%
	NET RESULT	**2.77**	**1.98**	**–42%**

TARGETS

Detailed modelling undertaken by pitt&sherry has identified that existing and new energy efficiency policies and programs may cost-effectively reduce energy consumption in buildings across the local government area without negatively affecting growth. Based on this assessment, this Master Plan has established the following targets for the City of Sydney.

- 31 per cent energy saving across the entire City of Sydney building sector by 2030 based on 2006 levels.
- Improved energy productivity commensurate with a target to double Australia's energy productivity by 2030 compared to 2010.

1. This Master Plan calls for compliance with existing policies and programs; new policies and programs; targets for energy and emissions; and enabling actions to make this happen.
2. Keeping existing energy efficiency policies and programs is critical for continued energy and emissions savings.
3. Rising energy prices, climate change and the enormous productivity potential makes now the right time for energy efficiency.
4. Energy efficiency is the best, low-cost outcome irrespective of where energy comes from.

THE CASE FOR ENERGY EFFICIENCY

There are multiple benefits of energy efficiency beyond the substantial cost savings. Using energy efficiently is a top priority for saving precious resources, improving productivity and resilience, and maintaining Sydney's position as one of the most desirable cities to live and work in.

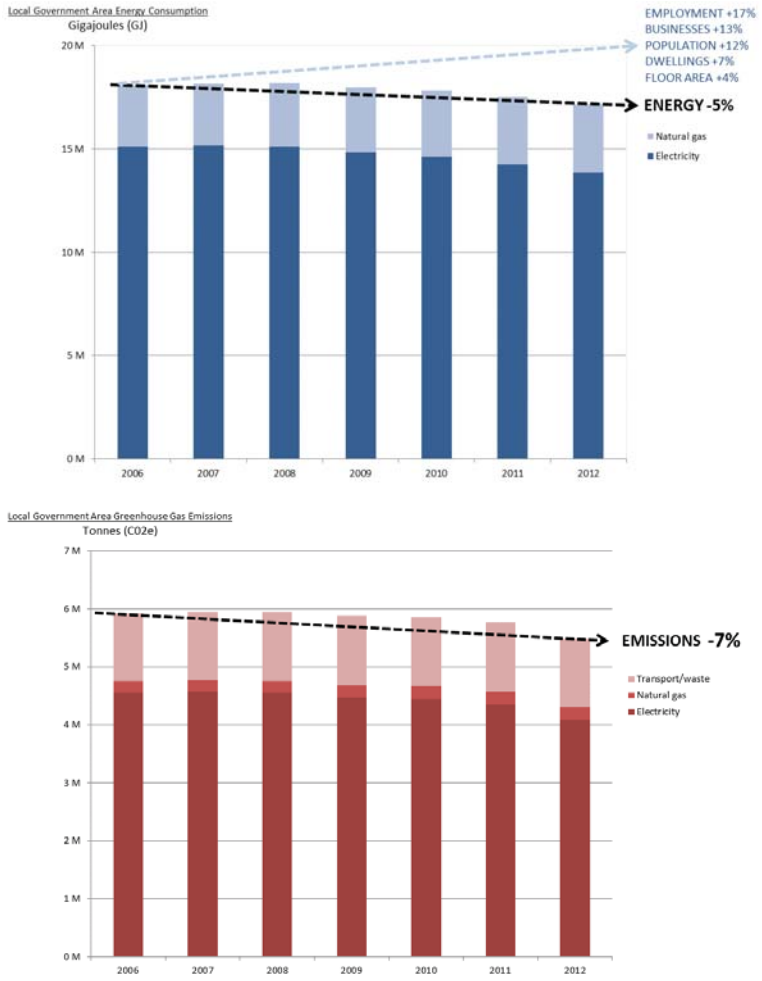
The International Energy Agency (IEA) defines 15 substantial benefits to society from improving energy efficiency including energy security, better utilisation of networks and infrastructure, and job creation. Both the steep rise in energy prices in recent years and the compelling need to constrain carbon emissions are key reasons why energy efficiency is necessary for future proofing our city.

ENERGY USE AND EMISSIONS ARE FALLING

We can already see the results of energy efficiency initiatives in our city; total electricity and gas consumption has fallen in recent years. The overall downwards trend in energy and greenhouse gas emissions for all buildings in the local government area is shown in Figure 1.

This decline reflects the efforts of individuals and businesses. For example the Better Buildings Partnership (BBP), which represents the owners of over half of the commercial office space in the city centre, reduced energy consumption by 27 per cent since 2006 by June 2013.

FIGURE 1. CITY OF SYDNEY LOCAL GOVERNMENT AREA ENERGY AND GREENHOUSE GAS EMISSIONS TREND



This falling energy trend has occurred at the same time as rapid economic growth, with increases in employment, new businesses, jobs, new dwellings and floor area. Over the past five years more than 2,000 new business and 50,000 jobs have been created. This represents 40 per cent of total job growth across the entire Sydney metropolitan area. Sydney generates around 25 per cent of the economic activity of New South Wales and approximately eight per cent of national gross domestic product.

Economic growth in Sydney is becoming decoupled from growth in energy use – a trend also observed elsewhere as efficiencies improve and energy usage behaviours change. However, without intervention, the potential for energy efficiency in the heart of Sydney will not be realised due to a range of barriers. These include the split incentive (where landlords make investments while tenants gain the benefits), complex decision-making processes, limited interest and access to capital.

The total floor area for buildings is estimated to increase by 29 per cent between 2006 and 2030, to around 10 million square meters. Without intervention, total energy use will increase. However, this Master Plan shows that despite growth, the recent falls in energy consumption and emissions can continue with existing and new energy efficiency measures.

SYDNEY CAN DOUBLE ENERGY PRODUCTIVITY

The Master Plan will significantly boost energy productivity, which is the economic output per unit of energy input. Any money not spent on energy can be used for other priorities. The link between energy efficiency and economic productivity is well recognised by economists and governments.

The City of Sydney is signatory with the Australian Alliance to Save Energy (A2SE) to a joint statement to double Australia's energy productivity by 2030.

TABLE 3. DOUBLING ENERGY PRODUCTIVITY BY THIS MASTER PLAN

	2010	2030
GDP	$100.8B	$166.1B
Total energy (terajoules)	17,820	12,644
$GDP per megajoule	$5.66	$13.14
Per cent of 2010 GDP	100%	232%

FIGURE 2. JOINT STATEMENT ON LIFTING ENERGY PRODUCTIVITY

2XEP Doubling Australia's Energy Productivity

AUSTRALIAN ALLIANCE TO SAVE ENERGY Creating an Energy-Efficient Australia

Joint Statement on

LIFTING AUSTRALIA'S ENERGY PRODUCTIVITY

We, the undersigned, agree that there is an urgent need to rapidly and substantially increase Australia's energy productivity. We must create more economic value for each unit of energy used to improve Australia's overall economic productivity.

In the last decade, Australia has lost its competitive advantage in energy costs. We must act now to lift energy productivity, as well as addressing energy prices. If we fail to do so, Australia faces continued decline in competitiveness, more job losses and further pressure on household energy bills.

While the economic potential for lifting energy productivity varies from sector to sector, there are major opportunities across the Australian economy. Business and government should collaborate to set and meet appropriate objectives to harness these opportunities. This will create new business opportunities and jobs, improve fuel security, reduce unnecessary capital investment in energy infrastructure, and moderate consumer and enterprise energy bills.

Therefore:

1. **We declare that Australia has an economic imperative to lift energy productivity.**
2. **We will contribute to a partnership of business, community and government to develop within 12 months an Energy Productivity Roadmap to improve Australia's energy productivity.**
3. **We support, subject to the findings of the Energy Productivity Roadmap, setting an overall target to double Australia's energy productivity by 2030 compared to 2010, and reporting annually on progress towards this goal.**

Signed:

Australian Industry Group · NSW Farmers · VISY For a Better World · Clean Energy Council · ENERNOC · energetics · Green Energy Trading · ICANZ · ClimateWorks Australia · TransGrid · NSW Business Chamber · City of Sydney · LJ Hooker

TECHNOLOGIES ARE CHANGING

This Master Plan models the energy and emissions savings that could be achieved through policies and programs based on technologies that are cost-effective and commercially available today. This includes major equipment like heating, cooling and air conditioning (HVAC) plant, as well as lighting, pumps, control systems and other technologies.

However, we are seeing rapid changes in both the efficiency and range of technologies available. Shifts in refrigerants, efficient lighting, and predictive building controls are likely to become mainstream technologies before 2030 which would generate savings over and above those proposed by this Master Plan. Energy efficiency opportunities will continue to grow as technology changes over time and the market for energy efficiency products and services evolves.

BENEFITS EXCEED THE COST

The total marginal costs for the new technologies, retrofits, policies and programs proposed by this Master Plan is $396.1 million, which would result in $604 million in energy savings over the life of the projects. The net savings to constituents of the City of Sydney is almost $208 million. This translates into around $1.50 in energy cost savings for every dollar invested into energy efficiency proposed by this Master Plan.

TABLE 4. ECONOMIC PERFORMANCE[1] OF EXISTING AND NEW POLICIES AND PROGRAMS 2015–2030

Sector	Total cost (AUD $m 2014)	Total cost saving (energy) (AUD $m 2014)	Net savings (AUD $m 2014)	% of 2010 GDP	Benefit cost ratio
Residential	$219.9	$377.5	$157.6	0.2%	1.7
Non-residential	$176.2	$226.7	$50.6	0.1%	1.3
Total	**$396.1**	**$604.2**	**$208.1**	**0.2%**	**1.5**

Further savings would be realised by all energy users connected to the same electricity transmission and distribution grids through avoided or deferred network expenditure as a result of the energy savings (meaning less investment needed to augment the poles and wires). Network cost saving estimates are listed in Chapter 4, however.

Energy efficiency opportunities proposed in this Master Plan are estimated to boost labour demand by around 470 full time equivalent (FTE) jobs during the investment phase and 130 FTE in the longer term. This is far greater than an estimated 24 job losses from traditional energy supply industries due to falling energy demand[2].

1. Sydney can be one of the world's most energy efficient cities by 2030.
2. This Master Plan shows 31 per cent energy saving in buildings is feasible by 2030 with net saving to society of $208 million.
3. The financial benefit proposed in this Master Plan is greater than the cost.
4. In addition to energy savings, this Master Plan could avoid millions of dollars' worth of network capacity.

1. Sectors with the highest energy intensity (megajoules per square metre) are cold storage, shopping centres, health, accommodation, education and non-premium grade office buildings.

2. More than three-quarters of total energy is consumed by non-premium office buildings, apartments, A-grade office buildings, accommodation and car park sectors – presenting the biggest opportunities for energy savings policies and programs.

3. Heating, ventilation and air conditioning (HVAC); lighting; equipment and appliances; space heating and hot water are the major energy uses and account for around 75 per cent of energy used by buildings.

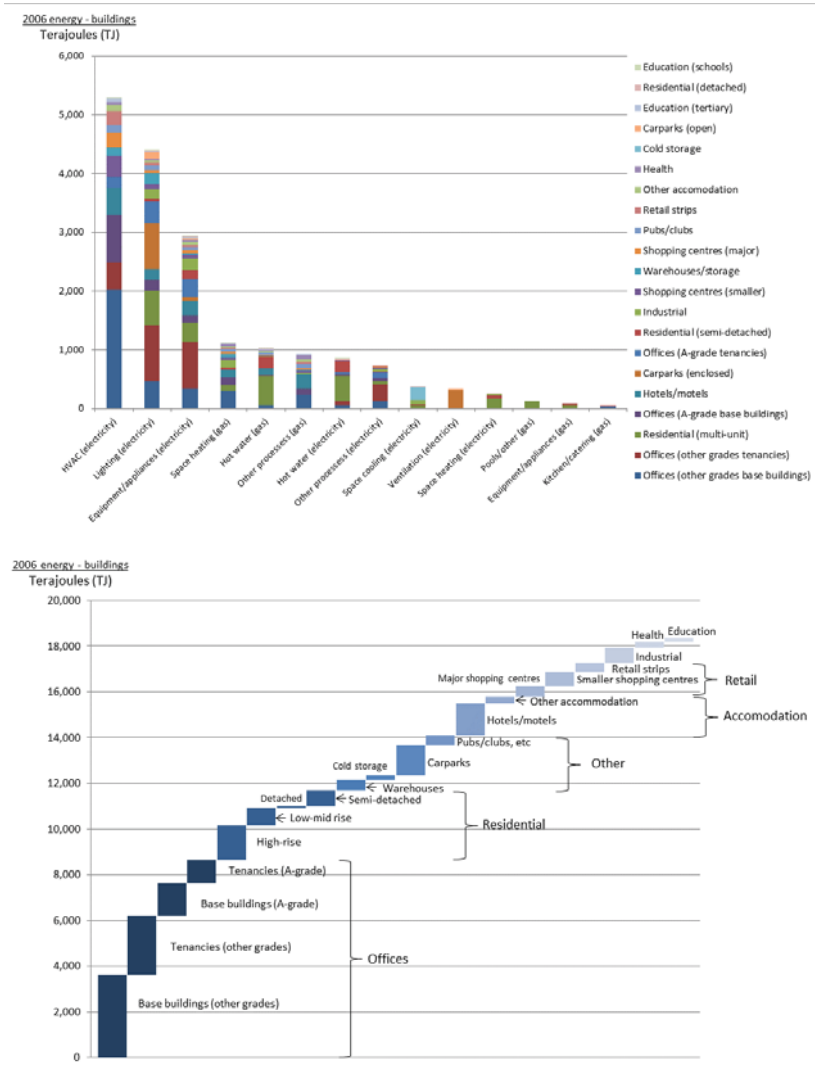
WHERE DOES THE ENERGY GO?

This Master Plan relies on a world leading assessment of energy flows conducted by the specialist consultancy pitt&sherry for the City of Sydney.

The detailed modelling tells us that the majority of energy used by buildings in the City of Sydney is consumed in heating, ventilation and air conditioning (HVAC), lighting and other equipment. These are the greatest opportunities for improvement and are the focus for policies and programs.

The largest energy-using sector is non-premium office buildings. These buildings make up a moderate proportion of total floor space and with typically high energy intensity. Apartment buildings make up a large proportion of the city but have relatively low energy intensity. Premium grade office base buildings are also relatively efficient; however, collectively they use a lot of energy owing to their prevalence.

FIGURE 3. 2006 TOTAL ENERGY BY SECTOR AND END-USE



EXISTING PROGRAMS ARE KEY

Existing policies and programs make a substantial contribution to reducing energy and emissions in the future. The City will work with other levels of government and key stakeholders to ensure the following initiatives are maintained or extended.

Minimum performance standards

- Minimum Energy Performance Standards (MEPS).
- NSW Building Sustainability Index (BASIX).
- National Construction Code (NCC).

Information and incentive programs

- Commercial Building Disclosure (CBD).
- Green Star.
- National Australian Built Environment Rating Scheme (NABERS).
- NSW Energy Savings Scheme (ESS).

Targets and strategies

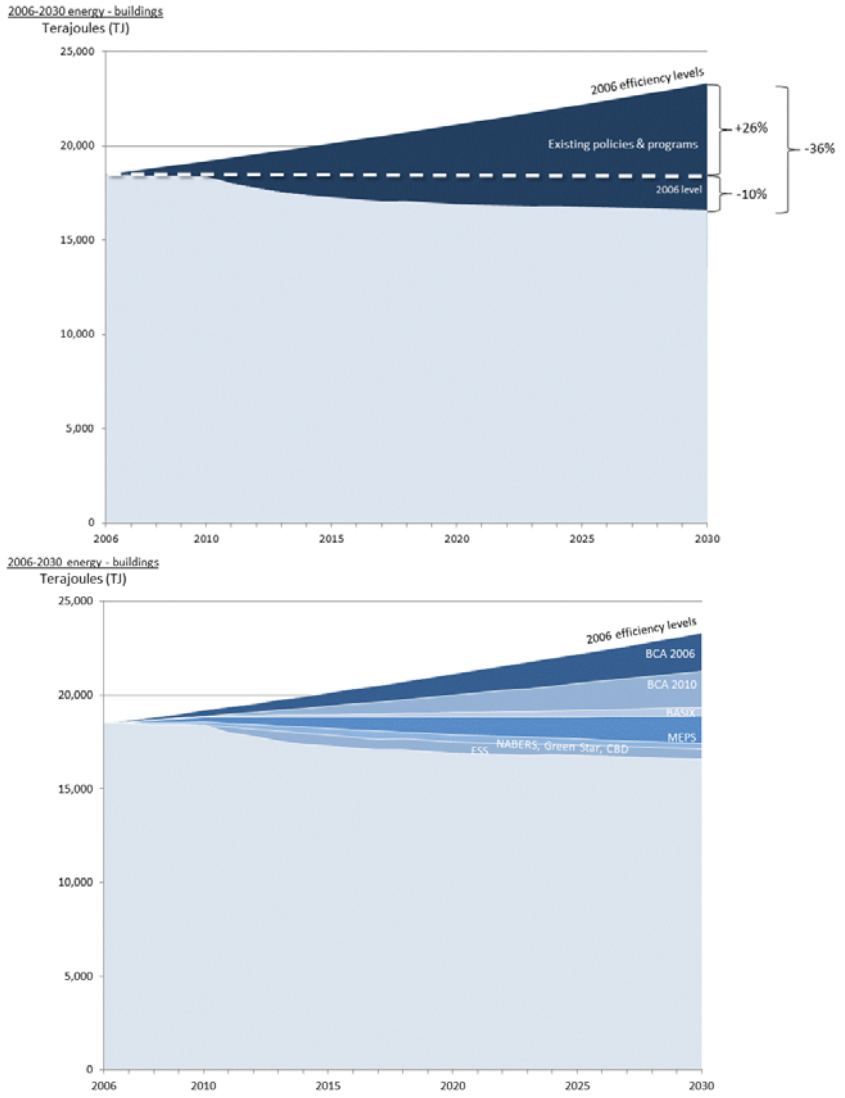
- NSW Government Resource Efficiency Policy (GREP).
- Australian greenhouse gas emissions target(s).
- Australian and State Governments Energy Efficiency Strategy.

City of Sydney programs

- Better Buildings Partnership (BBP).
- CitySwitch Green Office.
- Smart Green Business.

If the existing policies and programs are simply maintained – a mix of market-based mechanisms, partnerships, rating tools, information programs and regulation – the modelling predicts they would reduce total energy by 10 per cent below 2006 levels for all buildings across the local government area by 2030. Without these programs total energy would increase by 26 per cent over the period.

FIGURE 4: 2006–2030 TOTAL ENERGY (EXISTING POLICIES AND PROGRAMS SCENARIO)



GOING BEYOND MINIMUM STANDARDS

There is a significant future role for building codes, minimum energy performance standards for appliances, building rating tools and voluntary programs at current levels. However, there is uncertainty surrounding levels of compliance with codes and whether buildings perform as well as designed and intended.

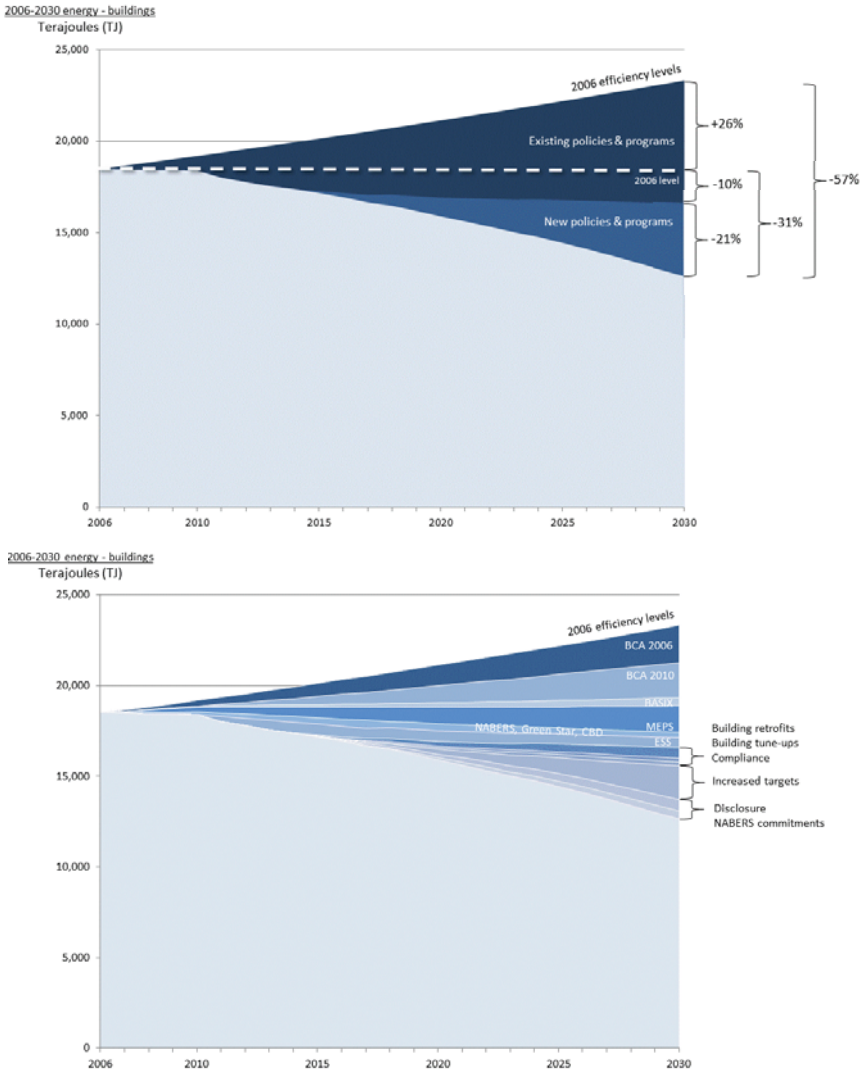
In addition to ensuring that existing policies and programs are working, our analysis identifies scope to increase codes and standards beyond current levels for greater efficiency while still being cost-effective.

