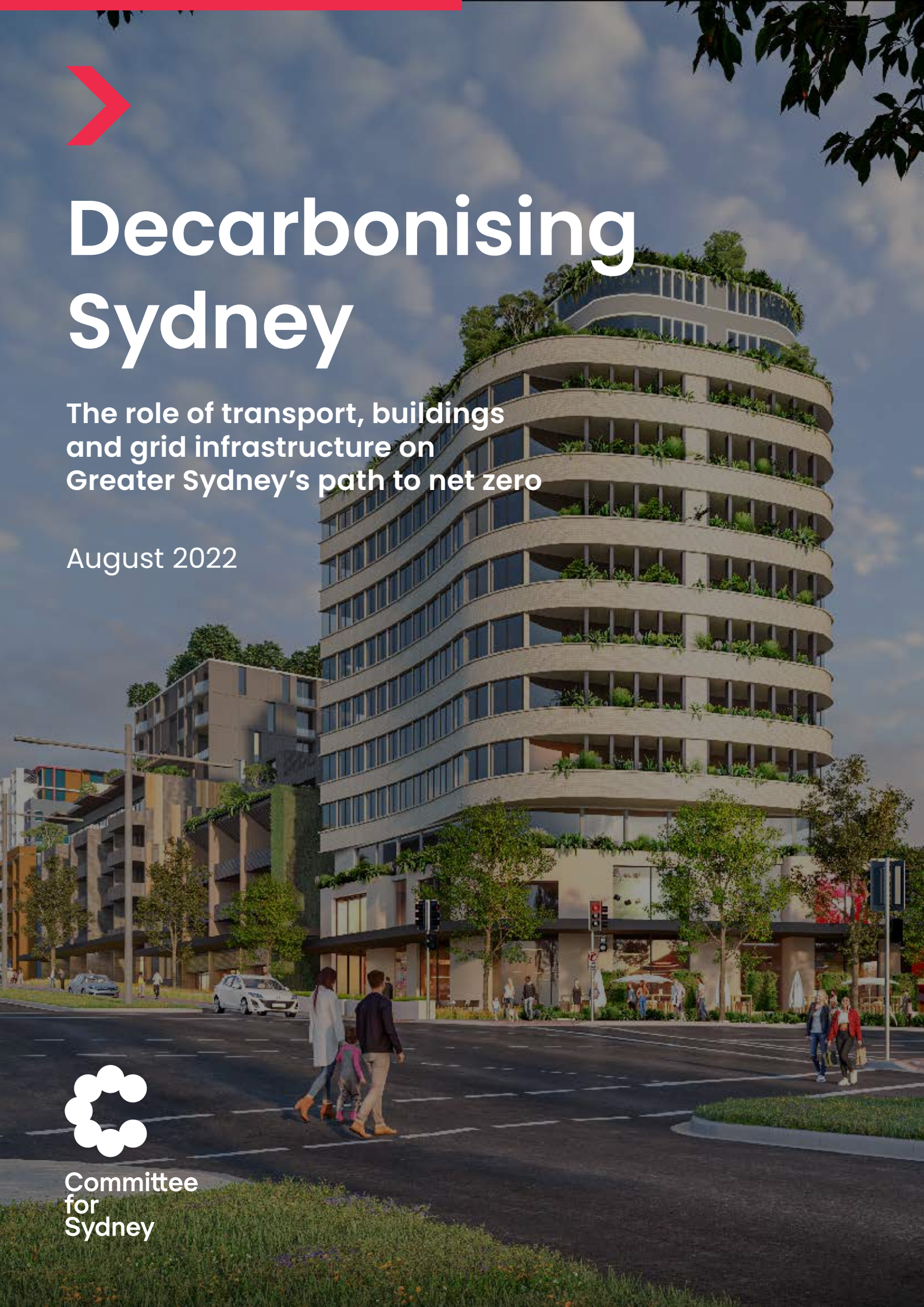
Decarbonising Sydney

The role of transport, buildings and grid infrastructure on Greater Sydney's path to net zero

August 2022



Committee for Sydney

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Memorial Oval
Image source: City of Canterbury Bankstown

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Charts

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Our plan to decarbonise Sydney

Image source: Tom Rumble, Unsplash

The NSW Government has an objective to achieve net zero emissions by 2050, and to be more resilient to a changing climate. The NSW Government's Net Zero Plan Stage 1: 2020–2030 (released on 14 March 2020) details how government plans to reduce 2005-level emissions by 50% by 2030 at a state level.

What does a decarbonised economy mean for Sydney – its households, businesses and energy infrastructure? What will it take to reach 50% emissions reduction by 2030, and net zero by 2050?

The Committee for Sydney led a collaborative research project on what a decarbonised economy means for the Greater Sydney[1] region [Sydney], the actions needed to deliver on the NSW Government emission objectives for Sydney, and the implications those actions might have.

Our research found despite NSW's climate policies leading the nation, Sydney is not on track to do its fair share in meeting the state's 2030 or 2050 net zero targets.

1 Greater Sydney does not include the Hunter or Illawarra for the purposes of this modelling.

Modelling the current *'Steady Transition'* trajectory, Sydney's emissions (36% of all NSW emissions) will fall by ~43% by 2030, and ~80% by 2050.

To cover this shortfall, we will need an *'Accelerated Net Zero Transition'* pathway to meet the 2030 and 2050 targets.

Power generation, primarily from large coal plants, is already decarbonising fast as we switch to renewables like wind and solar farms. On the announcements made by July 2022,[2] all NSW coal power generation is planned to close by 2039, removing almost all NSW power sector emissions.

By 2030, power generation emissions are projected to fall ~60%, but while this shift creates a very large financial and environmental incentive to electrify as many things as possible, cleaning the grid will do some, but not all, the heavy lifting on decarbonisation.

Our work considers further actions required to achieve decarbonisation, noting that the outcomes put forward rely on the successful delivery of the NSW Electricity Infrastructure Roadmap, which provides the 'baseline' emissions reduction upon which this report builds.

In Sydney, transport (36%) and buildings (31%) are the largest emitting end-use categories today. To meet NSW's 2050 targets, electrification of transport and buildings, and a shift away from fossil fuels (petrol, diesel and natural gas) will be essential, alongside a modal shift to public transport, cycling and walking, and newer forms of mobility via e-scooters and EV taxis.

To reach the 50% emissions reduction target by 2030, the only realistic levers are rapidly increasing the adoption of electric vehicles (EVs) and closing additional coal plants to reduce the carbon intensity of the energy we consume. If EVs don't reach ~30% of Sydney's total passenger vehicles by 2030, which would require an unlikely 100% of new car sales to be electric by 2027, reducing the use of coal in the generation mix is the only lever large enough to close the gap.

Households and businesses will benefit from accelerating the electrification of cars and homes, with household energy costs falling significantly by 2030, and the benefits of reduced energy costs from rooftop solar shared with apartment and low-income households through emerging technologies like community batteries.

However, household adoption depends on millions of individual purchases, not just large capital investments, and consumer decisions will need to be guided towards greener choices.

Success in delivering the *Accelerated Net Zero Transition* scenario brings its own challenges, as without efforts to manage household and business electricity demand, peak demand is forecast to grow 24% by 2030 (versus 2020), and more than double by 2050, with implications for our grid.

While a broad array of initiatives are already in place, Sydney is just beginning its net zero transition and bolder action is required to achieve our 2030 target and net zero emissions by 2050.

2 Coal-fired power closures included in AEMO ISP 2021 assumptions and additional market announcements of Eraring and Baywater closures being brought forward.

A mix of well-promoted leadership, collaboration, incentives and regulation are required to overcome upfront barriers to transition, and ensure households large and small, and across the income spectrum, can reap the benefits of renewable energy and electrification. Government at all levels, business, and the community each have a role to play.

This report identifies five key moves to put Sydney on track to meet its 2030 and 2050 emissions targets:

1. **Electrify Sydney's road transport:** introduce emissions and fuel efficiency standards for petrol/diesel cars and trucks; set a 2030 modal shift target of 40% to sustainable transport; and set a date to transition all sales of passenger and light vehicles to electric and heavy truck fleets to battery and hydrogen.
2. **Enhance residential and commercial building sustainability:** electrify space heating, water heating and cooking in new and existing buildings; phase out gas connections in new commercial buildings and residential homes and apartments; and require disclosure of energy performance ratings for residential sales and rental transactions.
3. **Increase uptake of distributed energy resources:** set a distributed battery storage target for Sydney; incentivise the adoption of rooftop solar, battery storage, and smart meters; and enable access for low-income groups, renters and others who are shut out of the transition.
4. **Invest in distribution to handle the transition:** prepare the energy grid for our distributed energy and electrified future; and introduce innovative tariffs and demand management measures to reward customer behaviour.
5. **Accelerate coal closures and enhance collaboration mechanisms:** establish Sydney scale collaborative forums and milestones, to track and manage progress towards 2030 and 2050 emissions reduction goals; and develop plans to accelerate coal closures to make up the deficit if needed.

Some of these actions, particularly electrifying road transport and increasing decentralised energy resources, are critical to meeting our 2030 commitments. Others, such as building electrification and investing in distribution, are needed before 2030 for Sydney to meet the 2050 target and to ensure the grid is ready for this transition.

We have the technology, we have clear targets, and now we have a plan to decarbonise Sydney.