New policies and programs scenarios modelled for this Master Plan include:

- Building retrofits and tune-ups.
- Improved compliance and targets for existing building codes.
- Mandatory disclosure of energy performance of buildings.

These have been identified as ready opportunities that are based on already established and accepted frameworks. Together with existing policies and programs the savings would be 31 per cent below 2006 levels by 2030.

FIGURE 5: 2006–2030 TOTAL ENERGY CONSUMPTION (EXISTING AND NEW POLICIES AND PROGRAMS SCENARIO)



PRIORITY TO REDUCE EMISSIONS

Australia has amongst the highest greenhouse gas emissions per person in the world. Reversing this undesirable trait requires significant decarbonisation of our economy through energy efficiency and the transition away from polluting energy sources.

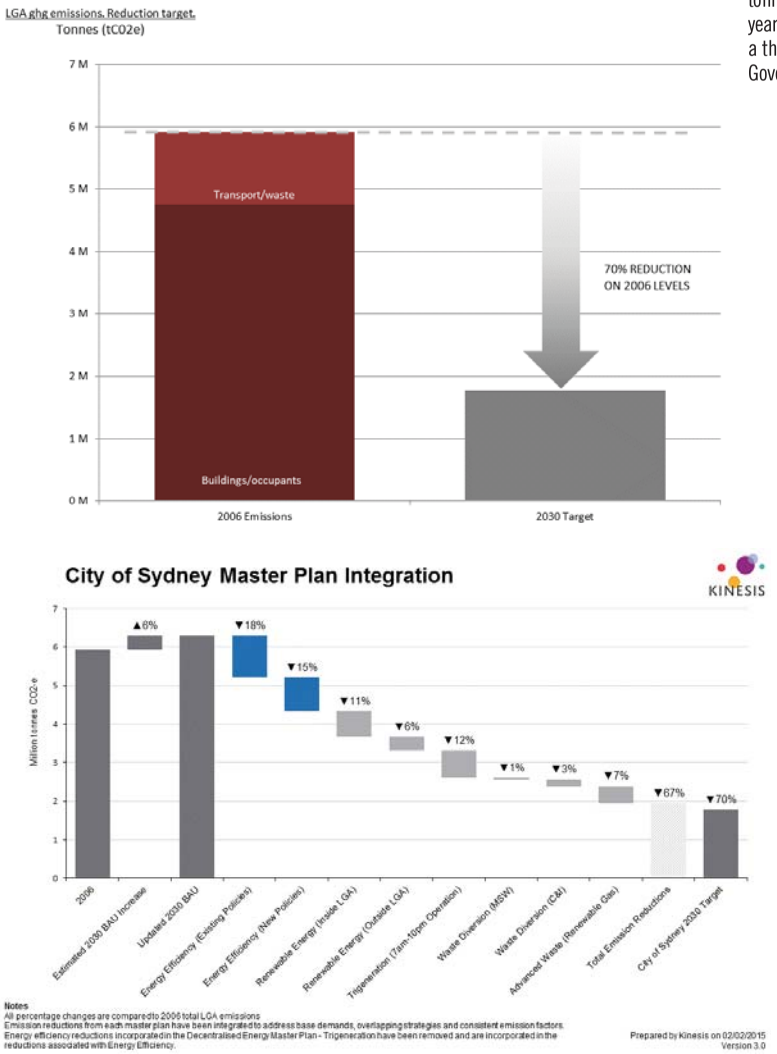
Sustainable Sydney 2030 is the green, global and connected vision for the City of Sydney. It was developed through extensive consultation and reflects our whole community's expectations. A headline target is to reduce 2030 greenhouse gas emissions for the local government area by 70 per cent based on 2006 levels.

To achieve this ambitious vision the City has developed a Green Infrastructure Plan which includes this Energy Efficiency Master Plan in addition to:

- Decentralised Energy Master Plan – Renewable Energy.
- Decentralised Energy Master Plan – Trigeneration.
- Advanced Waste Treatment Master Plan.
- Decentralised Water Master Plan.

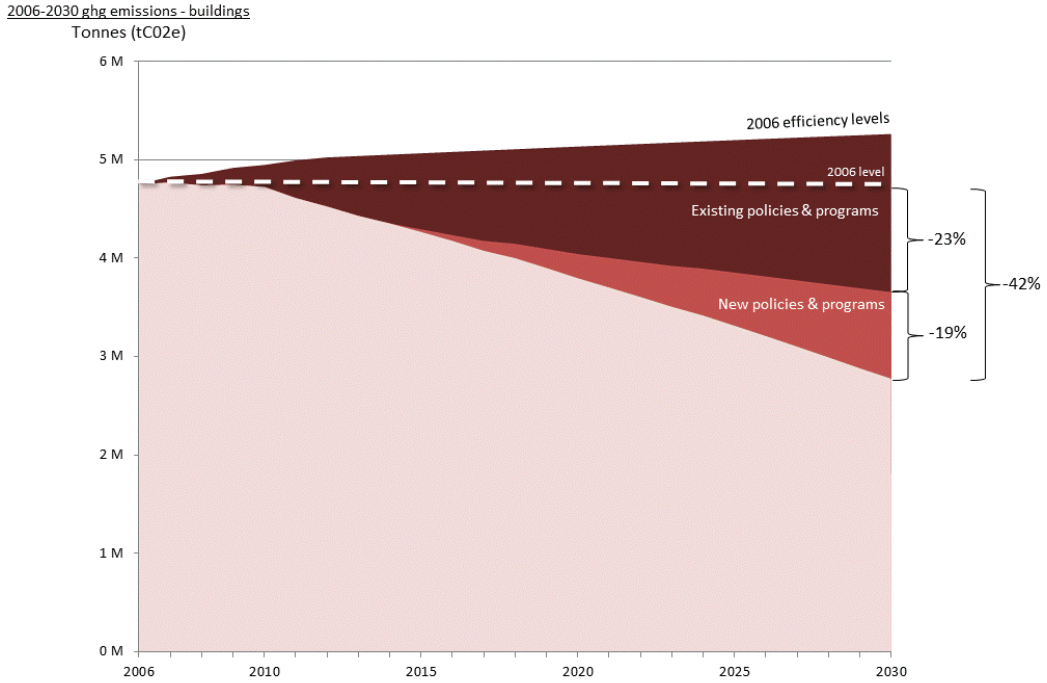
The City has conducted extensive modelling in developing these Master Plans. The results show that energy efficiency is the single greatest, most cost-effective and environmentally beneficial opportunity toward achieving the City's target to reduce emissions by 70 per cent by 2030 based on 2006 levels.

FIGURE 6. TRACKING THE 2030 EMISSIONS TARGET



Continuing existing and new policies and programs would avoid almost two million tonnes greenhouse gas emissions per year by 2030. This is substantial – over a third of the emissions of the total Local Government Area.

FIGURE 7: 2006–2030 TOTAL ENERGY (EXISTING AND NEW POLICIES AND PROGRAMS SCENARIO)



1. Energy efficiency is cost-effective and will make the most significant contribution – almost half – of the City's emissions target.
2. Existing policies such as building codes and energy standards can save one million tonnes of $CO_{2\text{-}e}$ each year by 2030.
3. With new policies and programs, cost-effective energy efficiency can save almost two million tonnes of $CO_{2\text{-}e}$ each year which is 42 per cent below 2006 buildings emissions, or 31 per cent of total LGA emissions.
4. Largest energy and emissions savings are attributable to mandatory efficiency measures.
5. The greenhouse gas abatement proposed by this Master Plan is negative cost – that means for every tonne saved there is a net benefit to the community.

A compelling reason for energy efficiency is that the costs of implementation are typically recovered by the savings in energy outgoings which effectively means that no significant additional spend is required to reduce greenhouse gas emissions.

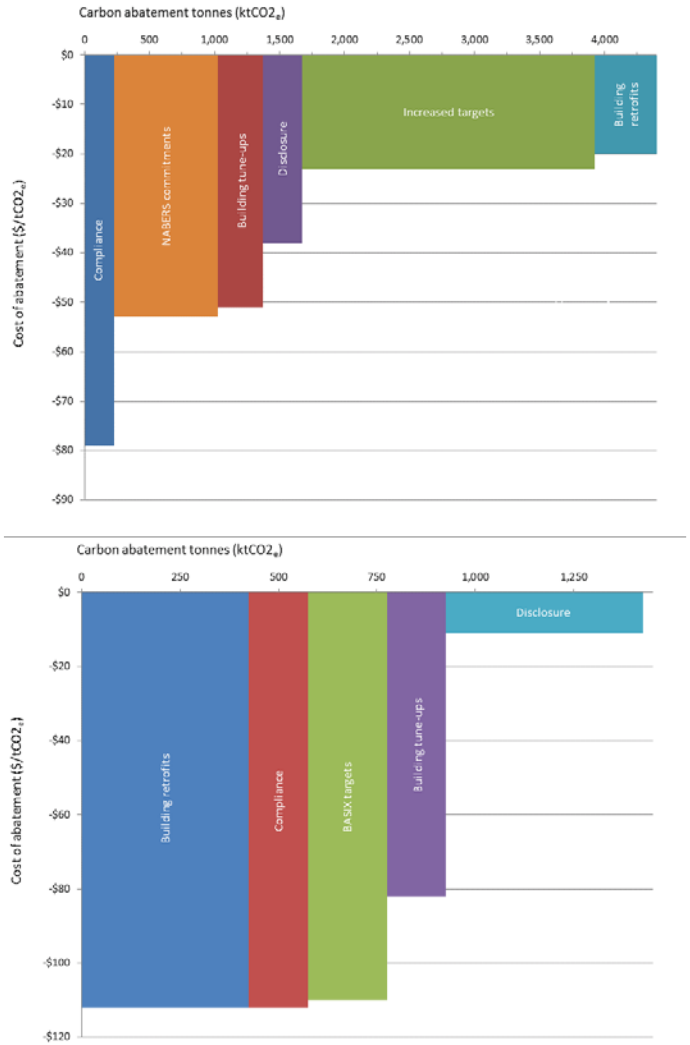
This is shown in Figure 8 which looks at the marginal cost to society (the social cost) of carbon abatement for new policies and programs proposed by this Master Plan. The width of each bar denotes the emissions savings potential. The vertical axis shows the marginal cost to implement each measure.

A 'negative' cost of carbon abatement (shown below the $0 line) means that there is a net economic benefit to society for each tonne of carbon abated. Figure 8 shows the cost of abatement for non-residential buildings (top) and high-rise apartments (bottom) – the two most common building types in the local government area.

All new policy and program measures modelled indicate a negative cost of carbon abatement with the exception of voluntary disclosure programs as these would have limited energy savings compared with the cost.

FIGURE 8. ABATEMENT COST CURVES FOR BUILDINGS

TOP GRAPH: NON-RESIDENTIAL BUILDINGS; BOTTOM GRAPH: HIGH RISE RESIDENTIAL



The most compelling opportunities to reduce greenhouse gas emissions in non-residential buildings relate to the performance of new buildings and upgrades to heating, ventilation and air conditioning (HVAC) of existing buildings. For residential buildings, the largest opportunities are mandatory disclosure, building retrofits and higher efficiency standards for new buildings.

MAKING IT HAPPEN

The City of Sydney has invested in this Master Plan to foster a more efficient, resilient, prosperous, liveable and competitive city. The analysis demonstrates the importance of retaining existing programs and policies and identifies where increasing minimum practice can be done cost-effectively.

We cannot implement this Plan alone. Implementing energy efficiency for buildings in the local government area will be a shared responsibility for all levels of government, businesses and residents, in partnership with the City of Sydney.

The City recently entered into an agreement with the NSW Government to work together on programs to realise this Master Plan, the Advanced Waste Treatment Plan and the NSW Energy Efficiency Action Plan. This partnership is essential for delivering on our commitments and ensuring the best outcomes for all energy users.

New models for financing energy efficiency projects are emerging that will overcome barriers such as the split incentive (concerning who pays for and who benefits from energy efficiency upgrades).

This Master Plan includes 11 enabling actions. The City of Sydney has varying roles in ensuring implementation of these actions. The enabling actions are:

1. **Safeguard energy savings** – *by maintaining core existing programs.*
2. **Improved building compliance** – *ensure buildings meet standards and codes.*
3. **Raising the bar** – *increasing minimum practice.*
4. **Show by doing** – *best practice for City of Sydney owned buildings.*
5. **Education, training and capacity-building** – *working with businesses and residents.*
6. **Building tune-up program** – *optimising building controls and operations.*
7. **Building retrofit program** – *plant and equipment upgrades.*
8. **Access to finance and incentives** – *funding to improve energy efficiency.*
9. **Ratings and disclosure** – *for sectors where there are gaps.*
10. **Sector targets and monitoring** – *for feedback and evaluation.*
11. **Equity** – *for low income sectors.*

While energy efficiency technologies continue to improve and costs fall, it is people who decide to implement energy efficiency measures and use resources wisely. The City of Sydney looks forward to working with you to make this Master Plan happen.

1. Continuing our successful working relationship with the NSW Government and other partners are essential for achieving the energy savings proposed by this Master Plan

2. It is people who make energy efficiency happen, and we need to build skills and motivation to turn this Master Plan into actual energy savings.

1. ENERGY EFFICIENCY OPPORTUNITIES

2.

3.

4.

5.

6.

ABOUT THIS MASTER PLAN

The City of Sydney has a strong leadership position on environmental sustainability and is committed to working with our residents and businesses. Sustainable Sydney 2030 is our vision for a green, global and connected future. The chief goal of Sustainable Sydney 2030 is to cut greenhouse gas emissions in the Sydney local government area by 70 per cent below 2006 levels by 2030.

To achieve this ambitious vision the City has developed a suite of Master Plans comprising:

- Decentralised Energy – Renewable Energy.
- Decentralised Energy – Trigeneration.
- Advanced Waste Treatment.
- Decentralised Water.

This Energy Efficiency Master Plan is an important component. It sets out the practical steps to achieve cost-effective delivery of energy efficiency savings in the City of Sydney built environment.

There are many successful examples of energy efficiency in action, however, significant untapped opportunities remain. Greater energy efficiency guarantees reduced greenhouse gas emissions, cuts energy bills and increases economic productivity.

Approximately 80 per cent of greenhouse gas emissions generated within the City of Sydney local government area come from energy consumed in buildings. This Master Plan is focused on energy efficiency in the built environment, rather than reducing emissions from transport or other sources of emissions.

In developing this Master Plan, the City engaged the specialist consultancy pitt&sherry in partnership with Exergy. Their modelling assessed the energy efficiency potential of all building types within the local government area using real-world data from local investments already undertaken.

With this information, pitt&sherry modelled five scenarios, namely:

1. A freeze at 2006 efficiency levels, without the recent trend of falling consumption.
2. A 'business as usual' of existing policies and programs.
3. A set of new policies and programs based on pilots and trial data sets.
4. Adoption of only technologies with a less than three-year simple pay back.
5. Emerging technologies – where technology surpasses current efficiency opportunities.

The pitt&sherry report is the basis for much of the content within this Plan and is attached as a Technical Appendix.

This Master Plan has been developed by the City of Sydney however realising the energy savings potential will require a shared responsibility between all levels of government, businesses and residents.

WHAT IS ENERGY EFFICIENCY?

Energy efficiency is the amount of useful work or output that results from using energy. It is about using less energy to produce the same output or producing more output with the same energy. Energy efficiency is heavily influenced by technology changes and social trends.

The law of conservation of energy states that energy can neither be created nor destroyed, but only transformed from one form into another. Energy losses occur when energy is transformed to a form that is not utilised. Energy efficiency reduces energy waste.

There are many opportunities to improve energy efficiency both where electricity is produced (supply-side) and where it is used (end-use). Local energy generation is a supply-side solution, and the subject of other City of Sydney Master Plans.

This Master Plan focuses on *end-use* efficiency, specifically the electricity and gas used by buildings within the City of Sydney local government area.

Many factors affect the efficiency of energy use. Better building design, changing components or the shell of buildings, or replacing energy consuming equipment and systems can all reduce losses and increase useful outputs.

However, behaviours are at least as important as technologies. If the world's most technically efficient lighting system is left on when no-one is in a building, then it is still wasting energy, as it is performing no useful work.

A key defining characteristic of energy efficiency is that it has an enduring, long-term impact on reducing energy consumption.

ENERGY HIERARCHY

The energy hierarchy is a classification of options to guide progress toward a more sustainable energy system. Supply of energy resources must be capable of meeting reasonable energy demands, lasting indefinitely, and without harmful by-products or emissions.

The highest priority is to prevent unnecessary energy usage by eliminating waste and improving energy efficiency. In this context, the energy efficiency opportunities proposed in this Master Plan should be pursued in balancing social, economic and environmental considerations.

Due to the typically long lead times in developing new zero and low-carbon local energy projects, implementing the City's other decentralised energy plans should occur in parallel with this Master Plan.

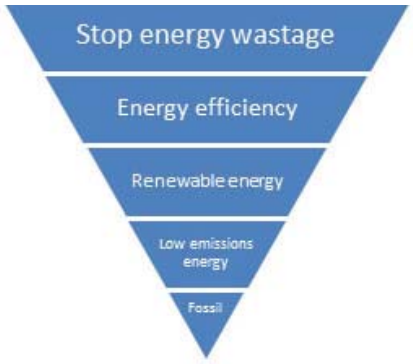
THE CASE FOR ENERGY EFFICIENCY

There are multiple financial and other benefits of energy efficiency, however the full potential is not being realised. Barriers outlined in Chapter 5 of this Master Plan make the case for government intervention.

Several significant factors have occurred around Sydney and more broadly which makes now an ideal time to take strong action on energy efficiency:

- The steep rise of energy prices in recent years.
- The identified link between energy efficiency and economic productivity.
- The need to mitigate our contribution to human-induced climate change.
- The need to make our buildings and energy systems more resilient to a changing climate.
- Energy security, better network utilisation and job creation.

FIGURE 9: ENERGY HIERARCHY



A recent report by the Organisation for Economic Co-operation and Development (OECD) and International Energy Agency (IEA) describes 15 substantive benefits associated with energy efficiency as depicted in Figure 10. It shows that energy efficiency can boost growth, jobs, health, government budgets and productivity.

These broader benefits provide a comprehensive business case for energy efficiency.

Another report by the International Energy Agency (IEA)[4] has quantified the energy efficiency savings of its 11 member countries – including Australia – and found total avoided energy use is greater than the total energy consumption of the European Union. Efficiency improvements in space heating, water heating, lighting and appliances has countered growing populations and larger dwellings in reducing absolute energy use.

The quarterly Investment Property Databank (IPD) Australian Green Property Index identifies multiple benefits of energy efficiency for owners of commercial buildings such as higher capital growth, higher rents and lower vacancy rates.

FIGURE 10: MULTIPLE BENEFITS OF ENERGY EFFICIENCY[3]

ENERGY PRODUCTIVITY

The City of Sydney regards boosting energy productivity as a key objective of this Master Plan with far reaching benefits for Sydney, New South Wales and Australia.

Energy productivity has become a key dimension of economic performance at a national, city and company level. The term refers to economic output, generally measured as gross domestic product (GDP) at a national level, for each unit of energy consumed.