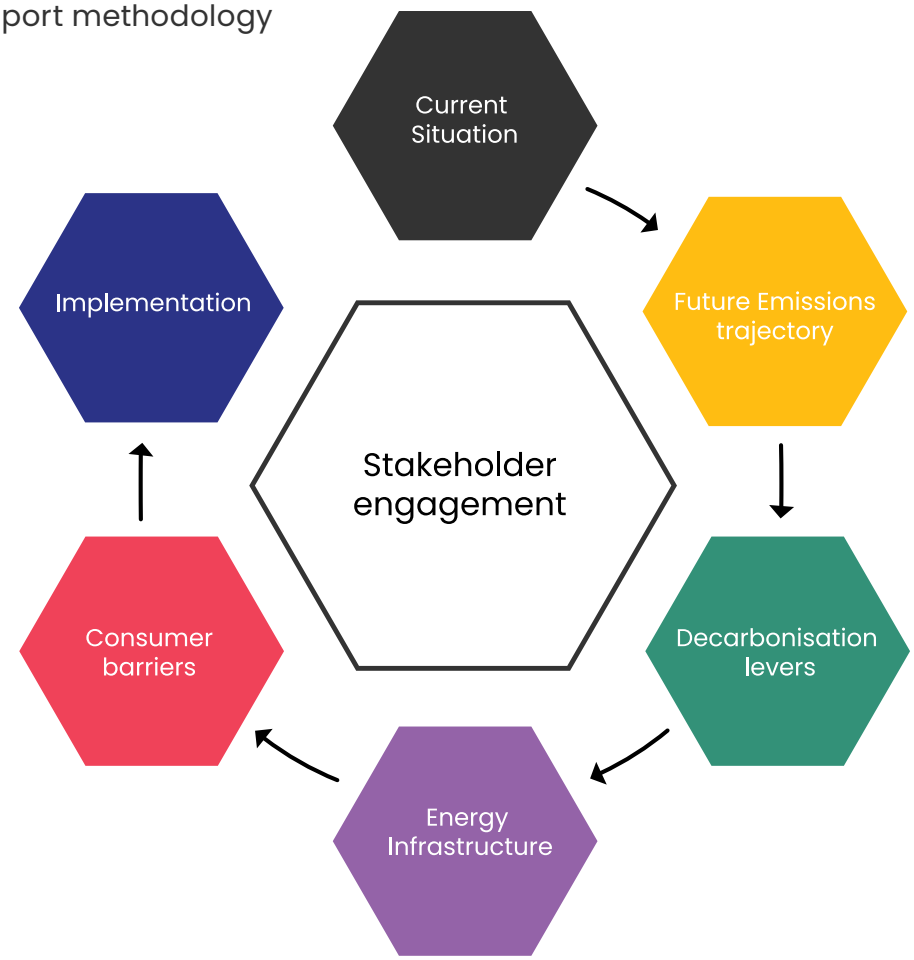
Our detailed roadmap to decarbonise Sydney is included in Appendix A.

Methodology

The development of this report and roadmap followed the following approach:

- Current situation: a review of current emissions by sector and geography, net zero aspiration, and the size of the gap
- Future emissions trajectory: *Steady Transition and Accelerated Net Zero Transition* emissions trajectories developed across all sectors, including an overview of key drivers of change (DER, EVs, electrification, built environment and population growth)
- Decarbonisation levers: identify a full set of decarbonisation levers for transport and building sectors; qualitative assessment of priority levers and associated decarbonisation costs ($/tCO$_2$e)
- Energy infrastructure: model of energy distribution infrastructure in Sydney with current situation, future scenarios, perspective on constraints, potential solutions and associated costs
- Consumer barriers: identification of behavioural, economic, and regulatory barriers preventing consumer decarbonisation action; suggested interventions to drive change
- Implementation: synthesis of key initiatives to accelerate Sydney's decarbonisation
- Stakeholder engagement: peer review findings with utilities, local government and regional organisations of councils, state government agencies, businesses, universities, and relevant non-government organisations.

Report methodology



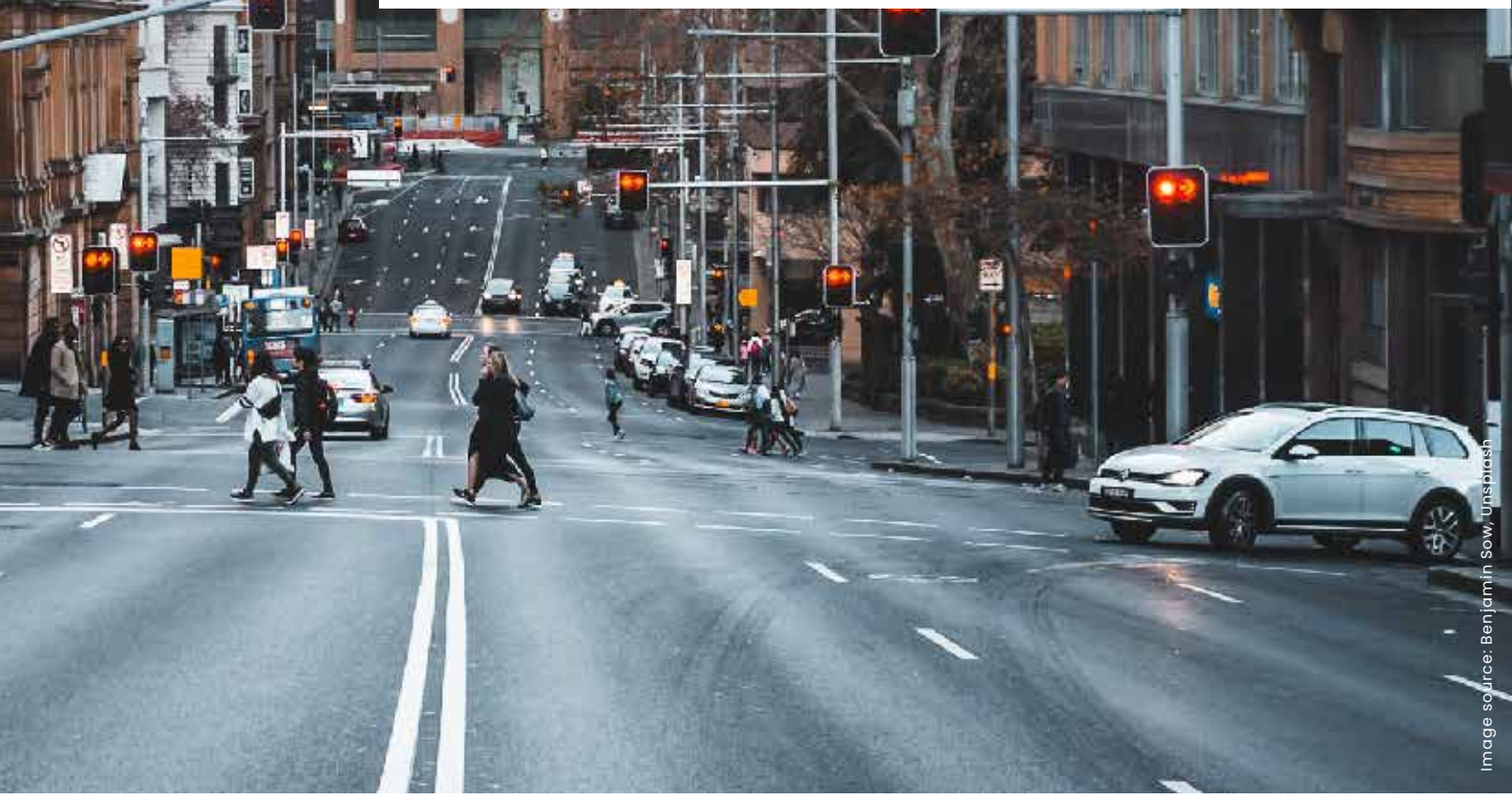


Image source: Benjamin Sow, Unsplash

Emissions abatement trajectory: Greater Sydney's [Sydney] emissions trajectory is modelled by building a baseline of the city's activities and their associated emissions across transport, buildings, industry, agriculture, waste and power (e.g. use of passenger cars is one activity).

Each of these activities then changes over time as population and economic activity in Sydney grow, as well as the 'technologies' used in each activity and their associated emissions intensity change (e.g. petrol cars are converted to EVs, petrol car fuel efficiency increases).

The trajectory of these activities and their underlying technology use is set in reference to published trajectories and statistics (e.g. population growth, freight), government policies (e.g. NSW EV strategy), expert interview and stakeholder input, and reference to the emissions pathways published in NSW Net Zero Plan, DISER Emissions Reduction Plan, and AEMO ISP.

Importantly, this report presents an economy-wide transition modelled specifically for Greater Sydney. As such, while specific elements of the trajectories presented in this report are aligned to externally published scenarios (e.g. AEMO ISP scenarios for DER uptake), in aggregate this report seeks to cover different considerations and will diverge from scenarios published elsewhere. We have therefore used different language to describe these scenarios from what is published externally.

Modelling of emissions: all Greater Sydney scope 1 and scope 2 emissions forecast from 2020 to 2050 (i.e. direct combustion from fuel use and allocated emissions from power generation). This means we have taken a 'consumption' (where energy is used) rather than 'generation' (where electricity is generated) based approach to where emissions are measured. We also assume power used in Sydney is from power generated in NSW.

Building emissions: all emissions associated with activity in residential and commercial buildings. Scope 1 emissions included in this report refer to emissions from the combustion of fuels in buildings for space heating, water heating, cooking and use of other equipment and appliances (mostly natural gas). Scope 2 emissions included in this report refer to the emissions from power generation associated with energy used in buildings. Scope 3 emissions (all those upstream and downstream of the building's activity, e.g. carbon embodied in construction the building) are excluded from the scope of analysis of this report.

This report presents an economy-wide transition modelled specifically for Greater Sydney.

***Steady Transition* scenario:** assumes strengthening decarbonisation across sectors, including announced changes in power *generation* (AEMO Step Change with announced coal-fired plant closures) and transport (NSW objective for ~50% EV sales by 2030, resulting in modelled EV adoption of total vehicles in Sydney of ~15% by 2030). Pathway models 43% reduction in 2030, 80% in 2050.

***Accelerated Net Zero Transition* scenario:** assumes a more rapid decarbonisation of Greater Sydney, consistent with the NSW Government target to decrease emissions by 50% (vs. 2005 levels). All sectors of the economy decarbonise more quickly, especially uptake of electric vehicles (reaching 30% of all passenger vehicles by 2030), and accelerated decarbonisation of the grid (additional coal closures are modelled to reach the NSW emissions reduction target). Emissions reduce by ~50% to 2030, and ~95% by 2050 (with residual emission offset elsewhere in NSW).

Greater Sydney: ABS Greater Capital City Statistical Area (not including the Hunter or Illawarra).

Image source: Pat Whelan, Unsplash

Glossary

AEMO: Australian Energy Market Operator.

AER: Australian Energy Regulator.

BASIX: building sustainability index.

BEV: battery electric vehicle.

Community or neighbourhood batteries: enables consumers to store excess power generated during the day by their rooftop solar cells for use later in the evening, when demand on the electricity network is higher. It means consumers can use more of the power they actually generate, helping stabilise the flow of energy on the grid.

DER: distributed energy resources, refers to often smaller generation units located on the consumer's side of the meter. Examples of distributed energy resources that can be installed include: rooftop solar (photovoltaic) units, battery storage, batteries in electric vehicles used to export power back to the grid, and combined heat and power units.

DNSP: distribution network service provider (e.g. Ausgrid, Endeavour Energy).

DSO: distribution system operator.

ESS: NSW Energy Savings Scheme.

EV: electric vehicle (in this report, 'EV' will be used to mean battery electric vehicle).

EVCI: electric vehicle charging infrastructure.

FCEV: fuel cell electric vehicle.

ICE: internal combustion engine (petrol and diesel vehicles).

HDT: heavy duty truck.

ISP: Integrated Systems Plan.

LDT: light duty truck.

LULUCF: land use, land-use change and forestry.

Microgrid: small, local network of electricity users, with a local source of power made up of solar and batteries, e.g. solar embedded networks for commercial premises, solar car parks for councils.

Micromobility: using lightweight vehicles such as bicycles or scooters, especially electric, that may be borrowed as part of a self-service, short use, hire scheme.

Modal shift or mode shift: the trend of individuals reducing use of private vehicles and switching to other forms of transport, including active transport, micromobility, shared and/ or pooled vehicles.

Mt: megatonne.

NABERS: National Australian Built Environment Rating System.

NCC: National Construction Code.

OEM: original equipment manufacturer, an organization that makes devices from component parts bought from other organizations (in this case car manufacturers).

Parc: all registered vehicles within a defined geographic region (from the French phrase 'parc de véhicules').

PHEV: plug-in hybrid vehicle.

PV: solar photo-voltaic (also known as rooftop solar).

Smart meters: electronic device that records information such as consumption of electric energy, voltage levels, current and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behaviour, and electricity suppliers for system monitoring and billing.

TCO: total cost of ownership over the lifetime of the asset, i.e. upfront and running costs.

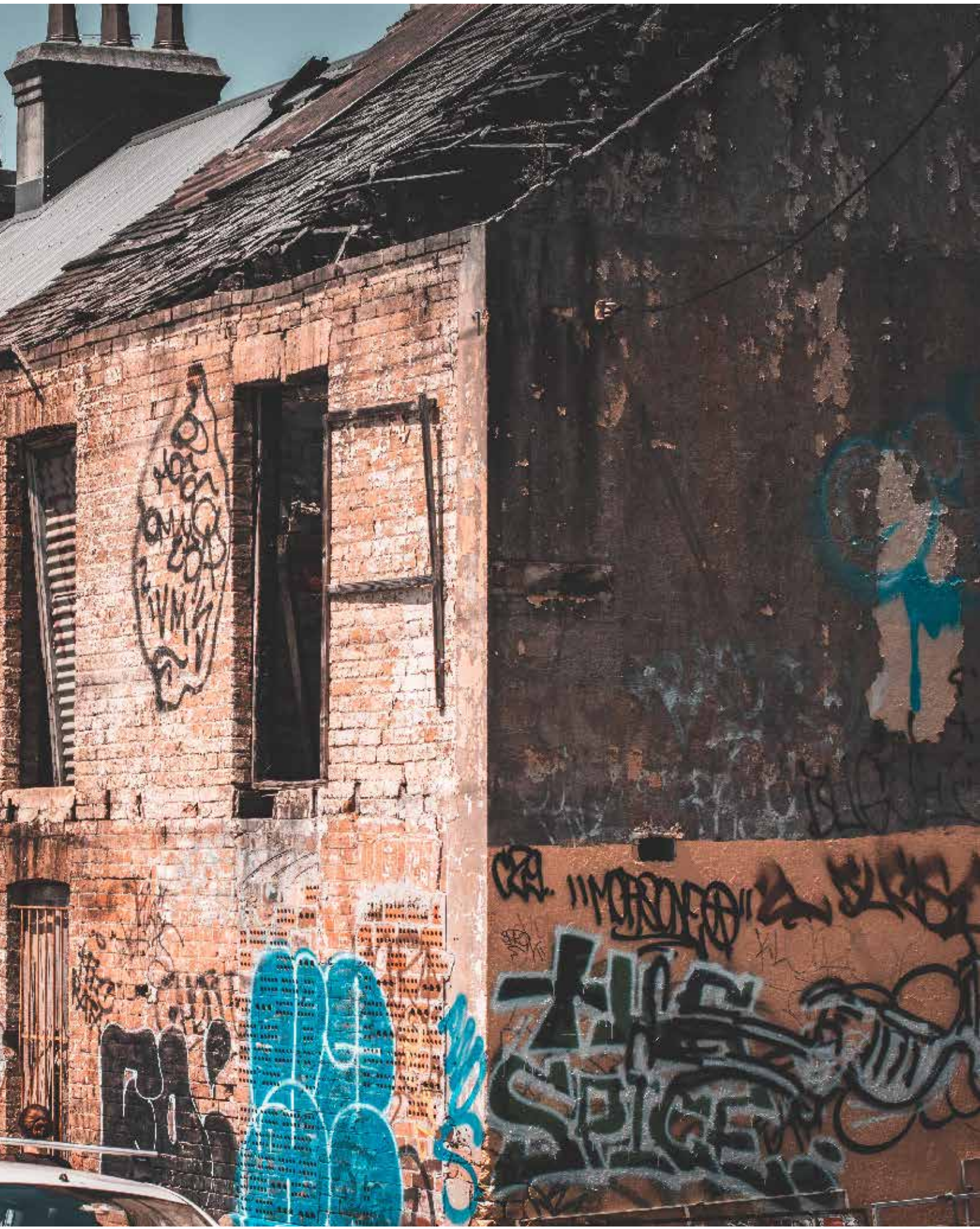
VPP: virtual power plant is a collection of home solar batteries that can provide on-demand battery power to support the electricity grid in times of need – can help stabilise the grid, prevent blackouts, lower electricity costs, and create financial incentives for participant.

V2G: vehicle to grid.

ZEV: zero emissions vehicle.

Image source: Endeavour Energy

Sydney is not on track to meet its 2030 or 2050 emissions goals



The NSW Government has an objective to achieve net zero emissions by 2050. Stage 1 of NSW Government's Net Zero Plan sets a 2030 target of reducing emissions ~50% on 2005 levels. In NSW, emissions rose slightly from the 2005 baseline of ~165Mt to ~174Mt, before falling to ~137Mt in 2019 (see Chart 1).

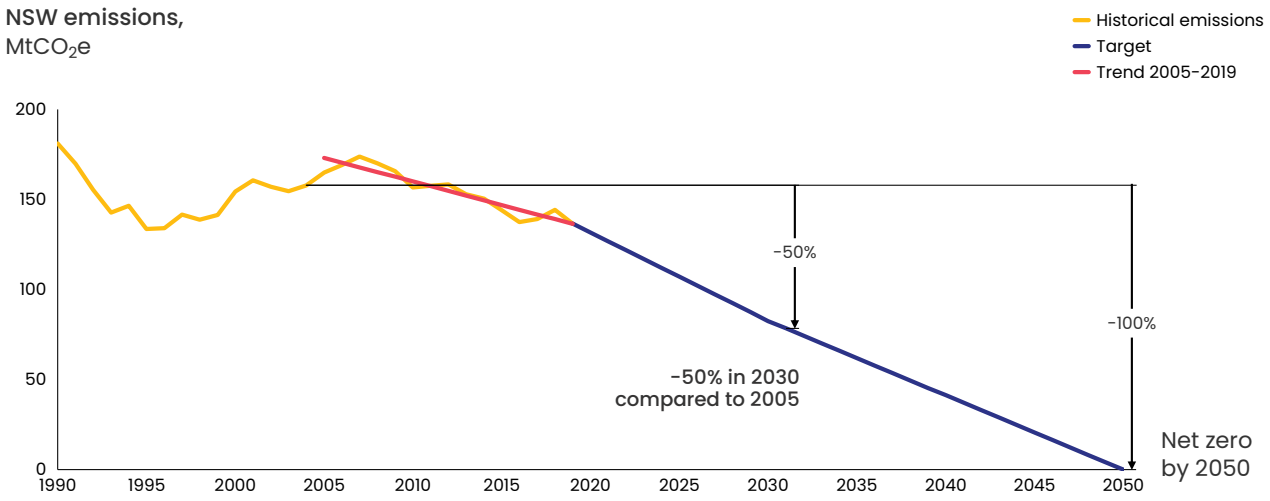
Sydney houses two-thirds of the NSW population, accounting for ~49Mt or ~35% of the state's emissions. For the purposes of this report, we use NSW targets for Sydney – a ~50% reduction by 2030, and net zero by 2050.

The current suite of policies and incentives (modelled in this report as the *Steady Transition* scenario) mean Sydney will not reach this 50% reduction by 2030 or net zero by 2050. Under the *Steady Transition* scenario (which includes announced coal-fired plant closures, NSW EV policy and strengthening market settings for other sectors), Sydney's emissions could fall ~43% by 2030, and ~80% by 2050.

Faster emission reductions will be needed in Sydney. Our *Accelerated Net Zero Transition* scenario sets out how (see Chart 2).

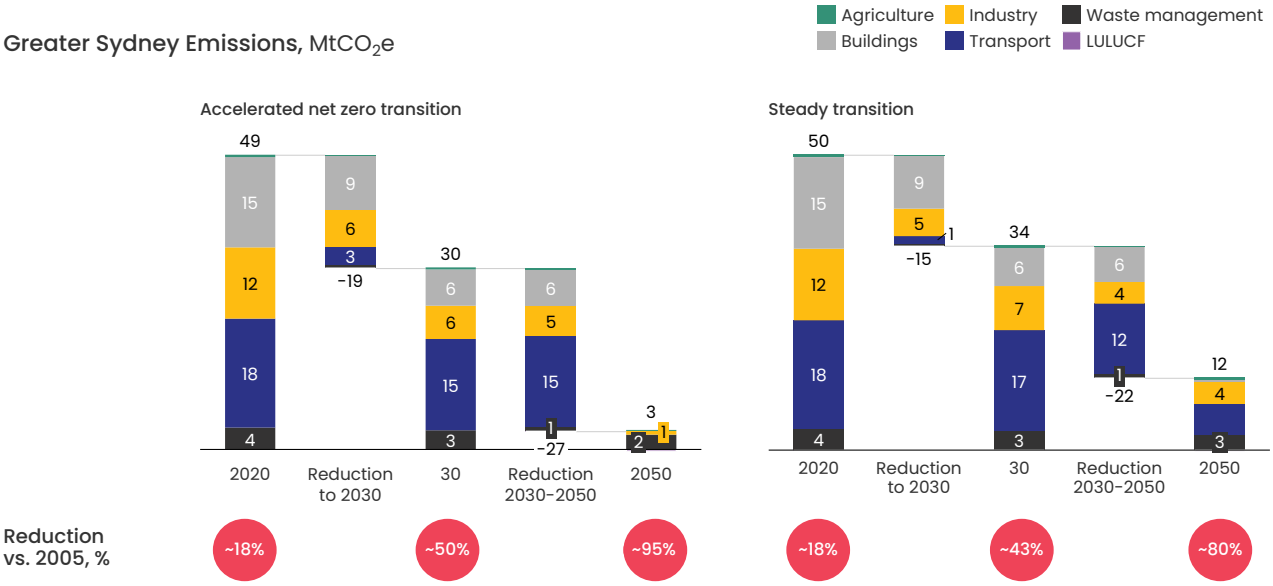
The *Accelerated Net Zero Transition* scenario will ensure also that overall emissions are minimised between now and 2050, when compared to the *Steady Transition* scenario (see Chart 3). Reduction of Sydney's annual emissions as in the *Accelerated Net Zero* scenario would enable Sydney to reduce the cumulative amount of its emissions by up to 20%, reducing its contribution to climate change.