The link between energy efficiency and economic productivity is well recognised by economists and governments alike. Energy productivity may be improved by using less energy to produce the same output (energy efficiency) or producing more output with the same energy (improved production efficiencies).

Energy productivity is improved by more energy efficient buildings and better knowledge and management of energy. Energy efficiency improves productivity and opens opportunities for economic development. There is greater output per unit of energy input, and the savings in avoided energy costs can be used for other economic activity leading to growth.

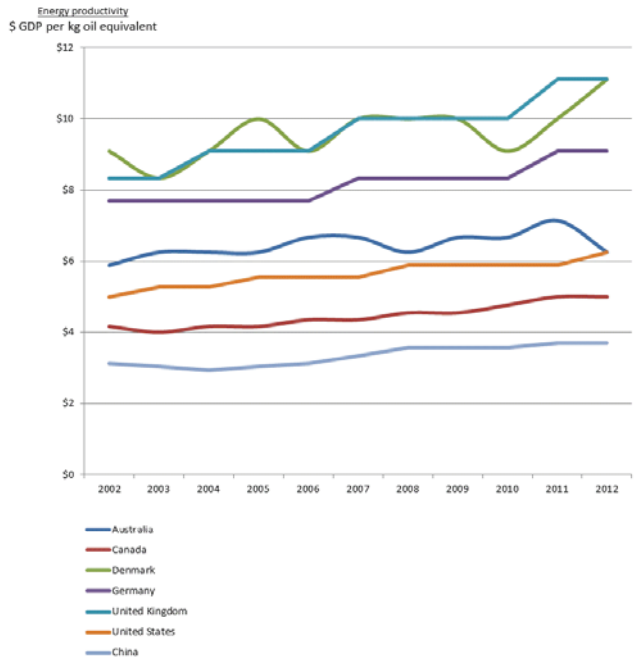
Occupants in energy efficient buildings have lower energy bills and higher levels of comfort and well-being. According to the Australian Bureau of Statistics Energy Consumption Survey, Australian households spend an average of $380 million every week on electricity and gas. An improvement of less than three per cent in energy efficiency could free up $10 million a week to be invested in other parts of the economy.

In the international context, the German Government has long recognised the productivity benefits of energy efficiency and has overseen a decoupling of GDP growth and energy consumption since the 1990s. As a result, German energy productivity increased by more than 40 per cent over the period 1990–2008.[5] Australian governments may learn from this success.

The Australian Alliance to Save Energy (A2SE) predicts that Australia needs to double energy productivity by 2030 to remain internationally competitive. According to A2SE, Australia has lost its competitive advantage in energy costs and is falling behind our economic competitors – including China, the European Union, and the USA.

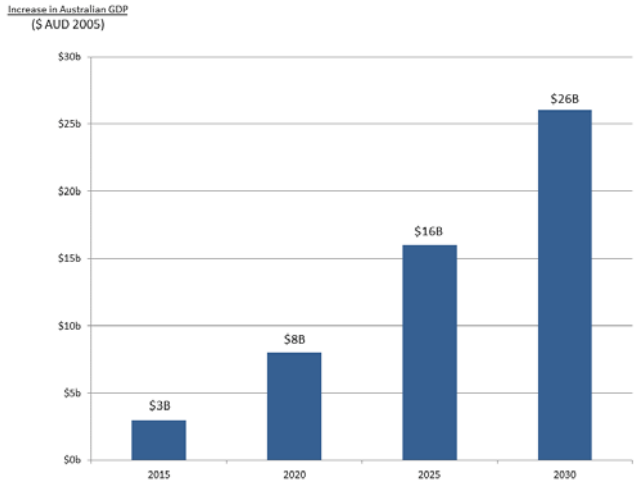
In 2014 the City of Sydney signed a joint statement that acknowledges the urgent need to improve Australia's energy productivity for international competitiveness and to reduce pressure on household energy bills. The City is committed to working with businesses, residents, and government to develop an Energy Productivity Roadmap to improve Australia's energy productivity.

FIGURE 11. 2002–2012 ENERGY PRODUCTIVITY OF COUNTRIES[6]



Improving energy productivity decouples economic growth from energy use, which can improve business competitiveness and reduce costs for households and businesses. An issues paper for the forthcoming Australian Government Energy White Paper notes that "rising energy prices have seen energy efficiency emerge as an increasingly important enabler of economic growth". The 2014 Energy Green Paper also makes reference to large Australian corporations which receive almost $4 in savings for each dollar invested into energy productivity. Figure 12 clearly shows the economic return that could be gained by increasing energy productivity for Australia.

FIGURE 12. CONTRIBUTION TO AUSTRALIAN GDP OF ONE PER CENT P.A. IMPROVED ENERGY EFFICIENCY[7]



Climate Works[8] research has found that energy efficiency can lead to a halving of the energy intensity of the economy between now and 2050. An annual one per cent increase in energy efficiency in Australia would boost 2030 GDP per capita by more than two per cent or $1,200 per person, and total GDP by $26 billion.

Deloitte Access Economics[9] estimates the 2010 City of Sydney GDP was $100.8 billion. This is around 25 per cent of the economic activity of New South Wales and approximately eight per cent of national GDP. In 2010 electricity and gas consumed by buildings was 17,820 terajoules (TJ) which means a baseline of $5.66 GDP output for each megajoule (MJ) unit of energy consumed.

Business activity and the number of businesses in the City of Sydney local government area have been growing and further growth is forecast.

- By 2030 GDP from the local government area is forecast to rise to $166.1 billion by 2030.
- Over the past five years, the area has seen 2,000 new businesses open and more than 50,000 new jobs created.
- New jobs in the City of Sydney represent 40 per cent of the total job growth across the entire Sydney metropolitan area.

This economic growth has occurred at a time of falling energy demand. Since 2007, total electricity demand has been falling in the City – as it has elsewhere in Australia. The fact that the City's economy can flourish as energy demand falls departs from the historical trend of growth dependent on greater energy consumption. We are showing that a decoupling of economy and energy is a reality.

This new trend presents great business opportunities for our global city. Increasing energy efficiency frees operational expenditure in business, allowing it to be spent on other more productive investments and activities. Fewer energy resources are wasted and energy can be used to maximise economic output.

The decline in total energy consumption observed in Sydney since 2006 indicates there may not have been a significant 'rebound effect' to date. This term describes a situation where efficiency gains can be lost or reduced, for example by greater overall consumption or growth.

The benefits of energy productivity are perhaps the greatest win of this Master Plan; whilst reducing our environmental impact we can simultaneously drive greater productivity.

FIGURE 13. JOINT STATEMENT ON LIFTING AUSTRALIA'S ENERGY PRODUCTIVITY

2XEP Doubling Australia's Energy Productivity

AUSTRALIAN ALLIANCE TO SAVE ENERGY Creating an Energy-Efficient Australia

Joint Statement on

LIFTING AUSTRALIA'S ENERGY PRODUCTIVITY

We, the undersigned, agree that there is an urgent need to rapidly and substantially increase Australia's energy productivity. We must create more economic value for each unit of energy used to improve Australia's overall economic productivity.

In the last decade, Australia has lost its competitive advantage in energy costs. We must act now to lift energy productivity, as well as addressing energy prices. If we fail to do so, Australia faces continued decline in competitiveness, more job losses and further pressure on household energy bills.

While the economic potential for lifting energy productivity varies from sector to sector, there are major opportunities across the Australian economy. Business and government should collaborate to set and meet appropriate objectives to harness these opportunities. This will create new business opportunities and jobs, improve fuel security, reduce unnecessary capital investment in energy infrastructure, and moderate consumer and enterprise energy bills.

Therefore:

1. **We declare that Australia has an economic imperative to lift energy productivity.**
2. **We will contribute to a partnership of business, community and government to develop within 12 months an Energy Productivity Roadmap to improve Australia's energy productivity.**
3. **We support, subject to the findings of the Energy Productivity Roadmap, setting an overall target to double Australia's energy productivity by 2030 compared to 2010, and reporting annually on progress towards this goal.**

Signed:

Australian Industry Group · NSW Farmers · Visy For a Better World · Clean Energy Council · ENERNOC · energetics · Green Energy Trading · ICANZ · ClimateWorks Australia · TransGrid · NSW Business Chamber · City of Sydney · LJ Hooker

THE COST OF ENERGY

Growing energy prices increase the incentive for energy efficiency and make the business case for investment in energy efficiency more viable. It has become cost-effective for households and businesses to invest in more efficient appliances and premises, and to alter energy consumption behaviours. Energy efficiency increases competitiveness and reduces energy bills.

One of the underlying assumptions of economic development in Australia since World War II has been access to very cheap and reliable electricity. In recent years, this assumption no longer holds true as economic growth becomes decoupled from energy consumption, and the domestic price of energy is no longer cheap by world standards.

ELECTRICITY

Over the five years to 2013/14, electricity networks in NSW were allocated an unprecedented $17.4 billion for capital expenditure. This investment is recovered through energy bills which have increased substantially as a result. Electricity network charges are now more than half of a typical bill. The various components that make up the final charge are important to help understand why energy costs have increased.

FIGURE 14. COMPONENTS OF A TYPICAL RESIDENTIAL ELECTRICITY BILL

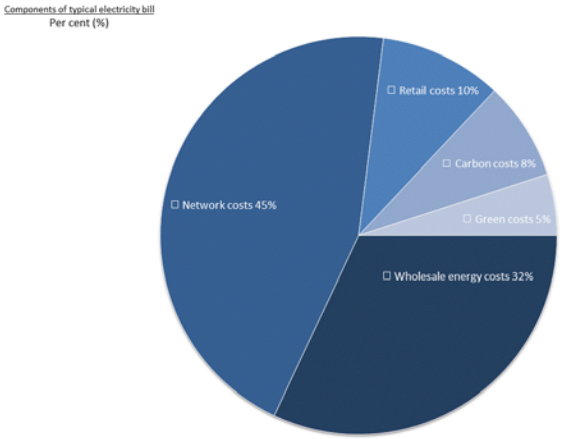


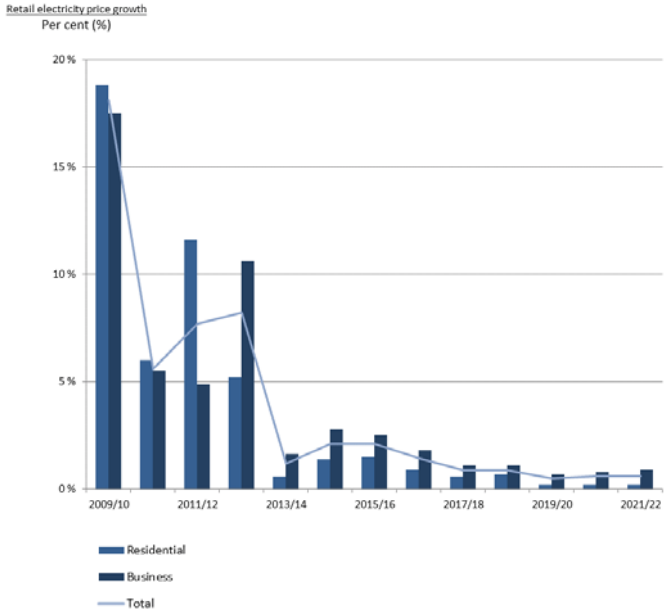
Figure 15 shows electricity prices for the period 2010 to 2022. The steep increases in recent years were primarily due to network costs. Although future increases are forecast to be lower, the legacy of recent price increases makes the time right to implement energy efficiency measures. Future energy price increases may flatten due to recent demand projections that have been revised downward, removal of the carbon price, and falling wholesale prices due to renewable energy.

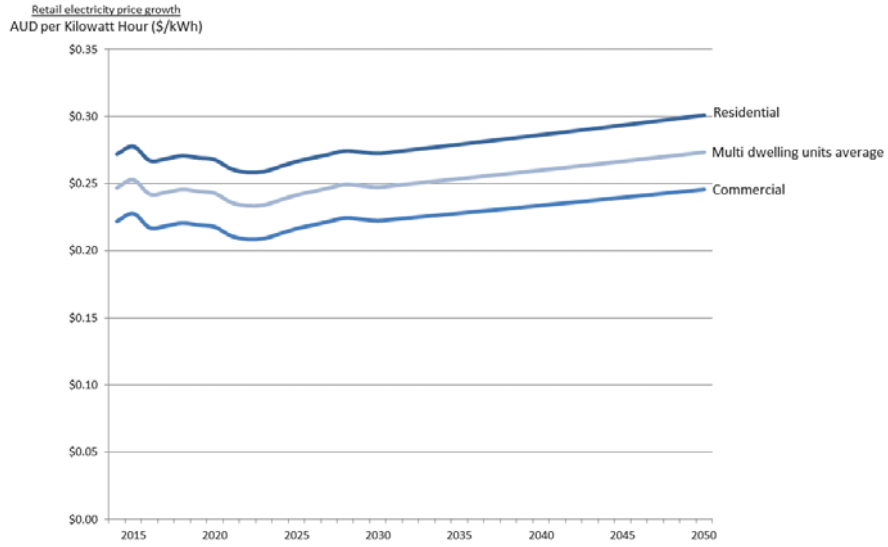
For this Master Plan electricity prices have been modelled to 2020 by pitt&sherry and Exergy based on information from the NSW Independent Pricing and Regulatory Tribunal, Frontier Economics and Australian Energy Markey Commission. After 2020, an average 0.5 per cent real price increase each year to 2050 was assumed.

Average prices to commercial customers are less transparent but are generally lower than for residential customers. Prices paid by multi-unit dwellings takes into account that base building energy billing generally attracts a commercial tariff, whilst the units themselves pay residential prices.

The energy savings modelled later in this Master Plan are deemed to be cost-effective based on these energy price forecasts. Any reduction in the forecasts may affect the financials of specific energy efficiency measures, however these price forecasts are considered to be conservative for the medium to long term.

FIGURE 15. NSW RETAIL ELECTRICITY PRICES ($)[10]





NATURAL GAS

Natural gas is typically used for water heating and cooking in residential buildings. Business use includes water heating, a wide range of industrial applications, and power generation.

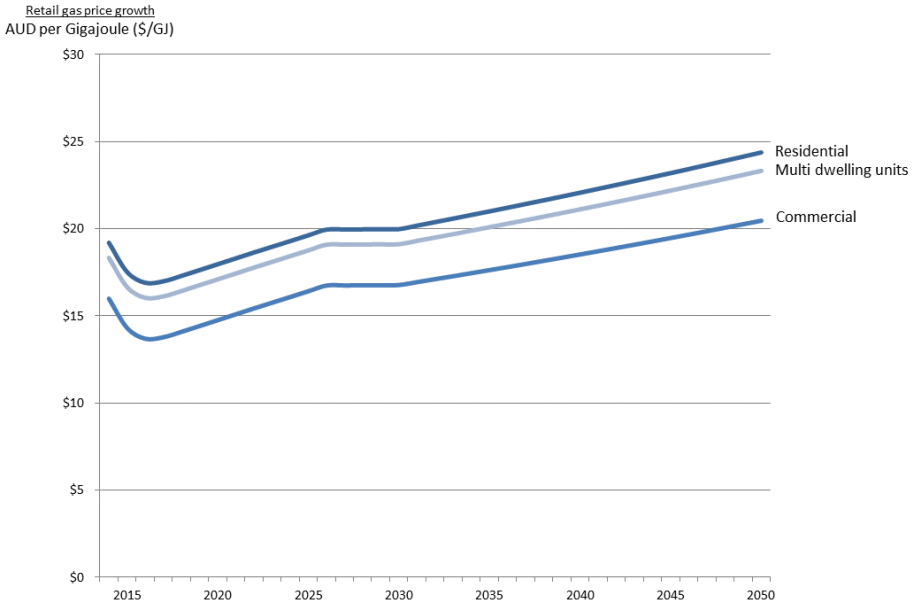
The gas market in New South Wales is changing with wholesale gas prices expected to increase in the short term and remain relatively high in the medium term. The pending export of natural gas from east coast terminals to international markets is the primary factor in price rises and it is contributing to greater focus on high costs of energy to the community and the economy.

Increasing gas prices may cause a decline in domestic gas consumption (similar to the way electricity usage fell due to higher electricity bills in recent years). Energy users may also choose to switch away from gas to electricity if prices rise too high.

For this Master Plan gas prices were projected by pitt&sherry and Exergy using information from the NSW Independent Pricing and Regulatory Tribunal and Australian Energy Regulator. Short term increases in wholesale gas prices are offset by phasing out of the carbon price. After 2017, wholesale prices are assumed to rise by $0.30/GJ per year in real terms.

Baseline residential tariffs are based on published tariffs with business tariffs assumed to be lower. As for electricity multi-unit dwellings prices take into account the split between commercial and residential tariffs.

FIGURE 16. NSW RETAIL NATURAL GAS PRICES ($)



THE RISING HEAT

There are at least three kinds of climate variability or change that are impacting, and will impact the future energy consumption of Sydney's building stock. These are:

- Anthropogenic (human induced) climate change.
- Year-on-year weather variations.
- The 'urban heat island' effect.

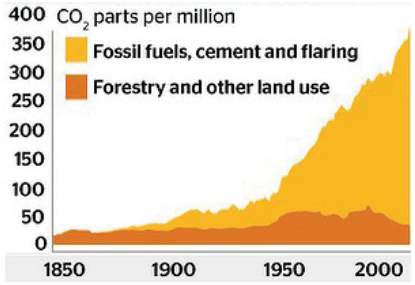
GREENHOUSE GAS EMISSIONS

Improving energy efficiency reduces greenhouse gas emissions, when it reduces the amount of energy generated from burning fossil fuels. The energy cost savings from efficiency generally pay for the upfront investments over a short period of time, so we can consider the associated greenhouse gas emission savings are effectively free of charge. Cost of abatement charts in Chapter 4 of this Master Plan show the very low costs of energy efficiency in reducing greenhouse gases.

The C40 Cities Climate Leadership Group notes that "energy efficiency is an important area for climate action – and one that is particularly attractive due to strong financial returns on investment through energy cost savings". Improving energy efficiency is a compelling carbon abatement strategy considering the multiple benefits.

The Intergovernmental Panel on Climate Change (IPCC) Assessment Report 5 (AR5) states that warming of the climate system is unequivocal and human influence on the climate system is clear and extremely likely to be the cause of warming since the mid-20th century. Anthropogenic climate change is caused primarily by the combustion of fossil fuels but also by land-clearing.

FIGURE 17. GLOBAL CARBON EMISSIONS



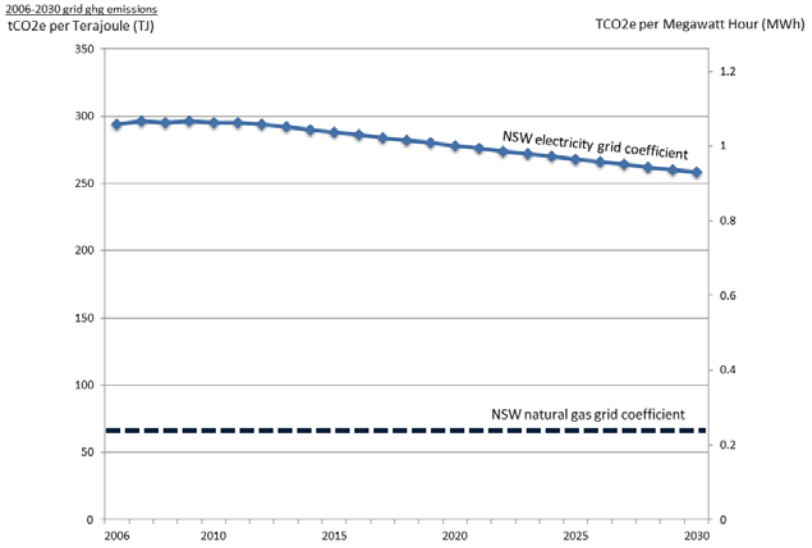
Most greenhouse gas emissions generated by buildings are indirect (Scope-2) meaning they occur from carbon intensive energy generated off-site. There are also emissions 'embodied' in the materials used to construct buildings, and in the construction process, but these are typically a small percentage of the emissions associated with a building's energy use over its lifetime.

Most electricity used in the City of Sydney is provided by a remote, centralised, predominately coal-fired electricity grid. This is highly polluting. Electricity used by buildings accounts for around 80 per cent of total greenhouse gas emissions for the local government area.