Chart 1: NSW needs to accelerate its emission reductions to meet its 2030 and 2050 targets



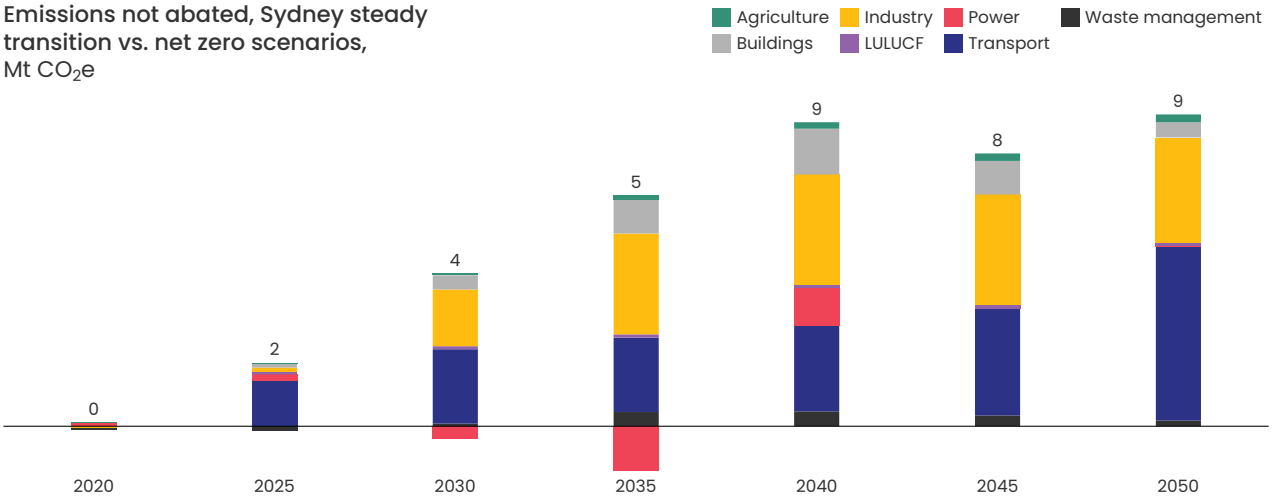
Source: NSW Government, Department of Industry, Australian Greenhouse Gases Information System
Note: Historical emissions are all inventoried GHG emissions in NSW, including land use, land use change, and forestry. NSW target trajectory taken to be linear.

Chart 2: An accelerated transition could reduce 2030 emissions by ~50%



Source: McKinsey Power Solutions, McKinsey Sustainability Insights, AEMO 2021 ISP Assumptions, AGL and Origin Announcements, McKinsey Centre for Future Mobility

Chart 3: Emissions not abated, Sydney - Steady Transition vs Accelerated Net Zero Transition



Source: McKinsey Power Solutions, McKinsey Sustainability Insights, AEMO 2021 ISP Assumptions, AGL and Origin Announcements, McKinsey Centre for Future Mobility

Transport and buildings provide the biggest opportunities for Sydney

Reductions needed to hit 2030 targets must come from sectors accountable for the highest share of emissions in Sydney:

- Transport – 36%
- Buildings – 31% (including direct emissions and power use)
- Industry – 17%
- Waste management – 7%.

Transport and buildings (both residential and commercial) offer the biggest opportunities to decarbonise Sydney, so we focus our attention on those two sectors. As a result, this report does not look at food consumption, waste, embodied energy or offsets, which are also important in the path to net zero.

The decarbonisation of transport and buildings will be enabled by increased generation of electricity from renewable sources in NSW, and replacing petrol and diesel vehicles with electric vehicles. Electric appliances and distributed energy resources will help reduce the use of grid electricity in residential and commercial buildings.

For a century, grid-scale supply in NSW has been coal-fired, supported by gas and the Snowy Mountain hydro scheme. Renewable energy generation has played a role growing role in NSW's generation mix over past 20 years, reaching 24.6% in 2021. By 2050, all electricity generated in NSW is expected to be from renewables.

A transformation is now underway. Electricity will serve more household needs, and distributed energy resources (like rooftop solar and battery storage) will be central to the energy market as they generate, store and share electricity.

As the use of distributed energy resources increases, more of the electricity used in Sydney will be generated by 'behind-the-meter' sources like rooftop solar and battery storage, bringing down building emissions even more quickly (see Chart 4).[3]

Transitioning Sydney's transport and buildings from consuming fossil fuels to running on clean electricity is the focus of this report, because those sectors share characteristics that require additional policy measures to ensure Sydney is on its net zero pathway.

Transport could deliver ~16% of NSW's emission reductions by 2030, mostly from uptake of passenger EVs (see Chart 5). Although building emissions are smaller, electric appliances (hot water, heating and cooling) will join EVs as needed products to reduce emissions. These products will enable decarbonisation up to and beyond 2030 due to the growing supply of grid-scale renewable and rooftop solar power. Smart distributed energy resources will add security and reliability to the distribution grid, as well as supporting decarbonisation efforts in the short term (see Chart 6 and 7).

3 AEMO, Draft 2022 Integrated Systems Plan, page 10, assuming Sydney shares the average for the National Energy Market.

Chart 4: The power system is being transformed to clean, renewable energy

ILLUSTRATIVE

Electricity system overview

Generation
NSW's electricity supply will become cleaner as coal generation is replaced by renewables and storage

Transmission
The transmission infrastructure will require billions of dollars of investment to transport energy to where people use it

Distribution
Substations, poles and wires to distribute electricity to homes and business will need to expand, as demand grows

Consumption
Homes and business will electrify more and more of their energy needs, including cars, heating, and cooking

Distributed energy resources
Consumers are more active participants in the energy market, both generating electricity (with rooftop solar), storing (with batteries) and actively optimising when they consume (aided by smart meters)

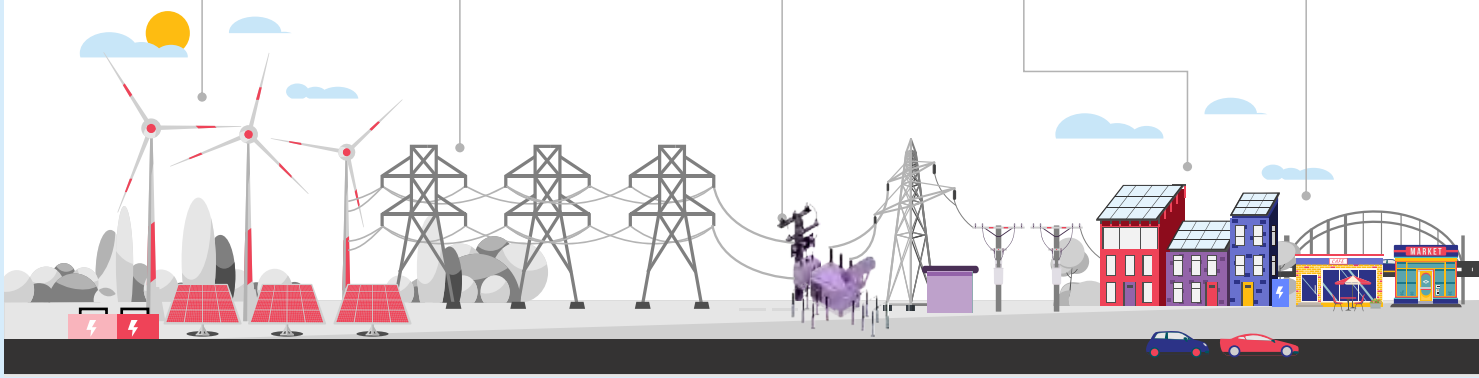
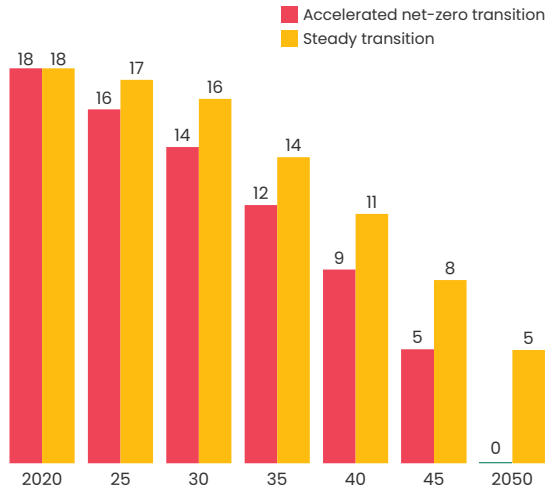


Chart 5: The Steady Transition approach reduces just 65% of transport emissions

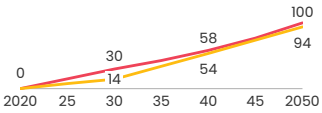
Greater Sydney Transport Emissions, Mt CO_2e



Source: McKinsey Sustainability Insights

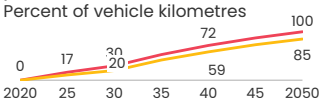
Key assumptions

Passenger BEV penetration
Percent of vehicle kilometres



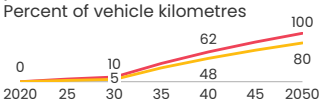
EV uptake reaches ~14% of parc by 2030 in the momentum case, similar to the NSW EV strategy