More than two thirds of primary energy generated in this traditional manner is lost either at the power stations as waste heat (thermal losses) or as it travels through the electricity grid network (transmission losses). Energy efficiency measures which reduce demand for coal-fired electricity therefore have the greatest potential for reducing greenhouse gas emissions.

A focus on energy efficiency combined with the City of Sydney's efforts in decentralising and reducing the carbon content of our energy supply will cut energy waste, greenhouse gas emissions and costs.

FIGURE 18. GREENHOUSE GAS INTENSITY OF NSW GRID ENERGY



Global climate change negotiations under the United Nations Framework Convention on Climate Change (UNFCCC) reflect an ambition to limit concentrations of greenhouse gases in the atmosphere to 450 ppm (parts per million) by 2050. This is considered an upper boundary for a 50 per cent chance of limiting the rise of global average temperatures to 2°C.

Current concentrations of greenhouse gases in the atmosphere are around 400 ppm – a level not reached in the last million years – with levels continuing to increase at a rapid rate.

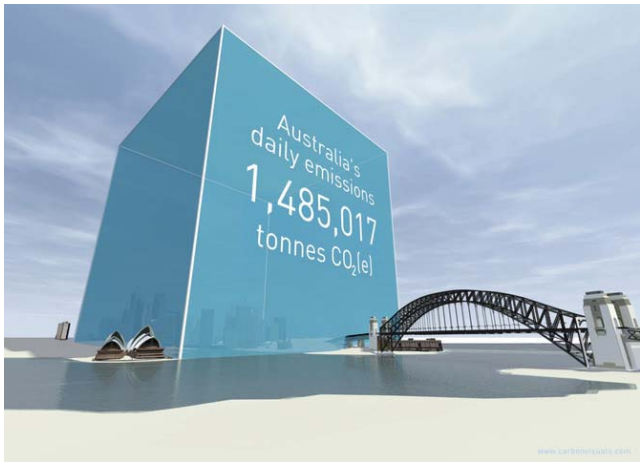
The International Energy Agency (IEA) determines end-use efficiency as the most cost-effective way for the world to meet the 2°C target. Energy efficiency could deliver almost half of the global greenhouse gas abatement required, and 60 per cent of that abatement is in the buildings sector[11].

Such compelling evidence must drive responsible governments to act. Any policy framework serious about reducing greenhouse gas emissions from our cities must address energy efficiency in the built environment.

Australia has amongst the highest greenhouse gas emissions per person in the world. Reversing this requires significant decarbonisation of our economy and the transition away from polluting energy sources.

This Master Plan is a key component of the City's response to the challenge of human induced climate change. Communities will always need energy, and sustainable solutions can be found. Using energy as efficiently as possible, irrespective of the source, is a key step in Sydney becoming a sustainable city mitigating the effects of human induced climate change.

FIGURE 19. VOLUMETRIC REPRESENTATION OF AUSTRALIA'S DAILY EMISSIONS[12]



THE URBAN HEAT ISLAND EFFECT

Urban heat island is the tendency for cities to be warmer than their surrounding areas due to:

- Heat build-up in the thermal mass of cities in particular buildings, pavements and roads.
- The albedo (reflective coefficient) of surfaces with darker colours absorbs more heat.
- Limited tree canopy and green space.
- Wind flow restricted by physical obstruction.
- Heat rejection from ventilation air outlets and heat exchangers.

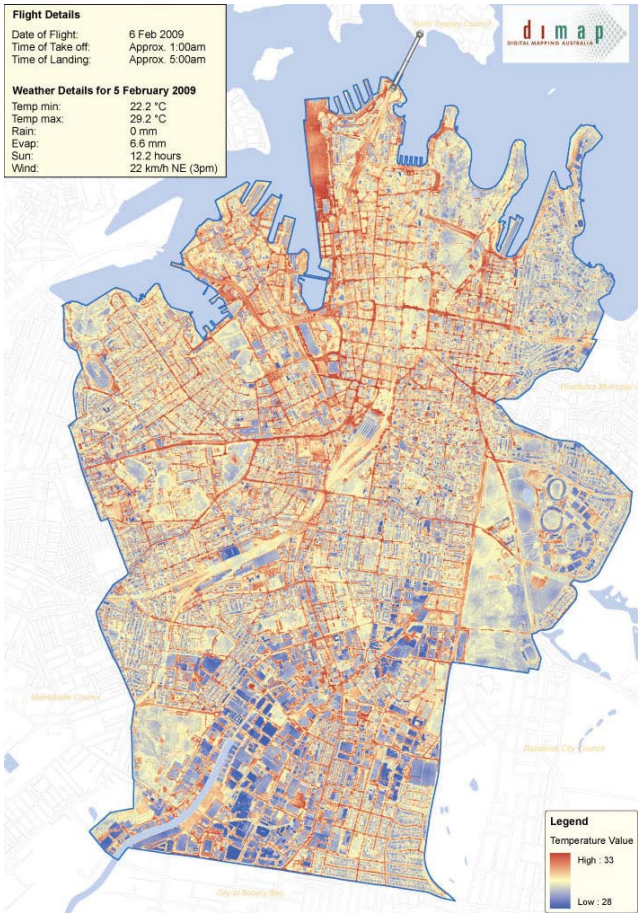
Urban heat, or the urban heat island effect can add significantly to thermal loads on buildings in summer, significantly increasing the energy required for cooling purposes. It may also reduce demand for space heating in winter, although not to the same extent as the summer demand effect.

The City of Sydney is currently collecting data to determine how much shade trees and pavement options can affect urban ambient temperatures. The impact of the urban heat island effect is present in actual energy consumption data presented in this Master Plan, however its contribution to the total building energy demand is unclear.

Figure 20 depicts the radiant temperature of different physical surfaces in the City of Sydney LGA. The image was taken between the hours of 1am and 5am which is when the ambient air temperature is generally at its lowest. However as illustrated, while the ambient temperature may have been 22°C, the ground temperature, and in particular temperature of the city's road network is radiating heat between 28°C and 33°C.

Research conducted by the Centre of Excellence for Climate System Science has estimated that the combined temperature increase in Sydney, due to both the urban heat island effect and anthropogenic climate change, could reach 3.7°C by 2050.[13]

FIGURE 20. CITY OF SYDNEY THERMAL IMAGE (FLOWN FEB 2009)



RESILIENCE

Climate change projections generated for the City of Sydney by consultants RPS and KPMG (Global Climate Models 'most consensus' scenario) indicate that temperatures in Sydney will increase in all seasons between 1.5 to 3°C by 2050. Peak heat events (heatwaves) are expected to occur more frequently. It is important to note that modest increases in average temperatures may be the result of extreme increases in peak temperatures.

This work has been reviewed by an expert scientific reference group with members from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Bureau of Meteorology, (BOM), National Climate Change Adaptation Research Facility (NCCARF), the NSW Office of Environment & Heritage (OEH) and the Climate Institute and has signicant implications for the way that buildings are designed and used.

Similar to urban heat island, increased average temperatures could create higher energy demand for cooling. Extreme heat events also put signiciant physical strain on electricity networks on those days, and can affect workforce productivity and human health.

Improving the energy efficiency of buildings, particularly during peaks, is critical for improving the city's resilience to increasing temperatures and peak heat events.

ENERGY SECURITY

Energy efficiency has a role to play in ensuring the secure and resilient supply of energy to Sydney. Greater levels of energy efficiency generally reduce strain on the local distribution and upstream transmission networks. The degree to which energy efficiency may improve overall system reliability is dependent on the time of day, scale and location of energy savings, as well as the condition of network assets.

In many scenarios, energy efficiency will reduce overall demand and also increase the difference between overall network capacity and demand on any one day. Generally when demand spikes do occur, they will be from a lower base, should not last as long, or will have a less pronounced spike at the peak usage time. It is therefore less likely that network infrastructure would fail as a result of overload, leading to improved system reliability.

Energy efficiency also maximises the output for each unit of energy input whether it be renewable or non-renewable, domestic or imported. Each of these sources is associated with risks and uncertainties. The conservative use of energy can mitigate these risks.

In addition to energy efficiency, local renewable and distributed energy systems provide a contribution to energy security. The City of Sydney has addressed these in separate Master Plans.

SMOOTHING THE PEAKS

Energy efficiency has significant potential to reduce peak demand in the electricity network, along with local generation and demand side response, however only where energy savings are concurrent with peak times and locations.

Each day, energy use rises and falls in line with people's activity at home and at work, creating a typical 'load profile'. In Sydney the electricity network peak is typically greatest in summer, between the hours of 11am and 8pm. The peaks are mostly driven by electric air conditioning systems which tend to be turned on (at around the same time) in response to rising temperatures, creating a 'peaky' electricity demand profile.

The peak period happens when business peak energy demand overlaps with residential peak demand into the afternoon and early evenings. Peak pricing tariffs do not totally coincide with when peak events actually occur. Proponents for energy efficiency projects to reduce peak demand in Sydney need to consider that avoided energy cost savings are based on both peak (high tariff) and shoulder (lower tariff) pricing thereby affecting returns and payback period.

The historic rise in the price of electricity discussed in the previous section has been driven by several factors, the largest being the high levels of investment in network infrastructure based on an assumption of continued growth in peak demand, which has since not occurred. Peak load reductions that arise from well-designed energy efficiency improvements present a broader economic benefit to society that should be taken into account when assessing the overall case for energy efficiency.

Energy efficiency has the potential to reduce the requirement for network augmentation when it also reduces peak demand loads. In its Powering Sydney's Future[16] program, Transgrid, the transmission network service provider for Sydney, notes that significant uptake of energy efficiency initiatives could help reduce peak energy demand, and therefore contribute to delaying the need to invest in network assets.

A major benefit of implementing this Master Plan is that it would reduce future pressure on the electricity transmission and distribution networks. This in turn can delay or avoid the need for capacity-driven investment in the networks and reduce future upward pressure on electricity prices. Chapter 4 outlines the extent of infrastructure savings possible.

FIGURE 21. INNER METROPOLITAN SYDNEY LOAD PROFILE ON DAY OF MAXIMUM DEMAND[14]

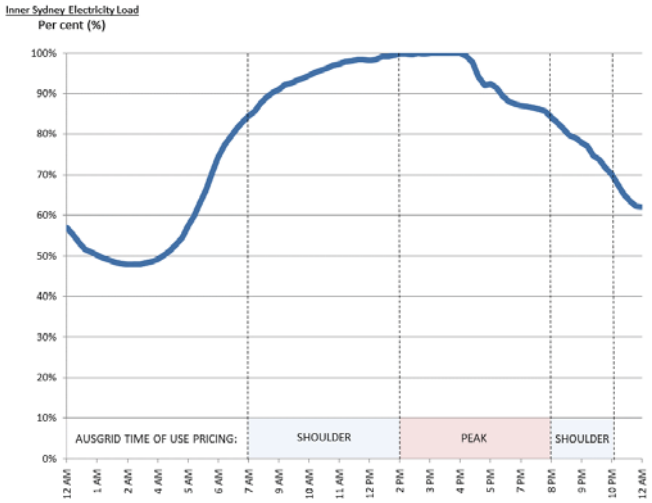


FIGURE 22. AUSGRID NETWORK LARGEST HISTORICAL 48 HALF HOUR INTERVALS PEAK DEMAND[15]

JOB CREATION

Analysis by pitt&sherry[17] estimates the energy efficiency opportunities proposed in this Master Plan would boost labour demand by around 470 full time equivalent (FTE) jobs for electrical engineers, consultancies, suppliers and so forth during the energy efficiency investment phase. In the longer term, the ongoing boost to labour demand is likely to be 130 FTE. This improvement is far greater than the estimated 24 job losses that could result from upstream activities.

TECHNOLOGY SHORTLIST

In developing this Master Plan, pitt&sherry reviewed a range of energy efficiency technologies as listed in this section. More information is contained in the Technical Appendix.

The selection of technologies was largely informed by extensive audits of buildings in the Sydney local government area undertaken by Exergy, as well as pitt&sherry data, and results from 30 multi-unit dwellings assessed under the City of Sydney Smart Green Apartments program.

Technical opportunities and assumptions listed in this section are sector averages only and may not be representative of results for individual buildings. The tables in this section show the main assumptions used by pitt&sherry.

The technologies listed here are commercially available today. Energy efficiency opportunities will continue to grow as technology changes over time and the market for energy efficiency products and services evolves.

APPLIANCES

Appliances are a key reason for changing energy patterns in recent years, and contribute to both standby and peak power demands, especially in residential dwellings. It is assumed that most appliances would meet increasingly stringent criteria under Minimum Energy Performance Standards (MEPS).

DOMESTIC HOT WATER

Substantial energy savings can be made through the replacement of hot water systems with either gas or electric heat pump systems, or solar gas boosted or solar electric boosted systems. Consumption of electricity or gas for hot water can be reduced by around 80 per cent.[18]

For this Master Plan, base-building opportunities primarily featured upgrades to hot water systems including switching to heat pumps, high-efficiency gas, and reducing losses through better pipe and tank insulation and flow controls.

Large, centralised hot water systems require the transfer of water over long distances – resulting in thermal (energy) losses. Additionally it is difficult to ensure that such large systems are always optimised to meet rises and falls in demand – again resulting in energy waste. Smaller systems, located close to end uses can contribute to minimising energy waste. Sensors that monitor for water leaks can also prevent energy (and water) waste.

Water efficient appliances and fittings prevent energy waste from heating surplus water, and heat pump and solar technologies can heat water with a minimum of electrical input. Heat recovery technologies make use of waste heat from other buildings to fully maximise efficiency.

Assumptions	Non-residential	High-rise residential	Mid-low rise residential
Life of investment (years)	7	15	15
2014 take up	30%	30%	30%
Maximum take up (share of eligible stock)	100%	100%	100%
Additional take up annually	1.3%	2.2%	2.2%
Learning rate (real cost deflation)	1%	1%	1%
Electricity savings rate (MJ/sqm p.a.)	5.7	0.5	0.5
Electricity savings (kWh/sqm p.a.)	1.6	0.2	0.2
Gas savings rate (MJ/sqm p.a.)	0.6	1.8	1.8
Capital cost ($2014/sqm)	$0.75	$0.27	$0.27
Simple payback (years)	2	3.9	3.9

BUILDING MANAGEMENT SYSTEMS (BMS)

Building management systems (BMS) provide great opportunities to improve energy efficiency. They centrally control and optimise energy use, and also help identify equipment failure or unusual patterns of energy usage, such as equipment being left on outside core building operating hours.

There is anecdotal evidence to suggest that many building management systems are not configured optimally, and/or that building or facility managers may be insufficiently skilled. BMS optimisation and training are major energy efficiency opportunities.

Feedback received during consultation with building owners and managers in developing this Master Plan indicates that there are skills gaps in running building management systems for mid-tier and smaller buildings particularly. There are also a limited number of providers. The City of Sydney and the NSW Office or Environment and Heritage are working on pilot programs which may address these issues.

A well-functioning BMS will include data from sub-meters which allow owners and businesses to monitor and control electricity use at a circuit and appliance level.

Assumptions	High-rise residential	Mid-low rise residential
Average life of investment (years)	10	10
2014 take up	10%	5%
Maximum take up (share of eligible stock)	90%	10%
Additional take up annually	2.5%	0.17%
Learning rate (real cost deflation)	1%	1%
Electricity savings rate (MJ/sqm p.a.)	7.0	7.0
Electricity savings (kWh/sqm p.a.)	1.9	1.9
Gas savings rate (MJ/sqm p.a.)	0.0	0.0
Capital cost ($2014/sqm)	$2.35	$2.35
Simple payback (years)	4.7	4.7

HEATING VENTILATION & AIR CONDITIONING (HVAC)

As noted in the previous section, air conditioning is the main cause for peak electricity demand on hot days, and despite ever improving efficiencies, many studies highlight opportunities to improve energy efficiency for space cooling.

Representatives from the Better Buildings Partnership and other key stakeholders engaged in developing this Master Plan note that upgrades to heating, ventilation and air conditioning (HVAC) offer significant energy efficiency gains with good payback. There is a significant advantage in that the target audience for change in this sector is concentrated and generally well informed.

In Australia, HVAC is commonly combined into a single system that functions for heating, cooling, ventilation and humidity control. The use of highly efficient equipment combined with automatic sensors can produce very useful efficiency gains.

However, these combined systems have large ducts and must move heat and cooling over long distances, which result in energy waste. It is also difficult for such integrated systems to finely manage the various loads that differ across the various zones within a building, based on its physical area, external façade and glazing, orientation, and the number of occupants. This leads to under performance in the actual conditioning task.

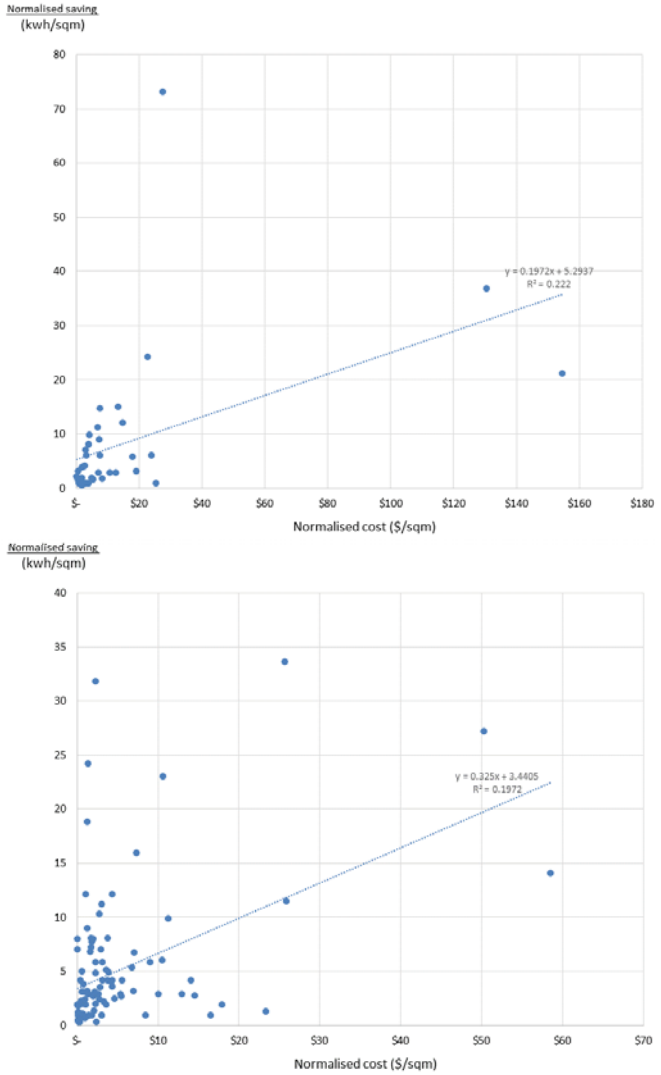
Lack of HVAC maintenance in existing buildings can also drive up energy consumption. For example, poor seating of a heating hot water valve can cause a flow of hot water through the heating coil even when this is not called up by the building management system. The unit itself compensates by supplying increased cooling, which is very inefficient, though is a common occurrence.

HVAC upgrades cover a wide range of individual treatments including:

- Replacing plant such as chillers, cooling towers, chilled water and heating hot water.
- Improving and tuning controls systems including economy cycles, fan controls, running hours, building management systems, and many others.
- Retro-commissioning including air flow rebalancing, repairing leaking ducts and valves, improving exhaust fans, and recommissioning whole HVAC systems.
- Power factor correction during commissioning and upgrades.

Figure 23 shows the range of incremental costs (the additional cost beyond industry-standard solutions) for commercial buildings to upgrade, replace and tune HVAC plant and controls. Mostly, these are relatively low cost and high-impact measures. These results show limited variation between energy savings and incremental costs from one building type to another (the sample set included offices, hotels, hospitals and retail shopping centres).

FIGURE 23. HVAC UPGRADE/REPLACEMENT (TOP) AND TUNING (BOTTOM) COST CURVES



Solar thermal systems are one way to reduce demand for conventional energy – they use solar energy to drive a cooling or refrigeration process. The application in Australia is limited to date, however the potential energy savings across an HVAC system are very large – in the order of 75 per cent.[19]

Hydronic (water) delivery of heat and cooling systems are another recognised solution for low energy buildings. The most efficient systems capture low temperature waste heat and incorporate active solar heating and evaporative cooling.

A cutting edge way to reduce energy waste is to separate the HVAC functions. For instance a dedicated outdoor air system can provide ventilation which allows air to be moved only when ventilation is needed, not when heating or cooling is needed.

Heating and cooling provided separately to discrete zones may also improve energy efficiency. Load can be precisely sized and ducts are short to minimise thermal losses and pressure drops. Energy savings of well over 40 per cent are possible.[20]

Assumptions	Non-residential	High-rise residential	Mid-low rise residential
Average life of investment (years)	15	15	15
2014 take up	20%	10%	5%
Maximum take up (share of eligible stock)	90%	90%	10%
Additional take up annually	2.2%	2.5%	0.15%
Learning rate (real cost deflation)	0.5%	1%	1%
Electricity savings rate (MJ/sqm p.a.)	55.2	3.7	3.7
Electricity savings (kWh/sqm p.a.)	15.3	1	1
Gas savings rate (MJ/sqm p.a.)	8.9	1.0	1.0
Capital cost ($2014/sqm)	$23.60	$0.40	$0.40
Simple payback (years)	6.5	1.4	1.4

The table above shows the assumptions used in modelling this Master Plan. The energy and emissions savings estimated from HVAC may be conservative as systems shift towards using more efficient and lower global warming potential natural or hydrofluoroolefin (HFO) refrigerants in place of hydrofluorocarbon (HFC) refrigerants.

The evolving nature of advanced control systems means they may become more widespread and result in greater energy savings than were considered for this Master Plan. A recent example is Australian Technology Park within the City of Sydney local government area where predictive science (weather) based optimisation is resulting in significant energy and cost savings additional to already high efficiency levels.

Readers are directed to the Australian Institute of Refrigeration, Air conditioning and Heating (AIRAH) which promotes energy efficiency and emissions reducing technologies and recently launched a free online benchmarking tool to assess the energy efficiency of a variety of heating, ventilation and air conditioning systems.

METERING

Although not specifically modelled as a technology solution for this Master Plan, the advent of 'smart' metering technology will help bring about efficient use and distribution of energy into the future. New affordable metering opportunities are being developed by companies not traditionally involved with energy supply.

Smart meters record energy in intervals of an hour or less and also enable two-way communication with the network operator or energy supplier. Smart meters are an important part of smart grids, where electricity flows in different directions and supply can be matched with demand. They allow for new tariff structures (e.g. capacity versus consumption based) and can co-ordinate the use of efficient appliances.

Dedicated sub-meters are already widely used in commercial properties, to monitor consumption and anomalies of major plant and assets. Sub meters also allow for accurate baseline measurement to generate certificates under the NSW Energy Savings Scheme and offset capital expenditure for energy efficiency works.

LIFT UPGRADES

Data collected from Exergy and interpreted for this Master Plan shows major lift upgrades are very costly and in most cases cannot be justified on energy efficiency grounds alone. The best time for major energy efficiency improvements is when lift upgrades or replacements are scheduled.

Smaller measures, such as improving lift lighting and standby power consumption have lower savings but significantly shorter paybacks.

Assumptions	Non-residential
Average life of investment (years)	25
2014 take up	10%
Maximum take up (share of eligible stock)	30%
Additional take up annually	0.3%
Learning rate (real cost deflation)	1%
Electricity savings rate (MJ/sqm p.a.)	22.0
Electricity savings (kWh/sqm p.a.)	6.1
Gas savings rate (MJ/sqm p.a.)	0.0
Capital cost ($2014/sqm)	$144.27
Simple payback (years)	102.7

LIGHTING

Lighting is a major energy use in buildings and there is potential for considerable energy saving through upgrades, such as changing fluorescents and halogen fittings to light emitting diodes (LED), or metal halides lamps to induction lamps.

Highly efficient lighting options are now available and in particular LED technology is well established and continues to improve in performance and efficiency (defined in lumens per watt) at a rapid rate. Stakeholders consulted in developing this Plan noted there could be a role for information and training around new and emerging technologies, possibly integrated with existing programs covered by Chapter 2.

The following list shows the comparative efficiencies for some common lighting types. The higher the lumens per watt, the more efficient the lighting type.

- Halogen lamps – 20 lumens per watt.
- Compact fluorescent lights (CFLs) – 60 lumens per watt.
- Linear fluorescents – 100 lumens per watt.
- High intensity discharge lamps – 120 lumens per watt.
- White LED lamps expected to exceed – 150 lumens per watt in the short to medium term.[21]

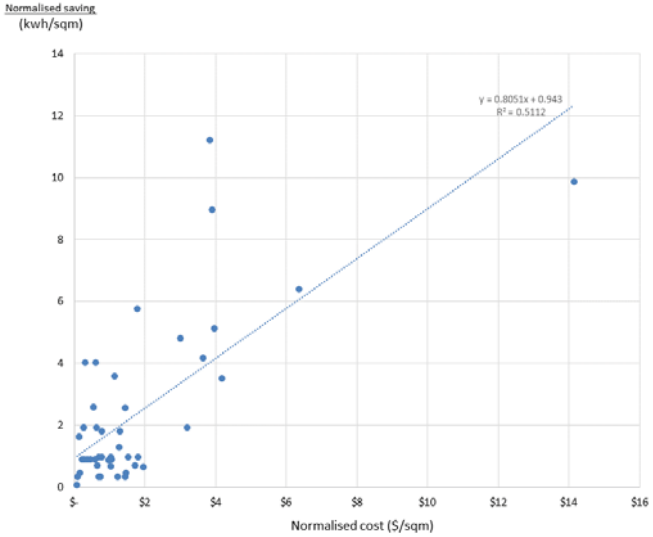
The integration of highly efficient light producing technologies, a sophisticated lighting control system that provides light only when needed, and a design that captures available daylight can reduce lighting energy use by more than 80 per cent.[22]

There are many different lighting upgrade options that could be applied to building stock in Sydney. For base buildings, there are luminaire replacements (changing the light fitting) and upgrades, upgraded hardware (lamps), and controls (sensors, switching). For tenancies, both retail and offices, similar measures are possible. In addition, simple de-lamping (removing excess lamps) and voltage control may improve energy efficiency.

Lighting upgrades are relatively easy to implement compared with major building or plant upgrades. Building owners may benefit by upgrading lighting as it generally improves their ability to lease space. Including lighting efficiency in the design standards for new fit out sites and making upgrades at time of lease renewal are key opportunities.

Figure 24 shows the spread of actual results for office base building luminaire replacements and upgrades. The electricity savings are shown on the vertical axis while the horizontal shows incremental costs (the additional cost beyond industry-standard solutions). Average values are used to account for variation between buildings and audit methods. Most luminaire upgrades are less than $2/sqm incremental cost.

FIGURE 24. LUMINAIRE REPLACEMENTS/UPGRADES COST CURVE



Artificial lighting systems are reasonably generic and retrofit opportunities are mostly determined by the starting point technology being replaced rather than the nature of the building in which the system is housed. An exception is where lighting designers aim to incorporate day lighting in the overall lighting solution, however the scope to do this cost-effectively depends on the facade type, window area, solar access and other factors.

Lighting cost curves developed for tenancies, base buildings, hotels and retail spaces developed for this Master Plan were quite similar, however they may not be applicable for specialised lighting applications.

Assumptions	Non-residential	High-rise residential	Mid-low rise residential
Average life of investment (years)	7	7	7
2014 take up	20%	50%	50%
Maximum take up (share of eligible stock)	100%	100%	100%
Additional take up annually	1.9%	1.6%	1.6%
Learning rate (real cost deflation)	1%	1%	1%
Electricity savings rate (MJ/sqm p.a.)	17.3	8.1	8.1
Electricity savings (kWh/sqm p.a.)	4.8	2.3	2.3
Gas savings rate (MJ/sqm p.a.)	0.0	0.0	0.0
Capital cost ($2014/sqm)	$3.83	$0.50	$0.50
Simple payback (years)	3.5	0.9	0.9

There are technologies which have recently entered the market that were not modelled for this Master Plan – yet these may well become affordable before 2030 through commoditisation. Local, central and distributed intelligent control systems can significantly reduce energy consumption and take the human factor out of the equation. For example, on board chip systems and power-over-ethernet products are available to optimise and control lighting levels. As prices fall with commoditisation these technologies may become the default for lighting.

POOL EQUIPMENT

Energy savings can be made through adjusting the set temperature of swimming pools, installing pool covers, and using more efficient pool pumps. For example, pool pumps with variable speed drives can deliver significant energy savings.

Assumptions	High-rise residential	Mid-low rise residential
Average life of investment (years)	10	10
2014 take up	5%	2%
Maximum take up (share of eligible stock)	50%	5%
Additional take up annually	1%	0.10%
Learning rate (real cost deflation)	1%	1%
Electricity savings rate (MJ/sqm p.a.)	4.0	4.0
Electricity savings (kWh/sqm p.a.)	1.1	1.1
Gas savings rate (MJ/sqm p.a.)	3.3	3.3
Capital cost ($2014/sqm)	$0.28	$0.28
Simple payback (years)	0.8	0.8

TIMERS & SENSORS

Perhaps the simplest saving that can be made is by turning off a service when it is not needed. Time of use control modifications include reduced run hours for central plant, and switch-off achieved by using triggered sensors such as occupancy or natural light sensors. Timers and sensors are generally easy to install, and can be used for new or existing buildings. The technologies and user acceptance has evolved to a point that installations are common and generally well received. Technologies continue to evolve, for example smart thermostats and smart phone capabilities.

Assumptions	High-rise residential	Mid-low rise residential
Average life of investment (years)	8	8
2014 take up	30%	30%
Maximum take up (share of eligible stock)	100%	100%
Additional take up annually	2.2%	2.2%
Learning rate (real cost deflation)	1%	1%
Electricity savings rate (MJ/sqm p.a.)	3.3	3.3
Electricity savings (kWh/sqm p.a.)	0.9	0.9
Gas savings rate (MJ/sqm p.a.)	0.0	0.0
Capital cost ($2014/sqm)	$0.69	$0.69
Simple payback (years)	2.9	2.9

VARIABLE SPEED DRIVES (VSD) CONTROLS & FANS

Considerable energy savings can be made through the use of variable speed drives (motors) which adjust power demand to better match the load for various applications including pumps and fans. Many buildings contain variable speed drives; however less than optimal configuration is commonplace. Correctly set variable speed drives on pumps and fans can achieve considerable energy savings. Resetting air handler pressures between commissioned minimum and maximum pressures provides considerable energy savings.

Assumptions	High-rise residential	Mid-low rise residential
Average life of investment (years)	10	10
2014 take up	50%	50%
Maximum take up (share of eligible stock)	100%	100%
Additional take up annually	1.6%	1.6%
Learning rate (real cost deflation)	1%	1%
Electricity savings rate (MJ/sqm p.a.)	6.8	6.8
Electricity savings (kWh/sqm p.a.)	1.9	1.9
Gas savings rate (MJ/sqm p.a.)	0.0	0.0
Capital cost ($2014/sqm)	$0.63	$0.63
Simple payback (years)	1.3	1.3

VOLTAGE REDUCTION

It is feasible in some circumstances to reduce voltage for plant and lighting systems without affecting performance or lighting quality. Step-down transformers or more sophisticated voltage monitoring and control systems may also be used to save energy.

Assumptions	High-rise residential	Mid-low rise residential
Average life of investment (years)	10	10
2014 take up	10%	10%
Maximum take up (share of eligible stock)	20%	20%
Additional take up annually	0.3%	0.3%
Learning rate (real cost deflation)	1%	1%
Electricity savings rate (MJ/sqm p.a.)	10.3	10.3
Electricity savings (kWh/sqm p.a.)	2.9	2.9
Gas savings rate (MJ/sqm p.a.)	0.0	0.0
Capital cost ($2014/sqm)	$2.68	$2.68
Simple payback (years)	3.7	3.7

WATER SAVINGS MEASURES

Hot water systems are a significant user of energy in residential buildings. Reducing hot water consumption through water saving measures can reduce total energy consumption considerably and for very little cost.

Assumptions	High-rise residential	Mid-low rise residential
Average life of investment (years)	8	8
2014 take up	60%	60%
Maximum take up (share of eligible stock)	80%	80%
Additional take up annually	0.65%	0.63%
Learning rate (real cost deflation)	1%	1%
Electricity savings rate (MJ/sqm p.a.)	21.0	21.0
Electricity savings (kWh/sqm p.a.)	5.8	5.8
Gas savings rate (MJ/sqm p.a.)	15.8	15.8
Capital cost ($2014/sqm)	$1.33	$1.33
Simple payback (years)	2.8	2.8

RE-THINKING RENEWABLE ENERGY

NEW BUILDS

In developing this Master Plan the City of Sydney convened workshops with key external stakeholders from government, energy and property sectors including the Better Buildings Partnership. During these workshops it became clear that new buildings and major refurbishments present a significant opportunity for energy efficiency.

A detailed examination[23] by pitt&sherry found that new commercial buildings could use between 58 and 68 per cent less energy, on average, than current code-compliant designs by 2020, although there is much variability depending upon the building type and location. Some commercial building types, like supermarkets, may also be built cost-effectively with high levels of energy efficiency to the point that onsite renewables can generate as much energy as the building uses over a year (zero net energy).

Best practice design for energy efficiency minimises the energy use for the entire building system. Designs that capture and control natural light with natural heating, cooling and ventilation greatly reduce the need for the building system to consume electricity or gas in the supply of light, space conditioning and other services.

High thermally efficient building envelopes require minimal energy consumption and can be achieved through insulation, sealing and glazing design, and technology selection. The energy savings opportunities of advanced envelope design in large commercial buildings are significant and can reduce the need for additional heating and cooling by up to 60 per cent.[24]

Smart design can also greatly reduce the energy consumption of residential buildings. European studies have found that 'passive house' designs (for both individual and small to medium multi-unit dwellings in Germany) can lower primary energy use to 28 per cent of that consumed in a typical existing dwelling.[25]

For this Master Plan pitt&sherry has considered the cost-effective technology potential for residential buildings which go beyond existing energy targets of the NSW Building Sustainability Index (BASIX). For commercial buildings, a similar assessment was undertaken whereby cost-effective technologies were applied to new buildings which exceed the minimum requirements set by the National Construction Code 2010.

Assumptions	Non-residential	High-rise residential	Mid-low rise residential	Detached residential	Semi-detached residential
Average life of investment (years)	10	10	10	10	10
2014 take up	0%	0%	0%	0%	0%
Maximum take up (share of eligible stock)	100%	100%	100%	100%	100%
Additional take up annually	3.15%	3.15%	3.15%	3.15%	3.15%
Learning rate (real cost deflation)	1%	1%	1%	1%	1%
Electricity savings rate (MJ/sqm p.a.)	313.2	53.2	41.7	10.7	14.1
Electricity savings (kWh/sqm p.a.)	87	14.8	11.6	3	3.9
Gas savings rate (MJ/sqm p.a.)	74	26.2	20.5	5.3	6.9
Capital cost ($2014/sqm)	$111.33	$14.9	$9.78	$2.79	$2.79
Simple payback (years)	7.0	3.5	3	3	2.3

RE-THINKING ENERGY EFFICIENCY

RE-THINKING ENERGY EFFICIENCY

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There are several significant factors that make this an ideal time for Sydney to take strong action on energy efficiency.

- The recent steep rises in energy prices.
- Decoupling energy consumption and economic productivity.
- Climate change mitigation and resilience.

This section of the Master Plan sets out the context of changing energy consumption, current policies and programs, and the approach used to develop the technical analysis which underpins this Master Plan.

CHANGING ENERGY PATTERNS

CONSUMPTION

Energy consumption refers to the amount of energy used over a given period of time, for example Figure 25 shows electricity consumption in gigawatt hours (GWh) per annum. Energy consumption differs to energy demand, which is the amount of energy that is required at a specific instant.

Until quite recently, the quantity of electricity used in Sydney increased each year. However, in the years since 2007 the amount of electricity used each year has been less than the year before and there is no evidence for a reversal of this trend in the short term. This trend is indicative of what happening in the National Electricity Market (NEM) as people are using energy in different ways, and they are using less.

There are many reasons to explain the decline. Initially, it was thought to be the result of the global financial crisis; however the lasting nature indicates other factors at play. A recent report by the Australia Institute[26] outlines the three largest factors contributing to the recent changes in consumption in the National Electricity Market are:

- Energy efficiency programs (mainly regulatory).
- Structural change away from electricity intensive industries.
- Response of electricity consumers (especially residential) to higher electricity prices.

Electricity consumers are continuing to act on the realisation that there are many opportunities to conserve and use electricity more efficiently that are easy to identify and not expensive to implement.

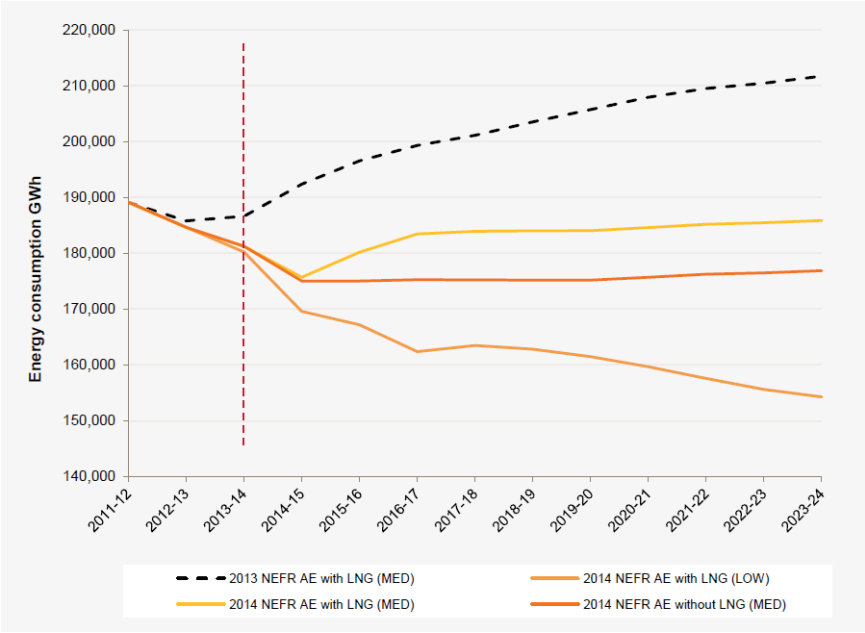
In addition there are influences from the growth in rooftop photovoltaics, uptake of solar water heating, and weather. Many energy service demands such as residential space cooling and hot water may have also reached practical market saturation, offset by ongoing improvements in the efficiency of appliances and building services.

Energy efficiency may account for around one-third of the relative drop in consumption of grid-sourced electricity in the National Electricity Market over the past decade. Energy efficiency programs are described later in this Master Plan.

The Australian Energy Market Operator has developed future consumption scenarios for the National Electricity Market as shown in Figure 25. The chart shows the recent falling consumption trend and how consumption may again increase (commensurate with historical trends), or flat line, or indeed continue to decline.

It is not clear whether sufficient allowance has been made for energy efficiency in predicting future consumption. Should consumption increase again, the role for energy efficiency will increase as the most socially cost-effective and environmentally beneficial way to meet energy needs.

FIGURE 25. NATIONAL ELECTRICITY MARKET (NEM) ANNUAL ENERGY FORECAST TEN-YEAR OUTLOOK[27]



NEFR AE = National Electricity Forecasting Report Annual Energy

FIGURE 26. CITY OF SYDNEY LOCAL GOVERNMENT AREA ELECTRICITY TREND[28]

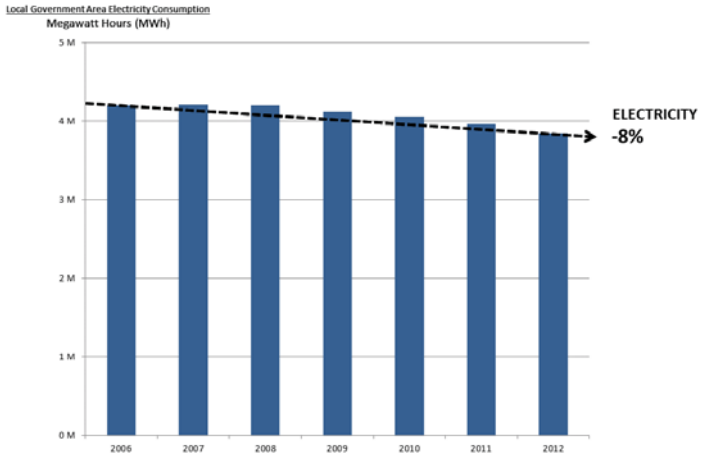
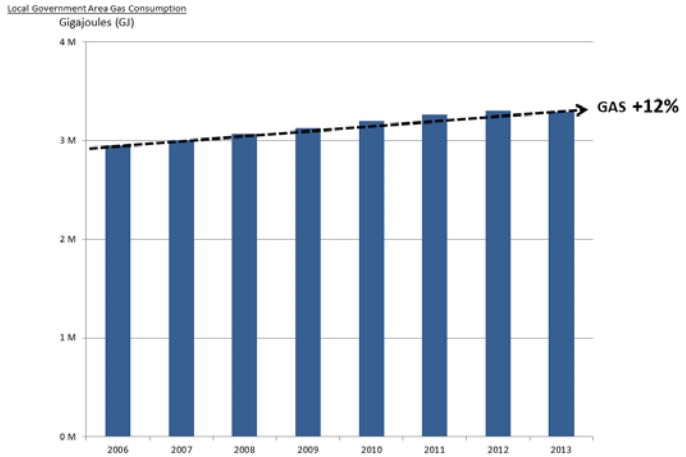


FIGURE 27. CITY OF SYDNEY LOCAL GOVERNMENT AREA NATURAL GAS TREND[29]



Within the City of Sydney local government area total electricity consumption has fallen from 4.2 terawatt hours in 2006 to 3.8 terawatt hours in 2012 – a fall of eight per cent, and this trend is continuing. Figure 26 shows historical electricity consumption since 2006 for the City of Sydney local government area based on Ausgrid network data. It does not include high voltage customers (for example rail, defence and data centres) which are estimated to represent around ten per cent of total consumption.