Light Duty Truck BEV/FCEV penetration
Percent of vehicle kilometres



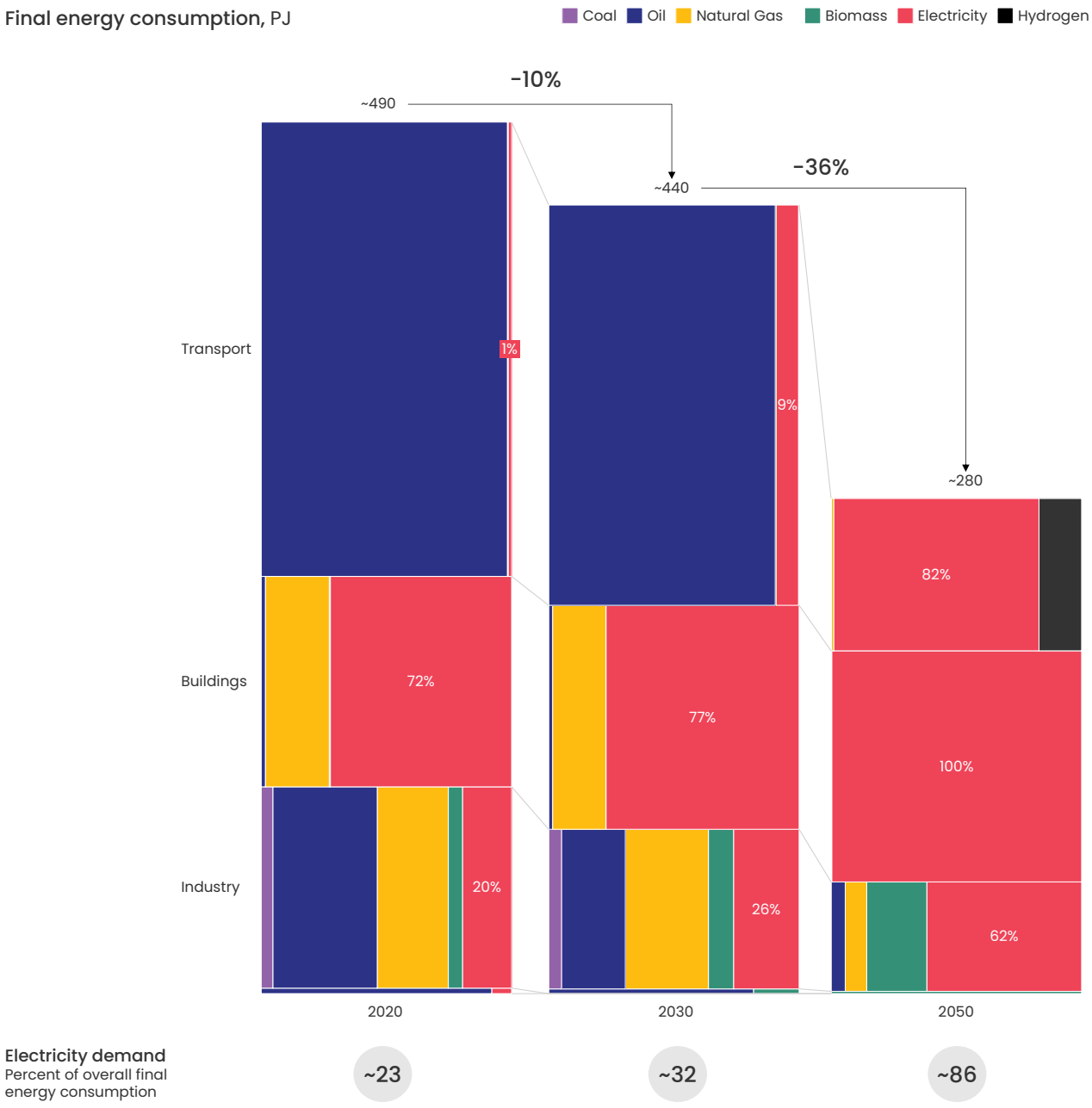
Light duty trucks (LCVs) decarbonise similarly quickly to cars, driven by business decisions based on TCO

Heavy Duty Truck BEV/FCEV penetration
Percent of vehicle kilometres



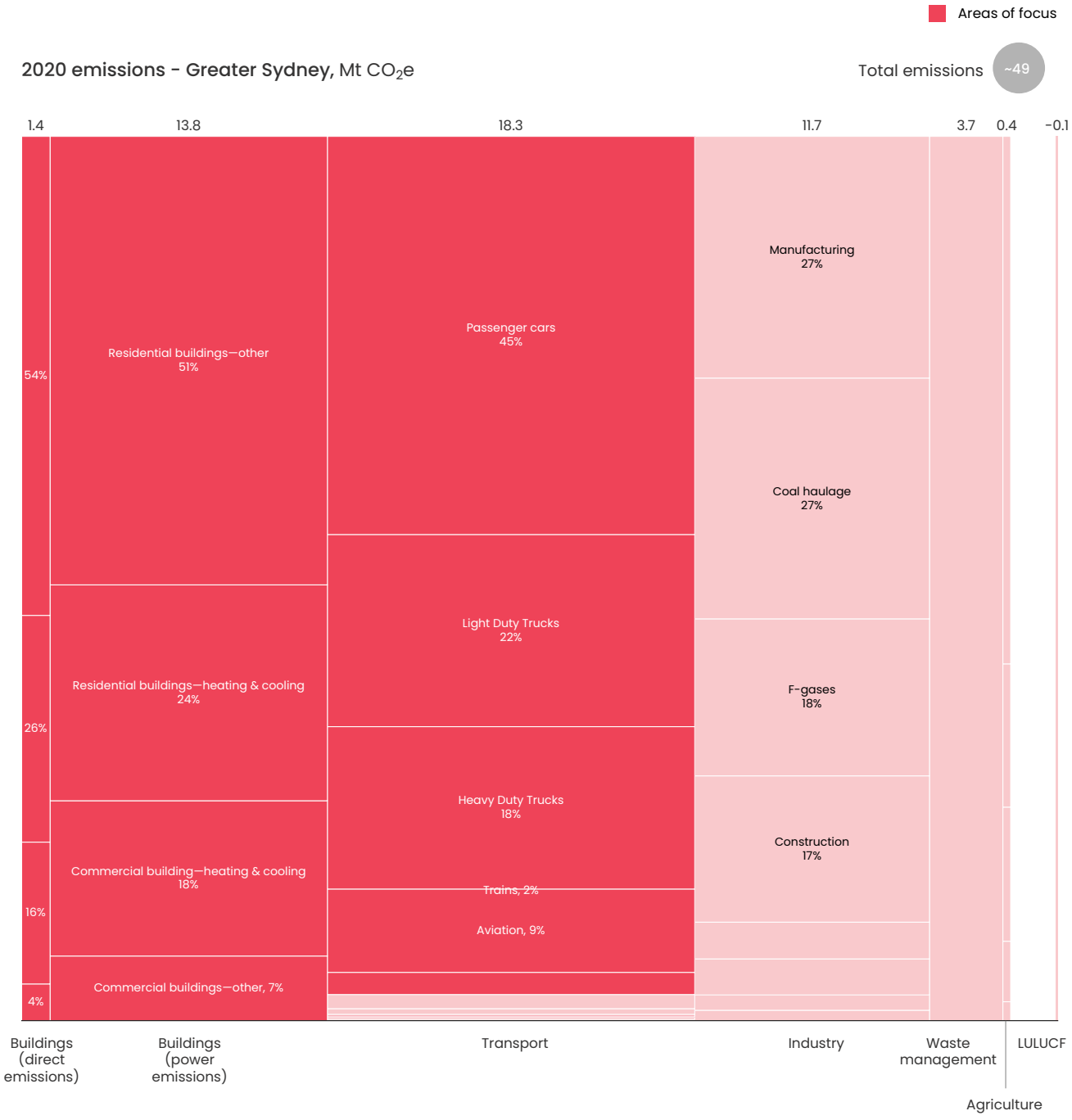
2030 uptake of BEV and FCEV heavy trucks is very low in the momentum case, only taking off from 2030 as economics and model availability improves

Chart 6: Electricity is expected to account for most of the energy consumption by 2050, as overall energy consumption falls



Source: NSW emissions from 2019 AGEIS UNFCC emissions report, adapted to Greater Sydney; McKinsey Sustainability Insights

Chart 7: Accelerating transport decarbonisation is fundamental to achieving net zero



Source: NSW emissions from 2019 AGEIS UNFCC emissions report, adapted to Greater Sydney, McKinsey Sustainability Insights

Image source: Pexels

Going electric will help consumers save on bills

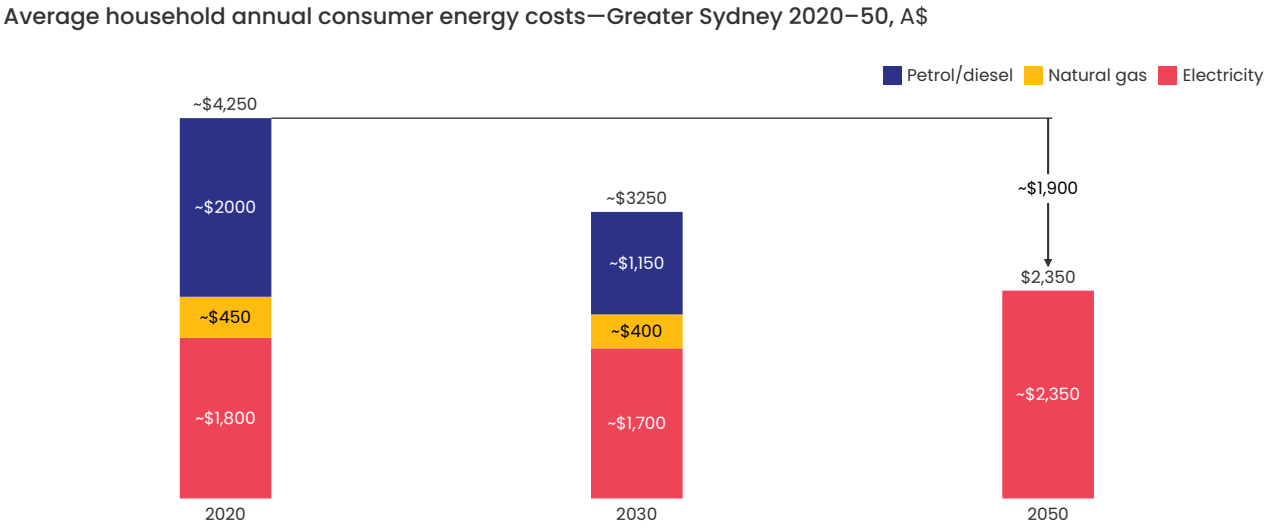
Technologies needed to reduce transport and building emissions should be attractive to consumers and policy makers alike, because most offer individuals financial savings (see Chart 8), while everyone shares in the environmental and social benefits.