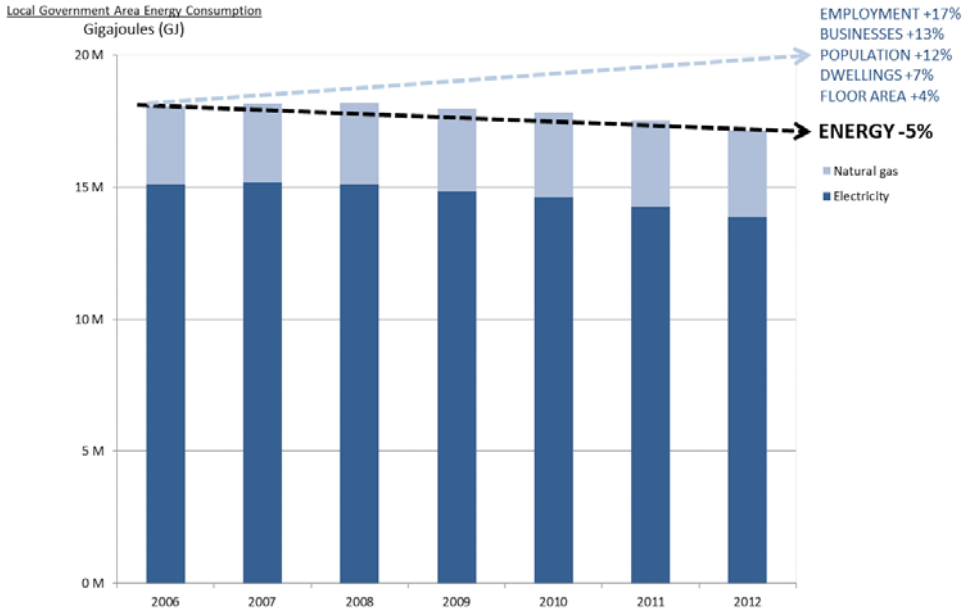
Total energy use in buildings has fallen five per cent in the City of Sydney from 2006 to 2012 and continues to decline.

In developing this Master Plan, pitt&sherry analysed seven years of residential and non-residential electricity consumption to develop detailed bottom-up modelling of the various energy efficiency measures which affect electricity consumption in Sydney. The model corrected the residential and non-residential split and produced historic results very similar to actual network consumption and is therefore considered reliable.

The modelling indicates that the fall in consumption below business-as-usual is influenced by the large price increase which occurred in 2009–10. Milder weather in 2012 may have contributed to a fall in electricity consumption but is less likely to have caused the further fall in consumption in 2013. The remainder of the decline is mostly due to energy efficiency policies and programs.

The trend for gas consumption in the City of Sydney local government area is different to electricity. Figure 27 shows how gas consumption has actually increased since 2006 with a small decline from 2012 to 2013. Residential consumption has increased at a greater rate than commercial consumption due to growth in residential dwellings (mostly apartments) which generally require gas hot water and cooking to meet BASIX targets.

FIGURE 28. CITY OF SYDNEY LOCAL GOVERNMENT AREA TOTAL ENERGY USAGE TREND



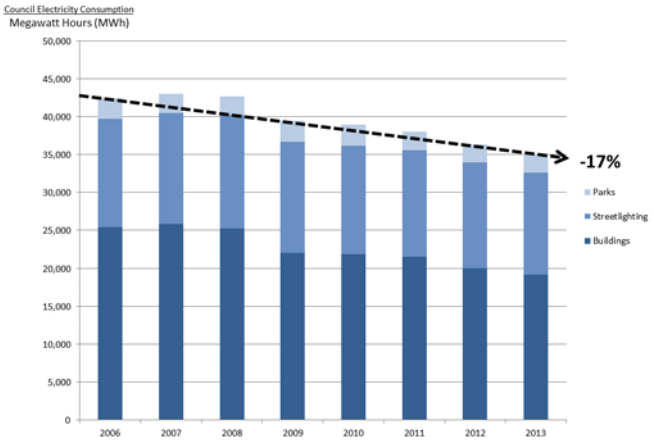
Non-residential gas consumption has generally largely remained constant and year on year changes most likely relate to changes in floor space and industry types, growth in the number of restaurants and cafés, and some local gas-fired energy generation.

Adding together electricity and natural gas consumption, Figure 28 shows that total energy consumption fell by five per cent from 2006 to 2012 across the local government area. This is a net decline and most notably, this has occurred concurrent with growth in population, jobs and the economy over the same period.

During this period there has been an increase in jobs (17 per cent), new businesses (13 per cent), population (12 per cent), new dwellings (7 per cent) and total floor space (4 per cent). It is clearly showing there is now a decoupling of energy from growth. Should this energy trend continue, by 2030 total energy consumption of buildings would be 20 per cent below 2006 levels.

In line with this trend of net energy decline for the local government area, the City of Sydney as an organisation has achieved significant energy savings by undertaking energy and water retrofits in its major properties, as well as implementing LED street lighting and renewable energy installations as shown by Figure 29.

FIGURE 29. CITY OF SYDNEY COUNCIL ELECTRICITY USAGE TREND

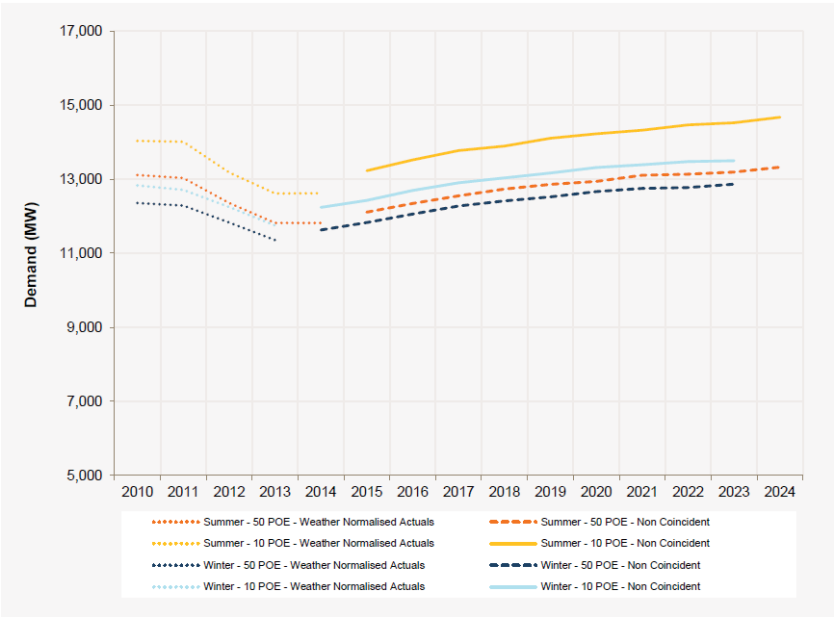


DEMAND

As outlined in the previous section, energy demand is not the same as energy consumption and refers to the amount of energy that is required at a specific instant. For example, Figure 30 shows the peak demand across NSW for electricity in megawatts (MW).

While electricity consumption has been falling, the peaks of electricity demand have not fallen at the same rate or at a consistent rate. In NSW demand has fallen in recent years but that growth is forecast again in the future.

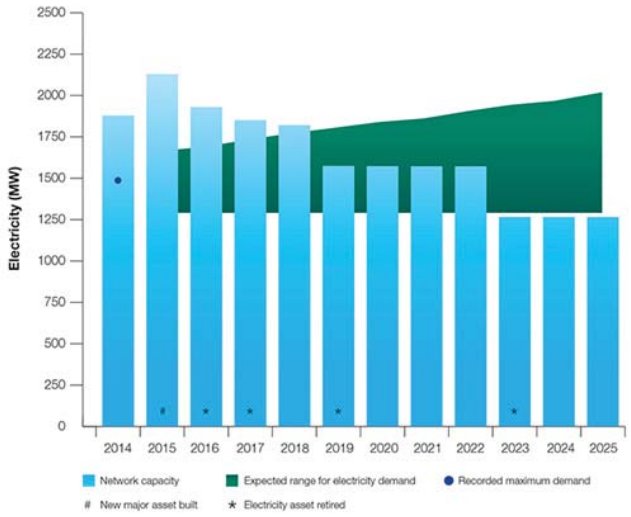
FIGURE 30. NSW ELECTRICITY DEMAND CAPACITY FORECASTS[30]



POE = Probability of Exceedance

For inner Sydney, recent demand growth forecasts developed by the transmission and distribution network service providers are shown in Figure 31. Demand may fall further due to local generation and storage, more energy efficiency, and demand management. Network capacity is expected to fall due to retirement of older network assets, and the timing of the replacement of these assets will reflect expectations about future demand trends.

FIGURE 31. INNER SYDNEY ELECTRICITY DEMAND CAPACITY FORECASTS[31]



THE FUTURE OF ENERGY EFFICIENCY

In Australia there is significant potential for existing and new buildings to reduce energy consumption through energy efficiency well beyond minimum requirements and standard practice.

Many countries globally are harnessing energy efficiency benefits. For example, the European Union has set a binding target to improve energy efficiency by 20 per cent by 2020. The EU directive that establishes this target (applicable to all 28 member states) also allows for further energy efficiency improvements, flagged to be 80 per cent by 2050.[32]

Studies in the United States estimate that commercial buildings energy use could be reduced by 80 per cent through efficiency measures alone.[33] Potential efficiency gains identified overseas are applicable within our own local government area, and we are not alone in pursuing the objective of energy efficiency.

Cutting edge upgrades to existing buildings can also yield impressive savings. The Lawrence Berkeley Laboratory recently conducted a 'deep retrofit' study on a small number of Californian homes. One home reduced energy use to 75 per cent less than the state average.[34] A residential 'Ultra-Low-Energy-Building' can require up to 90 per cent less energy compared to a conventional new residential building.

These high levels of energy savings depend on the entire building system being fine-tuned for energy efficiency. Each energy end use system must be highly efficient and be contained within an efficient building envelope that minimises the work required of the energy using equipment.

The scope for efficiency gains in new buildings is generally larger than for existing ones, because they can include design improvements as well as efficient equipment. While there may be a cost associated with the additional design and coordination required for a highly energy efficient building, it is offset by both construction cost savings such as downsizing mechanical plant and electrical lighting needs (which reduces developer costs) and energy cost savings (which reduces building owner/occupants costs).

There are numerous methods and technologies that can dramatically reduce the energy consumed in buildings for example in space conditioning, lighting, hot water and design. The magnitude of savings is dependent on climate zones. With its milder climate, the need for heating and cooling in Sydney is lower, presenting an opportunity for very low energy buildings.

Chapter 4 of this Master Plan outlines scenarios for energy efficiency under existing and new policies and programs scenarios. It also shows the technical potential which includes measures that may not be cost-effective today but provide a picture of possible future opportunities.

Overall, the technical potential to reduce energy consumption in buildings for Sydney – using energy efficiency strategies alone, and without consideration of cost-effectiveness – is at least 50 per cent below 2006 levels.

It is important that 'cutting edge' buildings and technologies continue to be developed and trialled, even if not fully cost-effective in the short term. This kind of applied research, development and demonstration is vital to prove up new techniques, designs and technologies, drive down costs, increase scale efficiencies, and up-skill the supply chain.

Chapter 6 of this Master Plan contains case studies of international and local leading practice which provides a glimpse into the energy efficient future for buildings and energy policy.

NSW ENERGY EFFICIENCY ACTION PLAN

In August 2013 the NSW Government released the NSW Energy Efficiency Action Plan[35] to help drive energy efficiency across the state and achieve an energy savings target of 16,000 GWh by 2020.

Some of the key actions from the NSW Plan that relate to this Master Plan are:

- The NSW Government commitment to support 220,000 low income households to reduce energy use by 20 per cent by 2014.
- To deliver retrofit programs with a target of 50 per cent of commercial floor space achieving a 4 star NABERS energy and water rating by 2020.
- Strengthening the existing Energy Savings Scheme.
- Investigating a voluntary energy rating system for residential buildings at the point of sale or lease.

These actions will assist in meeting both the City of Sydney and NSW Government ambitions for energy efficiency.

Figure 32 shows the NSW energy efficiency target against an assumed growth scenario. Consumption in NSW has been declining in recent years, partly due to energy efficiency measures, which positions NSW well for meeting its 2020 target. The NSW Energy Efficiency Action Plan contains 30 targets to increase the uptake of energy efficiency for NSW as shown by Figure 33.

FIGURE 32. NSW GOVERNMENT ENERGY EFFICIENCY TARGET

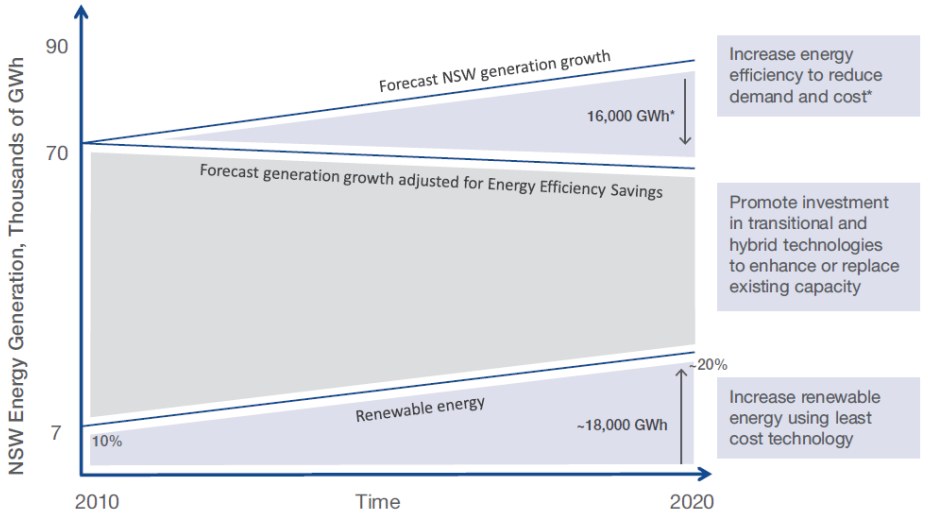


FIGURE 33. NSW ENERGY EFFICIENCY ACTION PLAN ACTIONS

Strengthen the energy efficiency market

The NSW Government will grow and mature the energy efficiency products and services industry. It will:

1 review the Energy Savings Scheme to see how it could be enhanced to help meet NSW 2021 targets
2 enhance the Energy Savings Scheme Rule to reduce red tape and improve access
3 investigate options to target energy savings at the times and locations of peak demand
4 explore options for market-based mechanisms to improve gas efficiency
5 deliver initiatives to position NSW as the Asia-Pacific region centre for energy efficiency
6 monitor, evaluate and report on the effect of energy efficiency programs.

Energy efficient homes

The NSW Government will make energy efficiency more accessible for NSW households. It will:

7 provide access to the Energy Savings Scheme for innovative behaviour change programs
8 enable the Energy Savings Scheme to support tradespeople to retrofit homes
9 streamline access to the Energy Savings Scheme for appliance retailers selling high-efficiency appliances
10 complete the Home Power Savings Program to support 40,000 more low income households save on bills
11 identify opportunities for improved access to energy efficiency for low income households
12 investigate voluntary ratings to help energy efficient homes stand out
13 explore measures to make finance for residential energy efficiency more affordable and accessible
14 share information, data and tools with households and their service providers through a digital platform.

Energy efficient business

The NSW Government will unlock business productivity by working with industry. It will:

15 increase upfront Energy Savings Scheme incentives and require savings to be verified
16 streamline energy efficiency projects with Energy Savings Scheme tools and business-case guides
17 accelerate the uptake of energy efficiency in priority sectors and technologies
18 offer hands-on training for site managers to help them apply best practice maintenance plans
19 provide energy efficiency basics training and information resources to general business advisors
20 standardise financial contracts for energy efficiency projects
21 build a digital platform to enable businesses to share data on energy savings.

Energy efficient government

The NSW Government will take a leadership role in adopting energy efficient technology. It will:

22 drive savings by key government agencies through a Government Resource Efficiency Policy
23 support agencies with a specialist team to help identify and implement projects
24 establish a pre-qualified tender panel to streamline procurement
25 improve the accessibility of finance for government energy efficiency projects
26 increase energy efficient office leases taken up by government
27 make government energy usage and energy efficiency data accessible.

Statewide delivery

The NSW Government will give communities across NSW access to initiatives. It will:

28 place energy specialists in regions to provide support for local communities
29 form partnerships with existing regional networks to accelerate the uptake of energy efficient solutions
30 provide easy-to-access online resources for households and businesses across NSW

POLICIES & PROGRAMS

This section of the Master Plan outlines the current policies and programs applicable to energy efficiency in the City of Sydney and which level of government or other body is responsible for each.

As outlined in Chapter 1, there are compelling economic reasons for and multiple benefits of energy efficiency. Policies and programs are significant drivers that interact with economic and commercial market forces such as energy prices, portfolio value and marketability.

Many energy efficiency policies were introduced between 2006 and 2010 with new construction codes; upgraded standards for equipment such as commercial lighting, air conditioners and refrigerators; and the banning of incandescent light globes. Energy savings from these and other initiatives are meaningfully contributing to declining energy consumption and demand.

Internationally, the Intergovernmental Panel on Climate Change (IPCC) notes that building codes and appliance standards, if well designed and implemented, have been among the most environmentally beneficial and cost-effective instruments for reducing greenhouse gas emissions.

Whilst energy efficiency is the product of technology improvements and minimum standards, it is also about user behaviours and motivations, and so policies and programs must be designed with specific end users in mind.

A broad range of energy efficiency policies and programs are in place across three jurisdictional levels (City of Sydney, NSW State and Commonwealth), which broadly fit into three categories:

- **Regulatory policies** – e.g. *NSW Building Sustainability Index (BASIX), the National Construction Code (NCC), Commercial Building Disclosure (CDB), and Minimum Energy Performance Standards (MEPS).*
- **Market based policies** – e.g. *NSW Energy Savings Scheme (ESS), and the now defunct price[36] on carbon.*
- **Voluntary schemes** – e.g. *National Australian Built Environment Rating System (NABERS), CitySwitch Green Office, the Better Buildings Partnership (BBP), and Green Star.*

As a local government authority, there are limits on the extent to which the City of Sydney is able to legislate and mandate change. For instance, performance standards for new residential buildings are set by the NSW Government and the City is not able to mandate higher greenhouse gas emissions controls or energy efficiency standards for this particular building sector.

The main way that the City is able to intervene is by working with other governments, implementing voluntary measures, developing partnerships, offering incentives, and ensuring compliance with existing mandatory measures.

BETTER BUILDINGS PARTNERSHIP

CITY OF SYDNEY

BEST PRACTICE LEASES

Best practice, or green leases are an important tool to enable improvements without waiting for typically long and staggered churn cycles of office buildings.

Many different parties are involved with leasing, with only a few holding a continued interest in better performance outcomes – the tenant and landlord. Best practice (or green) leases establish a framework for collaboration and facilitate setting expectations that result in capacity building, upgrade works, building tuning and other energy efficiency improvements.

The energy consumed by a typical commercial building is roughly split equally between base building services and tenancy lighting and consumption. Green leases can set standards for both tenants and landlords to achieve and maintain energy efficiency and other sustainability goals throughout the lease term.