While these technologies are likely to become dominant over time, their uptake needs to be accelerated, which means upfront cost and other barriers to adoption must be overcome.

We've calculated that by 2050, on average, solar panels could save households ~$1000 per year in energy bills, an EV could save up to ~$1,250 per year in fuel costs, a home battery could reduce those bills by a further ~$850 per year, and converting gas appliances to electric could save another ~$150 per year (see Chart 9).

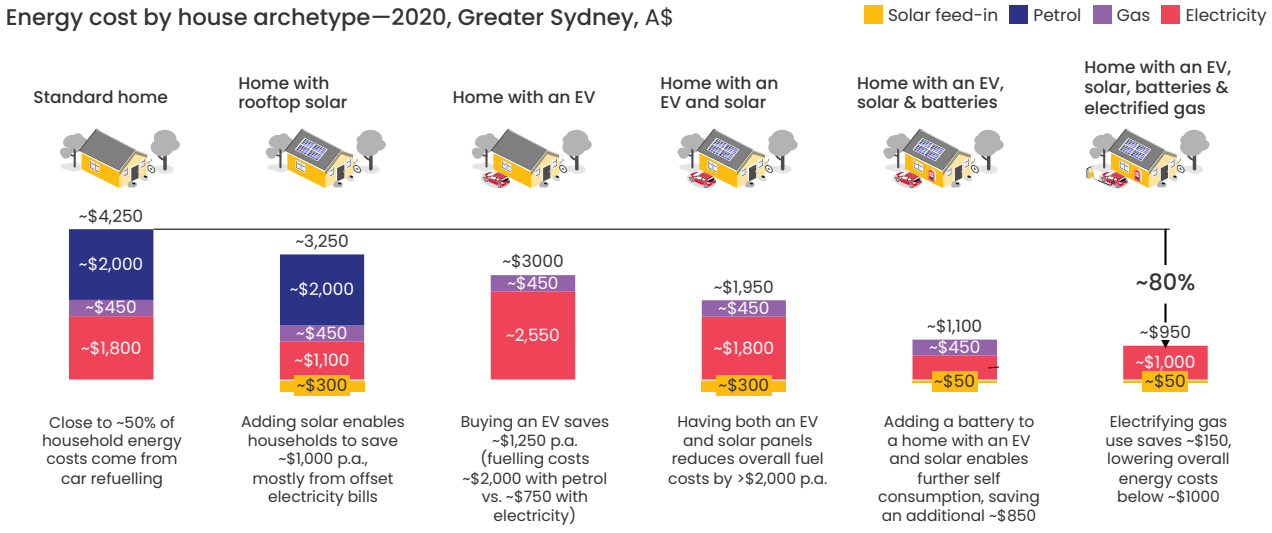
These cost savings have the greatest potential to help low-income households in Sydney who spend a larger proportion of their income on energy.

Chart 8: Electrification of household energy use could reduce household energy costs ~$1900 per year by 2050, a 45% reduction from 2020



Source: McKinsey Sustainability Insights, McKinsey Power Solutions, ACCC electricity cost benchmarking, EIA oil price forecasts, AEMO GSOO 2021

Chart 9: Decarbonisation technologies could reduce consumer energy costs by ~80% to <$1,000, from ~$4,250 today



Source: McKinsey Sustainability Insights, McKinsey Power Solutions, NSW household load curve 2021

For Sydney households in the bottom quintile in terms of income, energy costs are estimated to account for ~20% of their disposable income. If these households adopted technologies such as rooftop solar, EVs, batteries and electric appliances, their energy costs could decrease to ~5% of their disposable income (all else being equal). This compares to the highest quintile where energy costs are only ~3% of disposable income and where savings could reduce this to ~1%.[4]

Community batteries could also help low-income households, and those unable to access solar power, to access the cost savings of renewable electricity (discussed in more detail in Section 3).

Most (~87%) of the options to abate emissions in transport and buildings also deliver financial savings over time, so are effectively 'cost-negative.' The largest source of emission reductions (converting passenger cars to EVs) is also one of the cheapest. The owner of an EV would save $380 per tonne of CO_2e emissions abated, assuming the EV has a 15-year life. Converting heavy vehicles to battery or fuel cell power would double that saving for the asset owner.

A small portion of abatement technologies are expensive. Installing a residential battery translates to *paying* ~$523 per tonne of CO_2e emissions abated. Not only is the battery costly upfront, but grid electricity is likely to become less emissions-intensive over time, so the battery will offset fewer emissions over time (see Chart 10).

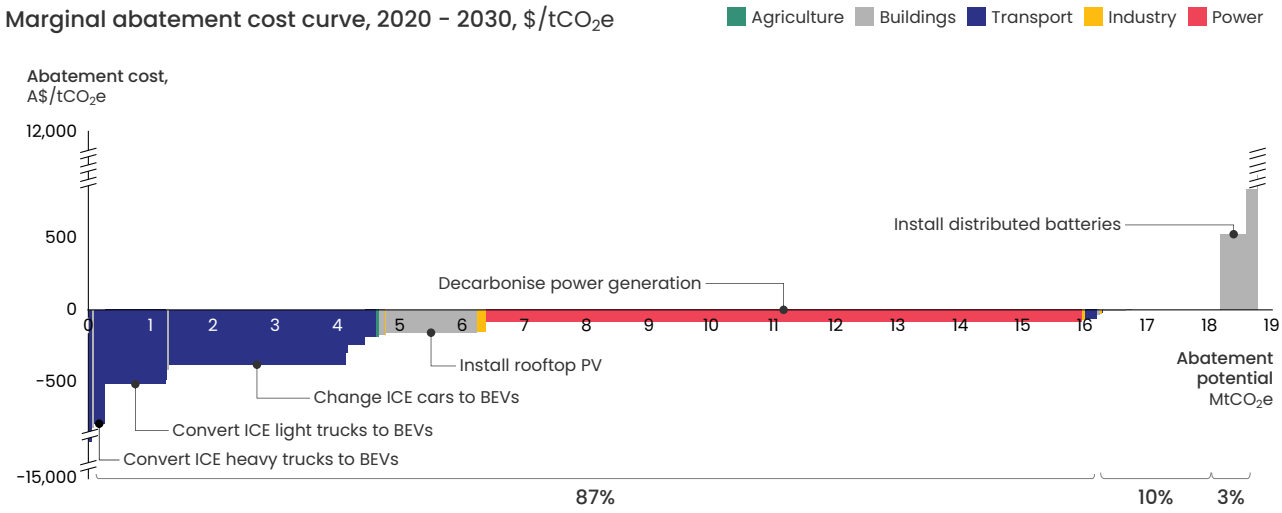
Going electric for transport and building power has additional societal benefits. This report does not duplicate the work of others in seeking to quantify those benefits, but they include:

- Health and liveability benefits of better air quality (indoors and out) and lower traffic noise –both of which promote walking and bike riding, complementing investment in active transport
- Energy security benefits of being self-sufficient in our energy needs.

These benefits are not independent, and often come together to support community resilience and equity in the face of deepening climate and cost of living pressures.

4 Based on ABS data FY18.

Chart 10: For Sydney, almost all abatement levers are cost-effective ways to reduce emissions



1. Between -10 and +10 AUD/tCO_2e

Source: McKinsey modelling results

Image source: Unsplash

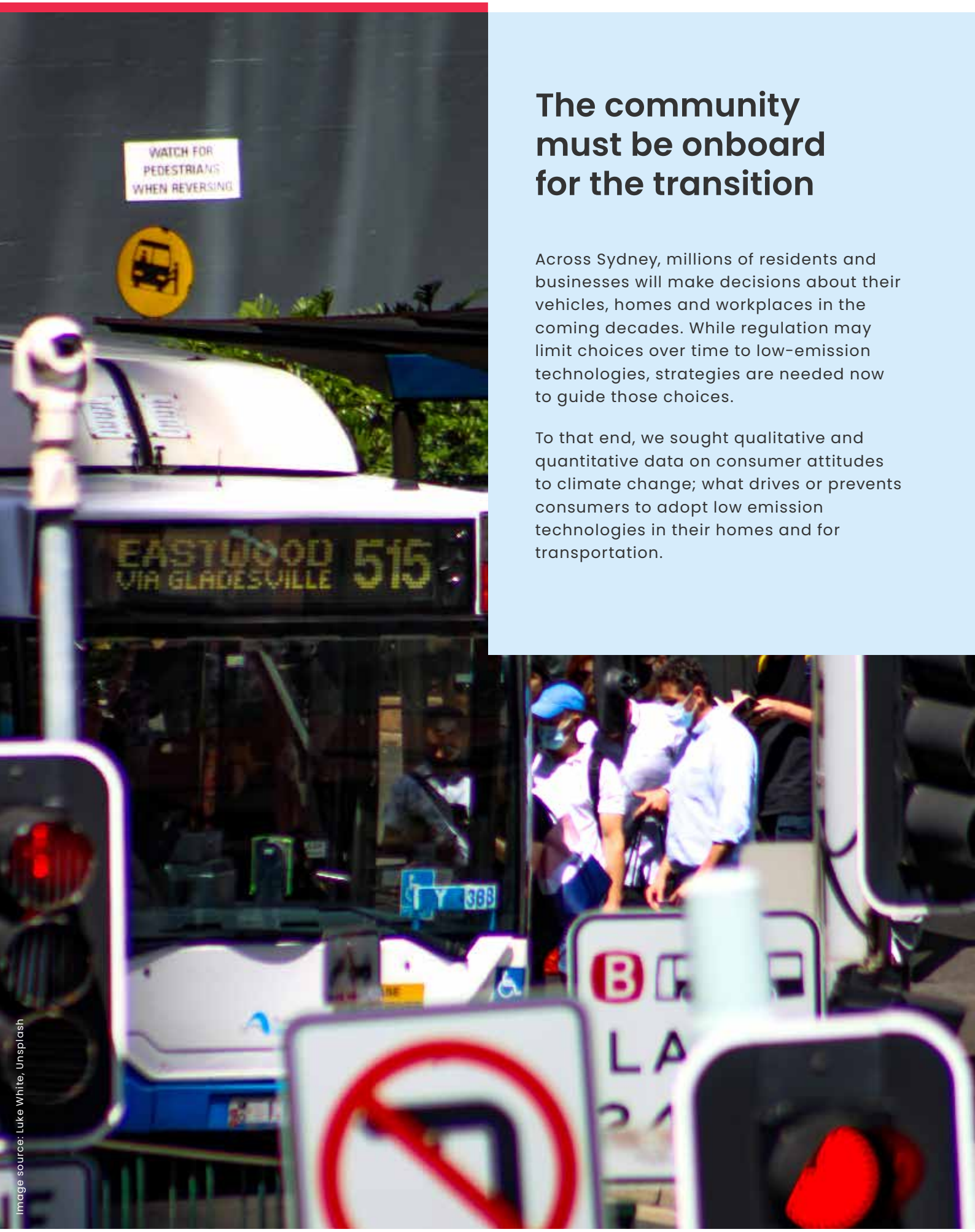


Image source: Luke White, Unsplash

The community must be onboard for the transition

Across Sydney, millions of residents and businesses will make decisions about their vehicles, homes and workplaces in the coming decades. While regulation may limit choices over time to low-emission technologies, strategies are needed now to guide those choices.