Green leases can also enable information sharing and streamline the use of environmental upgrade agreements or other forms of finance to upgrade building systems and lighting traditionally not possible.

The Better Buildings Partnership (BBP) has developed a suite of tools to map out the process of green leases for the broad gamut of stakeholders to support best practice leasing, including:

- Leasing Lifecycle Tool.
- Why Choose High Performing Buildings Factsheet.
- Templates for Site Selection Briefs.
- BBP Model Lease Clauses (24 template clauses that cover 4 broad categories):
  - –Cooperation and Management.
  - –Consumption, Waste and Recycling.
  - –Specifications and Standards.
  - –Compliance and Costs.

Research undertaken by the Better Buildings Partnership[37] of commercial property leases in the Sydney CBD shows nearly two-thirds of all leases signed in the past two years have included green leasing and more than 80 per cent of all prime-grade buildings' deals include best practice leasing. In prime-grade buildings, focus on collaboration and resource consumption are key, with over half of the BBP Model Lease Clauses used on average.

These high uptake rates demonstrate that commercial leasing lawyers operating in Sydney need to be aware of, and actively encourage green leases. To 'show by doing' the City of Sydney has signed 24 green leases with tenants across our whole commercial property portfolio.

Other Green Lease resources include:

- **Green Lease Guide for Commercial Office Tenants** – *Investa Property Group.*
- **Green Leasing Principles** – *CitySwitch Green Office.*
- **Tenant's Guide to Green Leases and the Green Lease Handbook** – *National Strategy on Energy Efficiency.*

The National Green Leasing Policy establishes a framework for minimum green lease standards in government office accommodation. The Commonwealth policy requires a minimum 4.5 star NABERS Energy rating for both government tenancies and buildings over 2,000sqm.

The NSW Government Resource Efficiency Policy likewise sets a minimum 4.5 star NABERS Energy rating for State owned and leased office buildings by 2017, and new and renewed leases of at least two years are to include a Green Lease Schedule. An action of the policy is to also review and update a *Green Lease Toolkit.*

Lead agency: Better Buildings Partnership.

Website: www.sydneybetterbuildings.com.au

BETTER BUILDINGS PARTNERSHIP (BBP)[38]

The Better Buildings Partnership (BBP) is a collaborative partnership of leading public, private and institutional commercial building owners representing over 50 per cent of office floor space in the Sydney centre and is a key stakeholder for this Master Plan.

The Partnership aims to develop collaborative solutions and initiatives to overcome barriers and achieve substantial improvements in the environmental performance of their buildings. There are multiple benefits of this Partnership:

- Common vision and performance targets.
- Incentivises leading businesses to action.
- Collective action on market or legislative barriers.
- Share models of best practice.
- Skills and information exchange with next tier property owners.

The Partnership has an emissions reduction target of 70 per cent for its portfolio based on 2006 levels which is the same target adopted in Sustainable Sydney 2030 for the local government area, and demonstrates real commitment and leadership by these building owners.

Substantial progress is already being made with a 31 per cent reduction in emissions already achieved. Energy savings are 27 per cent, as shown in Figure 34. As of June 2013 members were saving over $25 million in electricity costs each year due to energy efficiency.

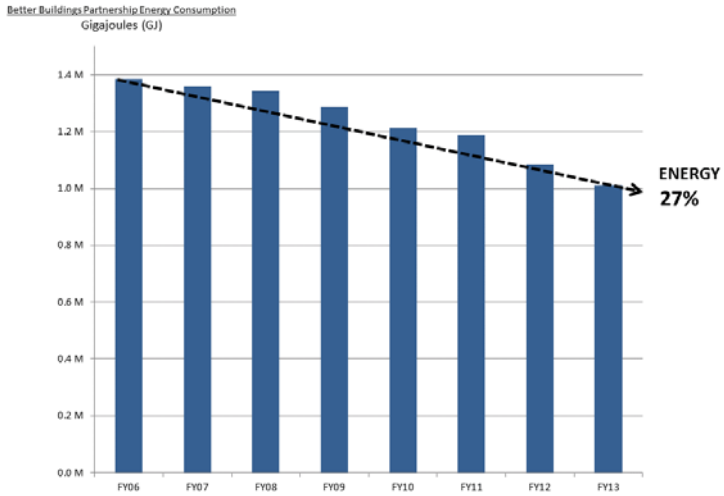
The Partnership continues to identify and produce resources and tools to share best practice and expert insights with the wider business community and improve tenant and landlord engagement throughout the leasing lifecycle. The Partnership has developed model lease clauses, a leasing lifecycle tool, and *The Tenants' and Landlords' Guide to Happiness* e-book.

The achievements of the Better Buildings Partnership have been recognised by winning the 2013 Best Energy Saving Program Award by the Energy Efficiency Council, the 2014 Banksia Innovator of the Year Award, and being highly commended in the 2014 NSW Green Globe Awards.

Lead agency: City of Sydney

Website: www.sydneybetterbuildings.com.au

FIGURE 34. BETTER BUILDINGS PARTNERSHIP ENERGY CONSUMPTION TREND



C40 CITIES CLIMATE LEADERSHIP GROUP

The C40 Cities Climate Leadership Group was established in 2005 as a global network of large cities to take action and reduce greenhouse gas emissions while addressing climate risks and impacts.

The City of Sydney is a founding member and involved in many C40 networks. The major network that focuses on energy savings is the Private Building Energy Initiative.

The Initiative includes almost 30 cities from Europe, North America, Latin America, Oceania and East Asia and seeks to drive the uptake of best practices in global cities by sharing diverse experiences and joint research in policies and programs that could be applied locally.

The program is currently focused on stakeholder engagement, data management, and policy development and is co-chaired by the City of Sydney and Tokyo.

Lead agency: C40 Cities Climate Leadership Group

Website: www.c40.org

CITY OF SYDNEY PLANNING CONTROLS

The City of Sydney assesses development applications with regard to the Local Environmental Plan (LEP), Development Control Plan (DCP), and other matters listed in Section 79C of the Environmental Planning & Assessment Act 1979.

There are six aims of the DCP, including to 'achieve the objectives of the City's Sustainable Sydney 2030 Strategy'. Energy efficiency provisions for non-residential development contained within the City's DCP include:

1. Development is to be designed and constructed to reduce the need for active heating and cooling by incorporating passive design measures including design, location and thermal properties of glazing, natural ventilation, and appropriate use of thermal mass and external shading, including vegetation.
2. Lighting for streets, parks and any other public domain spaces provided as part of a development should be energy efficient lighting such as LED lighting.
3. In multi-tenant or strata-subdivided developments, electricity sub-metering is to be provided for lighting, air-conditioning and power within each tenancy or strata unit. Locations are to be identified on the development plans.
4. Electricity sub-metering is to be provided for significant end uses that will consume more than 10,000 kWh/a.
5. Car parking areas are to be designed and constructed so that electric vehicle charging points can be installed at a later time.
6. Where appropriate and possible, the development of the public domain should include electric vehicle charging points or the capacity for electric vehicle charging points to be installed at a later time.

Lead agency: City of Sydney

Website: www.cityofsydney.nsw.gov.au

CITY OF SYDNEY GRANTS

The City of Sydney offers services and engages with owners and occupiers of buildings and facilities within key sectors of the City of Sydney. These currently include commercial office tenants, office building owners, apartment owners and residents, hotels and other large businesses. Each of these engagements offers a range of services targeted to the needs of the sector including a range of competitive grants for local residents, building owners and their service providers that are designed to encourage action that improves environmental performance. There are three grants that specifically relate to this Master Plan:

- **Innovation grants** – For demonstration projects and feasibility studies.
- **Building operations grants** – To reduce energy and water consumption in buildings such as through the installation of systems, fixtures and fittings.
- **Ratings and Assessment grants** – To provide the information on the opportunities available, by subsidizing initial energy ratings and energy audits.

In addition six other grant programs contribute to environmental outcomes.

- Matching Grants.
- Knowledge Exchange Sponsorship.
- Quick Response Grants.
- Venue Support Grants.
- Sponsorship.
- Street Banner Sponsorship.
- Accommodation Grants.

Lead agency: City of Sydney

Website: www.cityofsydney.nsw.gov.au

CITYSWITCH GREEN OFFICE[38]

CitySwitch Green Office is a high-value, no-cost service which supports commercial office tenants to improve office energy efficiency through a range of services, with the ultimate aim of achieving a 4.5 star or higher NABERS Energy rating.

The National program is run in partnership with multiple cities and the NSW Office of Environment and Heritage. The City of Sydney is the national administrator and runs the Sydney program.

The program aims to educate and inspire through events, provision of toolkits, case studies, information, site tours and linkages to other programs and incentives. Achievements are acknowledged through annual awards and member promotions.

There are more than 100 signatories to date within the City of Sydney which represent around 20 per cent of office floor space in the local government area. The average NABERS Energy rating of CitySwitch signatories in Sydney was 4.1 stars as at December 2014. The 2015 target is 4.5 stars.

CitySwitch supports commercial building tenancies to reduce energy consumption, improve energy productivity and reduce greenhouse gas emissions and is a key program to achieving the aims of this Master Plan.

Lead agency: City of Sydney

Website: www.cityswitch.net.au

COMMERCIAL BUILDING DISCLOSURE (CBD)[38]

The Commercial Building Disclosure (CBD) scheme requires energy efficiency information to be disclosed for commercial office space of 2,000 square meters or more at time of sale, lease or sub-lease. It applies to both base buildings and tenancies where triggered and has been operating since 2011.

The mandatory scheme is a market-based incentive for owners to improve their properties with cost-effective energy efficient upgrades that are attractive to buyers and tenants.

Sellers or lessors are required to obtain a Building Energy Efficiency Certificate (BEEC) which includes a NABERS Energy star rating, a tenancy lighting assessment, and general guidance. Assessors are required to be accredited. A building's NABERS Energy star rating must be included in any advertising material.

A Building Energy Efficiency Certificate is valid for one year. To avoid potential delays when a building is nominated for sale, many intuitional owners are routinely conducting annual assessments to ensure certificates remain current.

The mandatory nature of the scheme, and the credibility of NABERS, has driven improved awareness of energy efficiency in the commercial property market and provides a way for property owners to attract tenants by offering relatively energy efficient office space.

The CBD program has had a big impact on second tier stock such as B and C grade buildings which may change ownership at frequent intervals and typically may not otherwise undertake energy efficiency assessments. This is a very important sector for achieving the aims of this Master Plan and the CBD program has a significant role to play.

By 2014, a total of 1,413 buildings have obtained their first NABERS Energy rating nationally since the CBD program commenced. The CBD program has tripled the number of NABERS ratings undertaken and driven significant improvement in the energy efficiency of office buildings with 657 buildings having reduced energy use by ten per cent or more[39].

As part of the Council of Australian Governments (COAG) National Strategy on Energy Efficiency, governments will consider expanding the scheme to other types of commercial buildings such as hotels, shopping centres, schools and hospitals, depending on regulatory impact assessment and consultation with industry.

The City of Sydney supports inclusion of more sectors and broader application within the commercial building sector. Modelling for this Master Plan includes savings from the CBD program within the existing policies and programs scenario. Expanded coverage to other building types is included under the new policies and programs scenario.

Many international cities have mandatory disclosure energy efficiency schemes including Tokyo, Singapore, Hong Kong, New York, Seattle and San Francisco. Many of these require the disclosure of information on an annual basis – not just on sale or lease, which provides an ongoing and more timely incentive to improve performance.

The CBD scheme was under review at the time of writing this Master Plan.

Lead agency: Australian Government

Website: http://cbd.gov.au

EMISSIONS REDUCTION FUND (ERF)

The price on greenhouse gas emissions which came into effect 1 July 2012 was repealed by the Australian Government in 2014 to be replaced in part by the Emissions Reduction Fund (ERF).

The ERF is designed to provide public funding to reduce greenhouse gas emissions at least cost and may include energy efficiency projects where cost competitive (compared to other greenhouse gas abatement actions such as renewable energy infrastructure and agricultural programs).

The Australian Government has developed a method for commercial buildings to demonstrate emissions savings under the ERF which is based on improving a NABERS Energy rating by at least one-star. A deeming provision is included which may assist with upfront costs in advance of delivered savings.

The Emissions Reduction Fund may provide a source of funding to improve the performance of buildings in the City of Sydney which would assist in meeting objectives of this Master Plan. The level of funding is unlikely to make a large contribution toward the total cost of an energy efficiency project, but may improve the overall business case.

It was not possible to reliably model energy savings of future projects funded through the Emissions Reduction Fund at the time of writing this Master Plan.

Lead agency: Australian Government

Website: www.environment.gov.au

ENERGY EFFICIENCY EXCHANGE

The Energy Efficiency Exchange (EEX) is a web-based information hub with a wide range of material on energy efficiency, chiefly for medium and high energy using businesses. Specific energy savings are not ascribed to the EEX for this Master Plan.

Lead agency: Australian Government on behalf of Australian, state and territory governments.

Website: http://eex.gov.au

CITY OF SYDNEY

ENVIRONMENTAL UPGRADE AGREEMENTS

Environmental Upgrade Agreements (EUAs) are a market-driven mechanism designed to make it easier to access finance for energy efficiency improvements in existing commercial, retail and industrial buildings. A finance provider lends funds to a building owner for energy efficiency upgrades with the loan repaid through a special charge on the land added to council rates.

Under the agreement, a building owner may pass on part of the cost of the upgrade to the tenant providing the amount does not exceed the financial saving that the tenant will benefit from as a result of the upgrade. This allows for the cost of an upgrade to be shared with the tenant who typically receives the benefit of reduced outgoings.

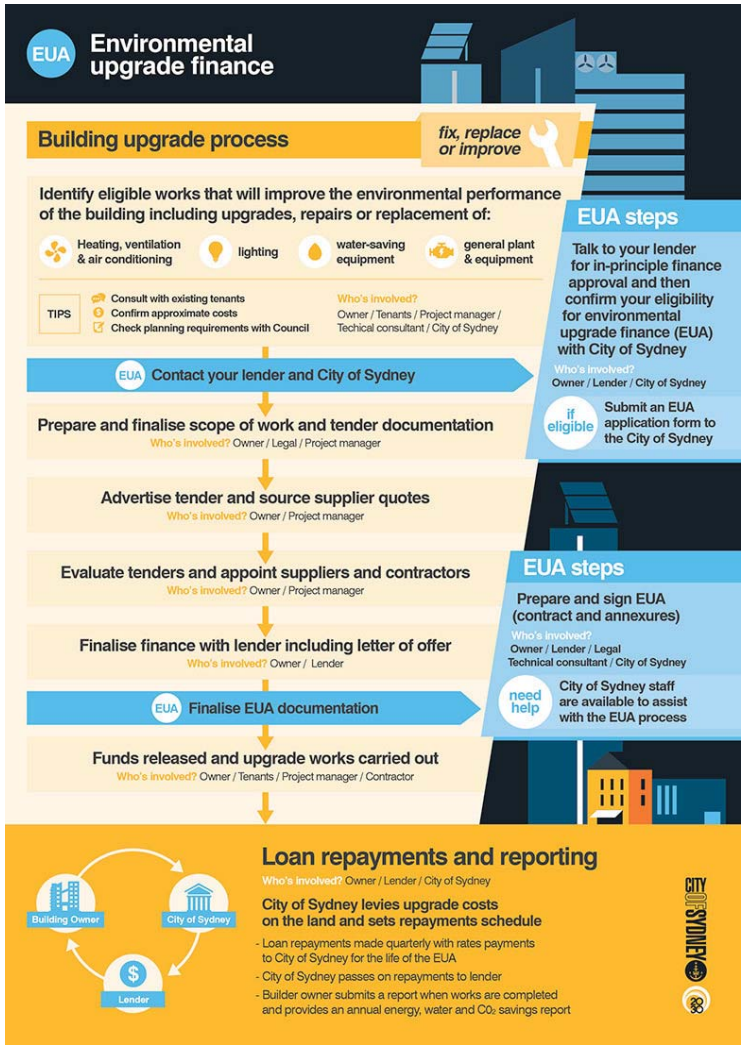
Feedback received during consultation in developing this Master Plan indicates that Environmental Upgrade Agreements are an effective mechanism to break down the split incentive between property owners and tenants; however, opportunities should be explored to increase the rate of uptake, particularly in smaller buildings. A pilot program is now underway with owners of non-investment grade commercial office buildings.

The City of Sydney has signed three Environmental Upgrade Agreements worth almost $30 million to date, with more proposals being considered. The NSW Government Resource Efficiency Policy sees a role for EUAs to finance energy efficiency upgrades in properties the State leases. The City is committed to offering the EUA service on an ongoing basis as an effective mechanism to increase energy efficiency as part of this Master Plan.

Lead agency: City of Sydney

Website: www.cityofsydney.nsw.gov.au

FIGURE 35. ENVIRONMENTAL UPGRADE FINANCE PROCESS



An Australian Government Initiative

GREEN BUILDING FUND

The Green Building Fund was established in 2008 and closed in 2011. It was fully subscribed and considered by many in the property industry as a successful program to improve energy efficiency in buildings.

Grants of between $50,000 and $500,000 were available through a competitive application process for commercial office buildings, hotels and shopping centres. Recipients were required to fund at least half of the project cost.

A total of 318 projects were funded for projects which included:

- Upgrades to heating, ventilation and air conditioning (HVAC).
- Building fabric changes such as glazing and shading.
- Building management and control systems.
- Onsite generation.

Lead agency: Australian Government

Website: www.business.gov.au

Green Living Centre

CITY OF SYDNEY

GREEN LIVING CENTRE

The Green Living Centre aims to create a community that is committed to low carbon living and one that is reducing its carbon footprint in line with a 70 per cent reduction by 2030. The Centre is a joint initiative of the City of Sydney and Marrickville Councils and was first established as The Watershed in 2002.

Lead agency: City of Sydney and Marrickville Councils

Website: www.greenlivingcentre.org.au

greenstar

GREEN STAR[38]

Green Star is a multi-criteria rating system to evaluate the environmental impact of the design, construction and operation of buildings and related communities. It includes a number of rating tools for building types such as office buildings, industrial buildings, shopping centres, and multi-unit residential buildings.

The rating tools cover nine performance categories including the energy category which rewards energy efficiency and integrates with the NABERS Energy tool. This voluntary program has been an important driver for improved environmental performance and energy efficiency for many buildings in the City of Sydney.

Lead agency: Green Building Council of Australia

Website: www.gbca.org.au/green-star

green villages

CITY OF SYDNEY

GREEN VILLAGES

The Green Villages program works to drive, build and celebrate sustainable villages within the City of Sydney local government area through the development of local sustainability programs, events and resources. Participants are encouraged to develop and drive their own local community projects supported through City of Sydney grants.

Lead agency: City of Sydney

Website: www.greenvillages.com.au

MINIMUM ENERGY PERFORMANCE STANDARDS (MEPS)

Minimum Energy Performance Standards (MEPS) and labelling specify the minimum level of energy performance that appliances, lighting and electrical equipment must meet or exceed before they can be offered for sale or used for commercial purposes. It is a form of mandatory disclosure. More than seven million appliances sold in 2013 carried the energy rating label.

MEPS and labelling encourage investment in energy efficiency innovation by helping to ensure better quality products are not undermined by competition from low-efficiency alternatives. Improving the energy efficiency of appliances and products has significant economic and environmental benefits and also reduces the running costs for households and businesses.

By targeting products that use energy (and produce waste heat), MEPS also improve the energy efficiency of building systems (including lighting and HVAC systems) and the energy efficiency of activities (such as electronic equipment). MEPS and labelling make an important and cost-effective contribution to the overall energy and emissions savings potential in buildings.

Products and appliance classes currently covered by MEPS ratings predominantly cover residential electricity use. Residential gas use and non-residential electricity use is covered to a lesser extent. Non-residential gas use is currently not impacted by these measures.

A recent report on the MEPS program[40] demonstrates the cost-effectiveness of energy efficiency showing that for every $1 of expenditure on the program (including costs to consumers), there is $4.60 worth of savings and a negative cost of carbon abatement.

Lead agency: Joint initiative of the Australian Commonwealth, State and Territory governments and the New Zealand Government

Website: www.energyrating.gov.au

NATIONAL AUSTRALIAN BUILT ENVIRONMENT RATING SYSTEM (NABERS)[38]

The National Australian Built Environment Rating System (NABERS) is a voluntary rating tool to measure the environmental performance of buildings. NABERS Energy rates a building from one-star to market leading six-stars based on annual energy use adjusted by the size and use of the building. NABERS currently applies to these building types:

- Data centres.
- Dwellings.
- Hotels.
- Offices (base building, whole building or tenancy).
- Shopping centres.