To that end, we sought qualitative and quantitative data on consumer attitudes to climate change; what drives or prevents consumers to adopt low emission technologies in their homes and for transportation.

Our research revealed three broad types of consumers, with a range of incomes in each group, and therefore differing levels of ability to afford upfront costs of low emission technologies (see Chart 11):

- **Hesitants** (22%) are aware of climate change, but doubt that individual action can make a difference and many also believe that proposed solutions might create perverse impact on the climate. They are waiting for government to lead the way with policies that seem sensible to most citizens.
- **Pragmatists** (around half of Sydney's residents) focus on affordable solutions that make their lives easier. They would consider solar panels and electric heating and water but have not gone looking for them. If they have, they must be convinced clean solutions match the convenience they're used to. Clear and transparent information is key to nudging positive change from this cohort.
- **Stewards** (26%) are far more motivated to adopt sustainable technologies. They seek out new solutions and information but expect government and businesses to support those options.

Despite their differences, the consumer archetypes have much in common. They all expect government and businesses to demonstrate bold action and help make it easy for them to change.

Chart 11: Three distinct types of consumers will require different strategies to change behaviour

Source: Qualitative interviews n=16 from Greater Sydney, McKinsey ACES survey n=3,052 for Australia and n- 1,238 for Greater Sydney

Solutions must address five needs shared by all groups

Our research suggests there are five broad beliefs that must be addressed if policy makers are to secure behaviour change at the scale needed in the *Accelerated Net Zero Transition*:

1. **Make it easy.** This belief typifies the pragmatic view. It suggests that electric vehicles and appliances will not be chosen unless they replicate (or improve) the way the existing technology does the job. Changing technology is never easy, as people either like things as they are, or don't like the trouble of change, or both.
2. **Reduce the price.** To date, electric vehicles, appliances and home energy systems have been more expensive upfront than their conventional equivalents. Except for rooftop solar, consumers have baulked at the upfront cost. While the premium is narrowing quickly in areas like passenger transport (detailed in Section 2), many perceive the price gap to be prohibitive.
3. **Provide trustworthy information.** Although awareness about climate change is near universal, many are overwhelmed by the information they receive, or have simply lost trust in it. Most people need someone they trust to recommend an option. The needle is shifting, but more evidence from trusted sources is required.
4. **Lead the way.** Consumers expect government and business to set up low-emission options, place limitations on emissions, and lead by example. They want to see electric vehicles for corporate and government fleets, and rooftop solar, batteries and electrical appliances in public buildings, including offices, hospitals and schools.
5. **Show the impact.** Once consumers have accepted there is a need to change, they want evidence their efforts are making a difference. This may include comparing household energy bills to past usage and neighbours, and demonstrating the impact of each household appliances on emissions. Tracking the emission 'footprint' of lifestyle choices can drive better choices.

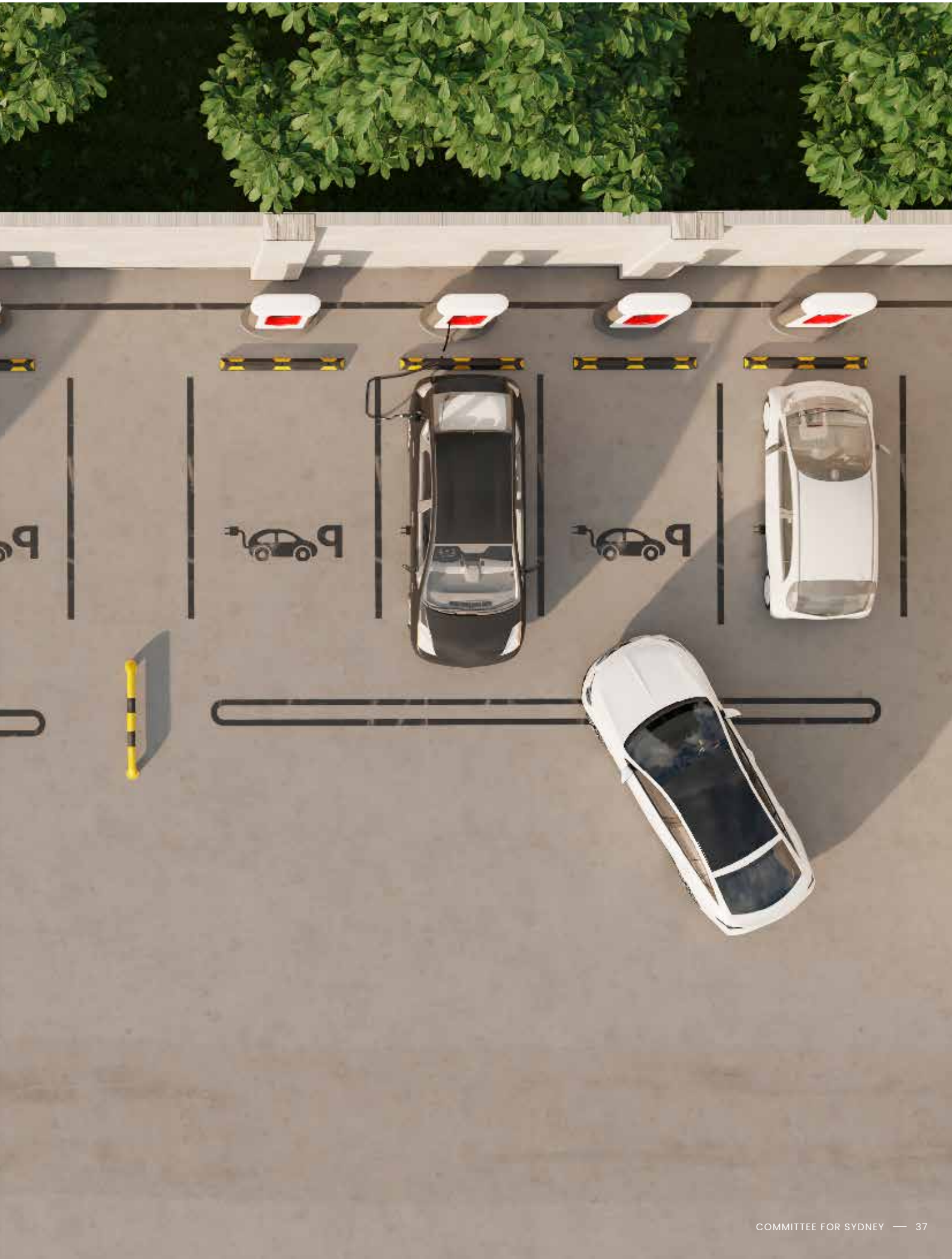
These attitudes hint at the initiatives that will be needed to accelerate the adoption of electric vehicles, appliances and distributed energy resources, like rooftop solar and batteries, across Sydney. As always, information, incentives and infrastructure are needed to support behaviour change. Alongside this, regulation will be needed for 2030 targets to be met.

The following sections set out the specific actions needed for our transport and buildings to 'go electric', and to ensure the grid is managed to support this transition.

Consumers expect government and businesses to lead by example.

Image source: Christian Dubhovan, Unsplash

I. Electrify Sydney's road transport



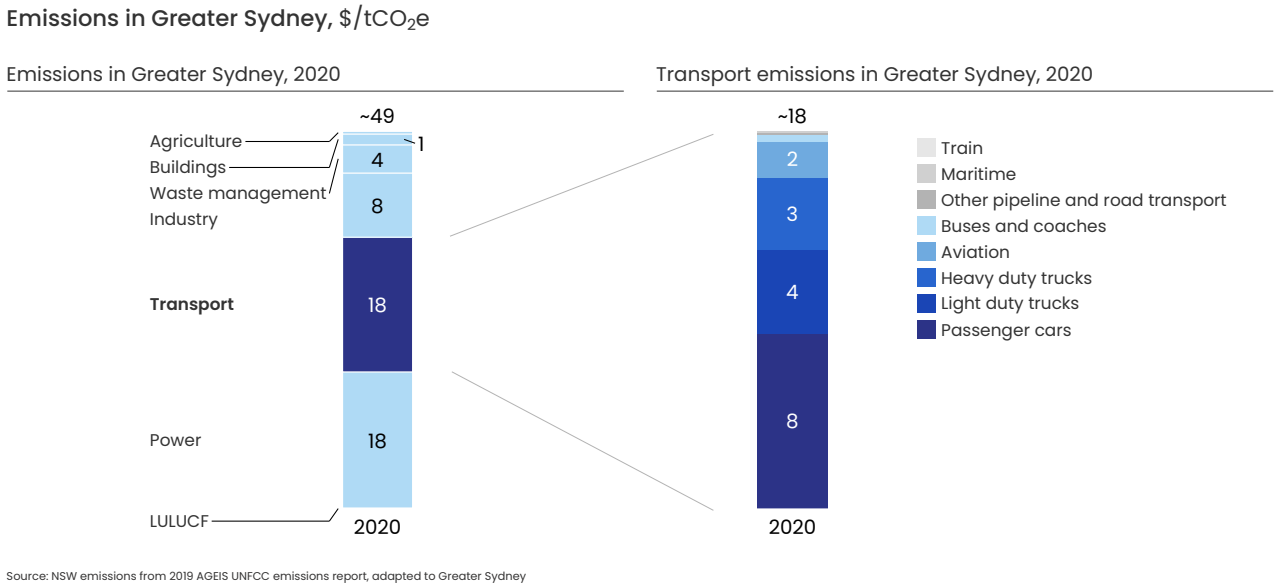
Transport is the largest source of emissions after the power grid itself. Of Sydney's ~18Mt of transport emissions, road transport accounts for ~88%, with passenger cars emitting almost half (~8Mt CO_2e) and freight vehicles emitting a little less (~7Mt).