NABERS ratings are easily understood, credible and provide the basis for several other programs, such as Commercial Building Disclosure (CBD), the NSW Energy Savings Scheme (ESS), the Emissions Reduction Fund (ERF), green leases, and the energy element of Green Star.

The NSW Office of Environment and Heritage recently found that buildings in the City of Sydney that have had two ratings or more have reduced their carbon emissions by an average of 16 per cent over an average of 2.5 years. The number of buildings with whole and/or base building NABERS ratings is increasing and the energy intensity of rated buildings is decreasing as shown in Figure 36.

Properties with high NABERS ratings have a strong differentiation in the market. The quarterly Investment Property Databank (IPD) Australian Green Property Index tracks the investment performance of commercial office buildings that have been awarded a NABERS rating. The 2013/14 Index showed high NABERS rated buildings outperformed low rated buildings with:

- Higher capital growth.
- Higher rent.
- Higher operating income.
- Lower capital expenditure.
- Lower vacancy rates.
- Longer weighted average lease expiry.

FIGURE 36. TRENDS FOR NABERS RATED BUILDINGS IN THE CITY OF SYDNEY

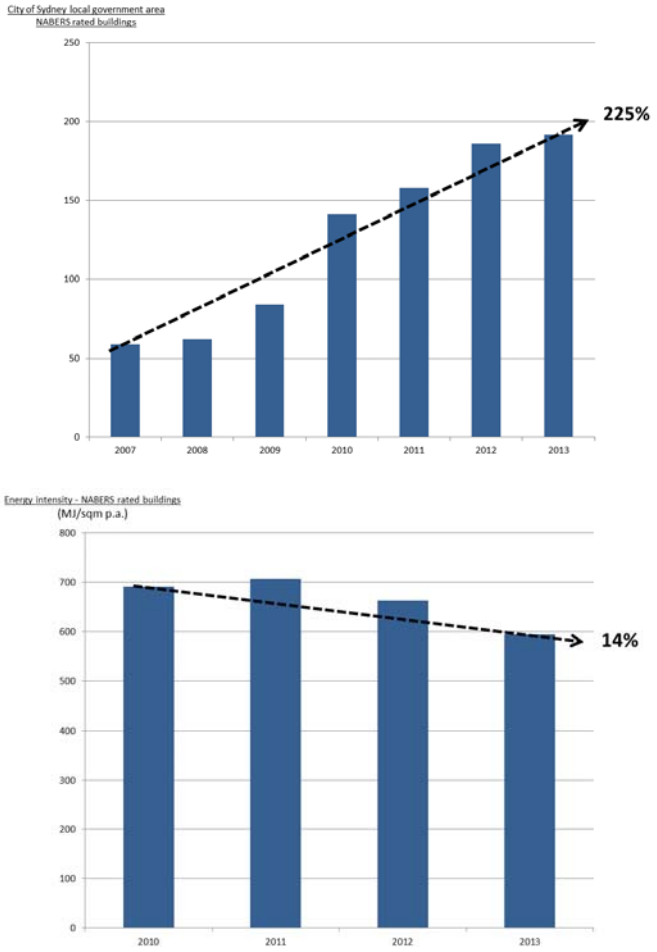
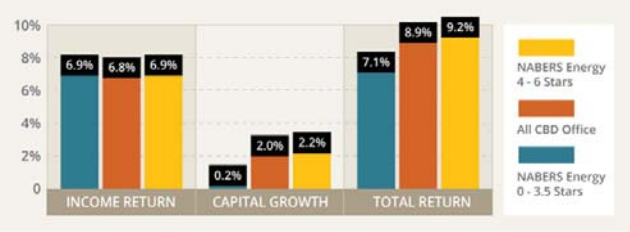


FIGURE 37. IMPACT OF NABERS RATINGS REPORTED BY IPD AUSTRALIAN GREEN PROPERTY INDEX 2013/14

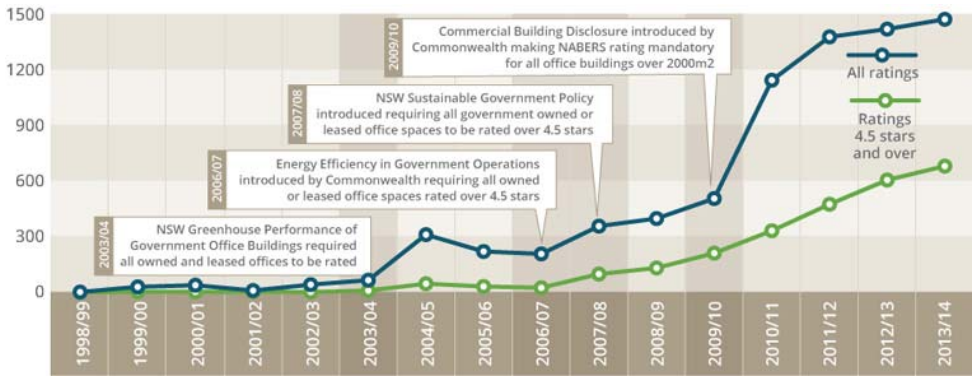


The NABERS Annual Report 2013/1441 shows 63 per cent of the NSW office market is now rated. The NABERS Energy average score for rated base buildings in NSW was 3.7 stars with 520MJ/sqm p.a. average building energy intensity. The NABERS Energy average for rated tenancies in NSW was 4.4 stars with 351MJ/sqm p.a. average intensity. The number of NABERS rated buildings and average star-ratings continue to increase as shown in Table 5 and Figure 38.

TABLE 5. NABERS ENERGY STAR RATING OFFICE BASE AND WHOLE BUILDING DISTRIBUTION[41]

NABERS rating	2010/11	2011/12	2012/13	2013/14
0 to 3.5 stars	60%	48%	36%	32%
4 to 4.5 stars	32%	37%	44%	41%
5 to 6 stars	8%	15%	20%	27%

FIGURE 38. NUMBER OF NABERS RATED BUILDINGS[41]



Lead agency: NSW Government on behalf of the Australian, state and territory governments.

Website: www.nabers.com.au

NATIONAL CONSTRUCTION CODE (NCC)

The National Construction Code is an initiative of the Council of Australian Governments (COAG) which incorporates all on-site construction requirements including the Building Code of Australia (BCA) into a single code.

The Building Code of Australia is the primary code referenced in state and territory building acts or regulations. In NSW it mainly applies to new buildings and significant renovations in the non-residential classes of buildings where BASIX does not apply.

The National Construction Code (then known as the Building Code of Australia) started to introduce energy efficiency measures in 2003. In 2006 all building classes were covered and the stringency of requirements was increased in 2010 with the objective of Section J of the Code of to reduce greenhouse gas emissions[42].

TABLE 6. BUILDING CODE OF AUSTRALIA: CLASSES OF BUILDINGS

BCA 2010	Type
Class 1A	Detached and semi-detached dwelling
Class 1B	Guest house
Class 2	Multi-unit dwellings
Class 3	Accommodation or residence in public building
Class 4	Dwelling in non-residential building
Class 5	Office buildings
Class 6	Retail building
Class 7A	Car park
Class 7B	Warehouse
Class 8	Laboratory or manufacturing
Class 9A	Health care building
Class 9B	Public assembly building
Class 9C	Aged care building
Class 10A	Sheds and garages
Class 10B	Non habitable structures

Section J of the National Construction Code sets out whole-of-building energy performance levels and 'Deemed-to-Satisfy' provisions for elements of buildings that impact energy consumption such as building fabric, sealing, air-conditioning and ventilation systems and lighting.

It is clear that the Code is generating large and cost-effective energy savings; however there are shortcomings, including:

- Performance requirements are 'as designed' (estimated) rather than 'as built' (compliant).
- Actual energy efficiency of buildings may fall short of energy performance requirements of the Code[43].
- Compliance and enforcement of Section J may be inadequate.
- For existing buildings Section J only applies where major refurbishments occur to energy systems.
- There is industry uncertainty about what constitutes 'major refurbishment' that triggers the Code and which elements or sub-systems of a building have to comply.
- Performance requirements could be more ambitious and are lacking in air tightness and heat recovery.

These issues could be better documented, and any shortcomings addressed, in order to build community and industry support for the continuation and expansion of this key policy tool.

The modelling for this Master Plan shows a significant share of total energy savings from existing policy settings will come from the BCA 2006 as it applies to most building classes considered in this study. The savings are relatively large because there were no mandatory energy performance requirements in the Code prior to 2006 (for commercial buildings) and before 2003 or 2005 (for single storey and high rise residential buildings respectively). Existing buildings that remain in use by 2030 are expected to have been built or upgraded to the energy performance requirements of BCA2006 or higher.

The 2010 version of Section J increased the stringency but there have been no further increases since then. This is calculated as an incremental saving to avoid double counting of energy savings. It is assumed that one per cent of building stock is demolished and replaced annually and one per cent of each building class is refurbished to the extent that the full Section J savings measures apply.

Lead agency: Australian Building Codes Board (ABCB)

Website: www.abcb.gov.au

NATIONAL ENERGY SAVINGS INITIATIVE

In 2011 the Australian Government coordinated work on developing a national Energy Savings Initiative (ESI) with the broad scope to introduce a national scheme that would potentially replace existing state based schemes. A Working Group was established and an issues paper developed which sought views from the public and key stakeholders on aspects for the design and implementation.

Since this time there has been little progress made and the National Energy Savings Scheme is now defunct. The City of Sydney would be supportive of a national scheme if it was at least as stringent and effective as the NSW Energy Savings Scheme.

Lead agency: Australian Government

Website: www.climatechange.gov.au

NATIONAL STRATEGY ON ENERGY EFFICIENCY

The National Strategy on Energy Efficiency (2010 update) aims to streamline roles and responsibilities across government by providing a nationally consistent and coordinated approach to energy efficiency. The original Strategy formed part of the National Partnership Agreement on Energy Efficiency signed by Australian Government, state and territory ministers in 2009.

Measures in the strategy relate to:

- Assisting households and businesses to transition to a low-carbon future.
- Reducing impediments to the uptake of energy efficiency.
- Making buildings more energy efficient.
- Government working in partnership and leading the way.

Recent energy efficiency improvements which have resulted from the strategy include amendments to Minimum Energy Performance Standards (MEPS) and the National Construction Code (NCC).

Lead agency: Council of Australian Governments (COAG)

Website: www.coag.gov.au

NATIONWIDE HOUSE ENERGY RATINGS SCHEME (NatHERS)

The Nationwide House Energy Rating Scheme (NatHERS) estimates the thermal performance of residential buildings and is designed to reduce energy and greenhouse gas emissions. NatHERS ratings determine the potential thermal comfort of a dwelling on a scale from zero to ten stars. A higher rating means less heating or cooling is required to stay comfortable.

The tool can rate a house at the design stage or after it is built however, it is a computer modelling tool and does not assess as-built performance. The rating looks at:

- Layout.
- Roof, walls, windows and floor construction.
- Orientation of windows and shading to sun path and local breezes.
- Local climate.

Energy consumption by hot water systems, lights or household appliances is not part of the rating. A shortcoming of the scheme is that it only tells part of energy story. NatHERS assessments by accredited professions may be used to assess thermal comfort requirements of BASIX. Typically this applies for complex designs and multi-dwelling developments.

Lead agency: Australian Government on behalf of Australian, state and territory governments.

Website: www.nathers.gov.au

NSW BUILDING SUSTAINABILITY INDEX (BASIX)

The Building Sustainability Index (BASIX) is a design tool which is part of the development application process in NSW. BASIX sets mandatory greenhouse gas and water efficiency targets in all residential dwelling types. It also sets minimum thermal performance levels for new dwellings reported as the energy maximum acceptable to heat and cool a dwelling.

In NSW BASIX overrides energy and water efficiency provisions in the National Construction Code and local government planning controls. A BASIX assessment must be completed for new buildings or alterations and additions with an estimated construction cost of over $50,000. A BASIX certificate must accompany the development application.

BASIX Energy targets are calculated as a percentage of savings against the NSW state-wide 2004 average benchmarks which for greenhouse gas emissions was 3,292kg of CO2e per person p.a. Targets vary by building type and region. BASIX targets are under review by the NSW Government as shown in Table 7.

TABLE 7. CURRENT BASIX ENERGY TARGETS FOR SYDNEY

Dwelling type	Current target
Detached & semi-detached	40
Low-rise (3 storey)	35
Mid-rise (4–5 storey)	30
High-rise (6 storey plus)	20

In 2014 the City made a submission to the NSW Government BASIX review with a recommendation that a minimum BASIX target of 55 could be applied to all dwelling types based on cost-effective energy efficiency opportunities (higher if solar PV is included). This recommendation was based on high-level analysis conducted by pitt&sherry.

The BASIX State Environmental Planning Policy mandates that a Local Environmental Plan (LEP) or Development Control Plan (DCP) cannot include provisions which require a development to exceed the BASIX targets, or provide other energy, water or thermal comfort design elements beyond those required to submit a BASIX certificate. This prevents the City from making higher targets mandatory for new developments. A more thorough assessment and industry consultation would be required to lift BASIX targets beyond what is being proposed by the NSW Government.

For this Master Plan, an assessment of energy savings attributable to BASIX has been derived from the reports published by NSW Planning and a report by Energy Australia which examines the actual measured performance of BASIX houses (detached dwellings only) over the period 2007–2009.

These reports, as well as feedback from stakeholders in developing this Master Plan, indicate that buildings designed under BASIX may not be reducing emissions at the same amount prescribed by the BASIX target due to issues such as dwelling size, the number and type of appliances, and behaviour. This requires further investigation and may present the case for BASIX to be amended or complimented by a new tool to rate the performance of existing buildings.

Lead agency: NSW Government

Website: www.basix.nsw.gov.au

NSW ENERGY SAVER PROGRAM

The Energy Saver Program is a NSW Government initiative which provides resources and advice to businesses to identify and implement energy savings opportunities in the form of subsidised energy audits, specialist advice, training courses and project support from approved energy efficiency specialists.

Lead agency: NSW Government

Website: www.environment.nsw.gov.au

NSW ENERGY SAVINGS SCHEME (ESS)

The NSW Energy Savings Scheme (ESS) is a successful white certificate scheme that provides financial incentive for energy efficiency projects. To date this scheme has supported projects that will save nine terawatt hours of energy and around $1.4 billion in energy bill savings.

It works by placing obligations on scheme participants – mostly electricity retailers – to purchase Energy Savings Certificates (ESCs) which are generated by accredited certificate providers for eligible energy saving projects.

The 2014 target for scheme participants is five per cent of liable electricity sales. Scheme participants can meet this target by either surrendering ESCs or paying a penalty.

Multiple methods are available for calculating and creating ESCs. A commonly applied method for commercial buildings is based on NABERS Energy ratings. Other methods include aggregated metered baseline, commercial lighting, high efficiency motors, home energy efficiency retrofits, power factor correction, project impact assessment and others.

The NSW Government has announced that the scheme will be expanded to include natural gas, and will continue until 2025 or until a national scheme is introduced.

The Energy Saving Scheme undoubtedly improves the uptake of energy efficiency products and services in NSW and the City of Sydney and is a key program for delivering on the objectives of this Master Plan.

Lead agency: NSW Government

Website: www.ess.nsw.gov.au

NSW GOVERNMENT RESOURCE EFFICIENCY POLICY (GREP)

The NSW Government Resource Efficiency Policy aims to reduce the operating costs of NSW Government agencies and include resource-efficiency considerations in all major decisions. Compliance is mandatory for government-sector agencies. Local government is also encouraged to adopt the Policy.

The Policy requires all NSW Government owned and leased office buildings over 2,000 sqm (and data centres) to achieve and maintain a NABERS Energy rating of at least 4.5 stars by June 2017. For other building types, new projects worth over $10 million will be designed and built to reduce energy consumption by at least ten per cent below minimum National Construction Code requirements.

All NSW Departments are required to undertake energy efficiency projects at sites representing at least 40 per cent of billed energy use by June 2018 and 90 per cent by 2024. Environmental Upgrade Agreements will be used where cost-effective for energy efficiency upgrades in leased properties. Tenancy lighting upgrades are required for leased space using 12 watts/sqm or more. All new electrical equipment must be at least the market average star-rating under Minimum Energy Performance Standards.

Lead agency: NSW Government

Website: www.environment.nsw.gov.au

NSW SUSTAINABILITY ADVANTAGE
Sustainability Advantage is a module based program designed for organisations from the not-for-profit, government and medium-to-large business sectors. The program provides expertise, training and business tools such as workshops, case studies, templates, specialist support, and networking. Modules include business planning, resource efficiency, staff engagement, supply-chain, carbon management, environmental risk and external stakeholder engagement.

Lead agency: NSW Government

Website: www.environment.nsw.gov.au

NETWORK SUPPORT PAYMENTS
Energy efficiency projects that are able to reliably reduce peak load may be suitable for network support payments by the transmission or distribution network service providers in network constrained areas. Network support payments may improve the business case, or in some cases become the catalyst for or bring forward energy efficiency projects.

The nature of network support payments is typically bespoke, highly dependent on location and local network constraints, and temporary in nature. Changes to the National Electricity Rules to improve the consistency, transparency and availability of network support or equivalent payment for reducing energy demand would provide a more transparent and consistent framework. This approach is advocated for by the City of Sydney and others.

Lead agency: Energy efficiency proponents, Transgrid & Ausgrid

SMART BLOCKS
Smart Blocks is a national web-based program helping apartment owners and their managers to improve the energy efficiency of common property (e.g. base buildings) in apartment buildings.

Residents of high and medium density apartment blocks typically use more energy than those in detached dwellings with 50–60 per cent of the energy used being for common area services such as lifts, hallway lighting, car-park ventilation and pool and gym services.

Smart Blocks identifies opportunities for projects in categories including lighting, water systems, pools and amenities, heating and cooling, and ventilation.

Advice and templates are also provided on the process of gaining approval from owners, seeking funding, and dealing with contractors. Toolkits are available to audit energy use and work out the feasibility and impact of different energy (and water) savings options.

Smart Blocks was developed in partnership between Strata Community Australia, City of Sydney, City of Melbourne, the Owners Corporation Network of Australia and Green Strata.

Lead agency: Smart Blocks

Website: www.smartblocks.com.au

SMART GREEN APARTMENTS
The City's Smart Green Apartments program – developed with assistance from the NSW Government Energy Saver Program – has been working with owners corporations and service providers to investigate and support sustainability improvement opportunities in 30 strata communities.

Each building uses energy differently and energy audits were key to identifying cost-effective opportunities relevant to specific building contexts. The program's data and lessons learned have been used extensively in developing this Master Plan, identifying efficiency opportunities for other apartment buildings.

The program showed that up to 60 per cent of a building's energy use can come from common property. On average buildings can reduce 30 per cent of energy through cost effective measures in areas such as lighting, swimming pools and ventilation.

By 2014, average annual savings for the owner corporations were over $70,000 with participating buildings having implemented 30 per cent of recommended projects and more in the pipeline.

Using these positive results, the City is developing a Residential Apartments Sector Sustainability Strategy; the first of its Sustainability Sector Strategies. The Strategy outlines a plan to achieve environmental outcomes in the apartment sector in line with Sustainable Sydney 2030.

By adopting actions for new and existing apartment buildings, the City stands to reduce apartment-sector greenhouse gas emissions by 40 per cent by 2030. This ambitious target also takes account of considerable growth in the sector.

Lead agency: City of Sydney

Website: www.cityofsydney.nsw.gov.au

SMART GREEN BUSINESS
Smart Green Business is a City of Sydney initiative in partnership with Sydney Water that assists large non-office based businesses in the local government area to improve environmental performance. The current program focuses on the accommodation sector and provides sustainability advice and support for water and waste reduction and also initiates referrals to State Government energy efficiency programs. For example, significant energy savings have been made by saving hot water in hotel showers and bathrooms.

Lead agency: City of Sydney

Website: www.cityofsydney.nsw.gov.au

YOURBUILDING
Your Building is a website with links to a vast array of information and technical advice about reducing the environmental impact of existing and new buildings. There are case studies, tools, advice and articles with a target audience that includes building investors, designers and constructors, managers and occupants.

Lead agency: Property Council of Australia

Website: http://yourbuilding.org

YOURHOME
Your Home is an Australian Government initiative to provide guidance for environmentally sustainable homes. Content is periodically updated and is available as a book or online via the website. Energy efficiency information is available for heating and cooling, hot water, lighting, appliances, meters and other topics.

Lead agency: Australian Government

Website: www.yourhome.gov.au