Sydney trains are already electric, and NSW buses are transitioning to an electric fleet.[5] Air travel is also preparing to decarbonise, with options including biofuels, hybrid planes and use of hydrogen in aviation. Trains, buses and planes are not the focus of this report.

Sydney's population is forecast to grow by ~50% between 2020 and 2050, so the challenge in getting to net zero will be to abate emissions from the expected 150% rise from today's travelling needs (assuming average passenger travel remains constant) (see Chart 12).

5 NSW Government has committed to transitioning its entire bus fleet to electric by 2035.

Chart 12: Transport makes up 37% of Sydney's emissions, with 88% of that from road transport



Source: NSW emissions from 2019 AGEIS UNFCC emissions report, adapted to Greater Sydney

Image source: Unsplash

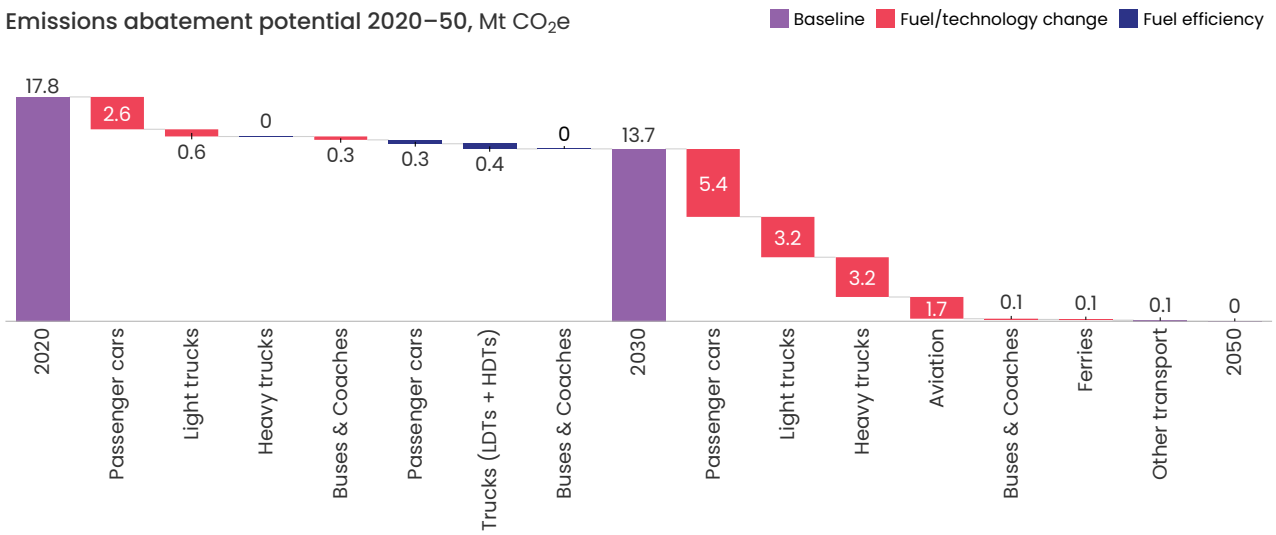
Image source: Unsplash

This section lays out our findings from the *Steady Transition* and *Accelerated Net Zero Transition* scenarios modelled for road transport:

- From now until 2030, faster adoption of electric vehicles is needed for Sydney to be on track to meet emissions reduction targets. After 2030, the conversion of light and heavy trucks will accelerate as more models become available, though planning could start immediately.
- If electric vehicles carry the vast bulk of achieving the 2030 target, 100% of passenger car sales will need to be EVs in 2027, leading to approximately ~850,000 passenger EVs on the road by 2030. Current market conditions make this highly unlikely.
- Enabling faster adoption requires an integrated range of policies, subsidies and awareness campaigns, and regulations that favour EVs – along the lines of the fuel efficiency standards in California, and phasing out petrol and diesel vehicles like the UK and Europe.

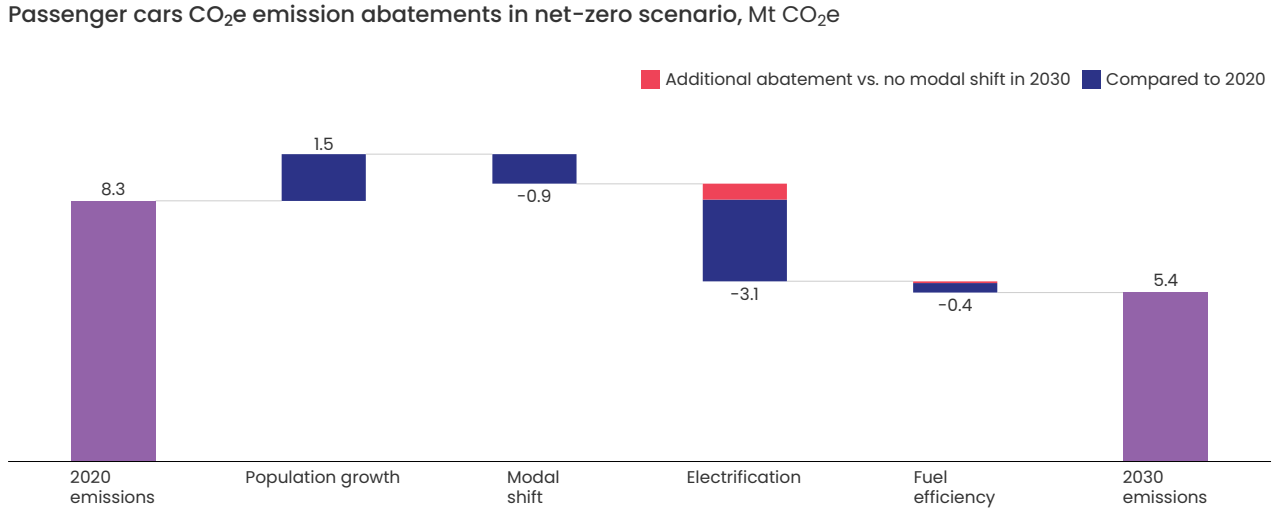
Our analysis demonstrates there is no real alternative to EVs replacing petrol/diesel cars on our roads. A shift to alternate forms of transport, and associated reduction in vehicle travel, is offset by population growth so does not avoid as many emissions as switching to EVs (see Chart 13 and 14).

Chart 13: Passenger cars lead emission reduction before 2030, trucks decarbonise faster after 2030



Source: NSW emissions from 2019 AGEIS UNFCC emissions report, adapted to Greater Sydney; McKinsey Sustainability Insights

Chart 14: Passenger emissions would fall from modal shift, adoption of EVs and fuel efficiency



Source: McKinsey Centre for Future Mobility Insights

RECOMMENDATIONS

1.1. Set a 2030 modal shift target for 40% of all kilometres travelled by sustainable modes

The best measure of how Sydney residents move about their city is the number of kilometres per year they travel, and what mode of transport they use to do it. As new ride-share and public transport options become available, people are projected to use private cars less.

In 2030, Sydney residents are still expected to travel ~15,000 kms a year, but their use of private cars could fall by about ~13% to less than 60% of those kilometres. By 2050, this shift could take about half a million cars off the road (a forecast total passenger fleet of ~2.3 million cars, rather than ~2.8 million).

We expect more people will chose to use public transport, walking, cycling and micromobility (e-bikes and e-scooters) as well as car-sharing and ride-sharing. NSW Government should set a target for the share of kilometres travelled by these sustainable modes to go from ~30% in 2020 to 40% in 2030.[6]

Setting a mode share target, supported by bespoke local and state policies, is needed to encourage active, shared and public transport . Without a target it is unlikely the share of these lower emitting modes will rise to represent 40% of travel in 2030 (in passenger kilometres per capita).

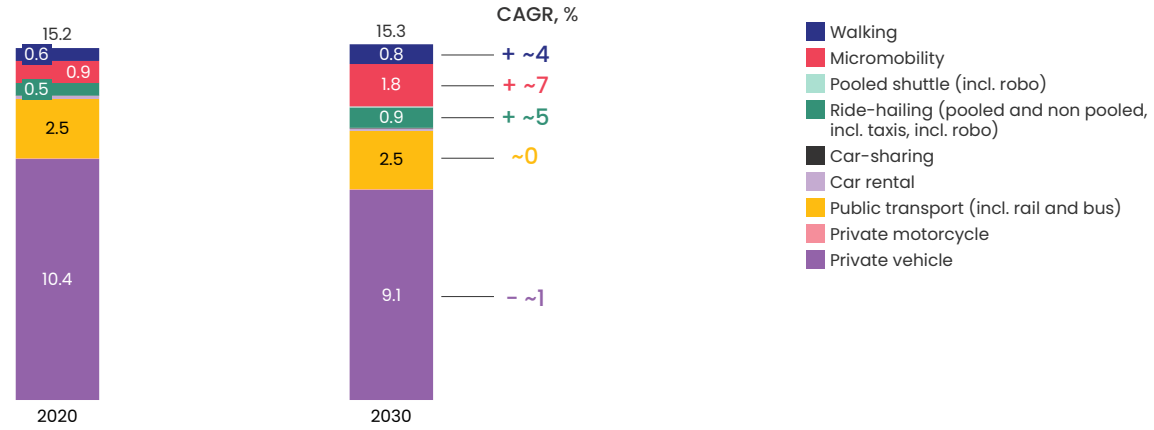
Action:

- Introduce a 2030 modal shift target of 40% with supporting policies and programs to encourage increased active travel, public transport use, car sharing and so on.

6 Exact individual share of active and public transport and micromobility are directional, requires additional detailed transport modelling for validation. Impact of exact share likely to be immaterial on overall emission reduction from modal shift.

Chart 15: Walking, cycling, ridesharing and public transport will all rise, will private car use falls

Projection of average transport mix for Greater Sydney in net zero scenario,
Passenger kms per capita per annum, Thousands, 2020–2030



Note: The numbers presented are directionally right; their trend only has been used in the baseline model. Further analysis required to have precise numbers.

Source: McKinsey Centre for Future Mobility

We expect more people will chose to use public transport, walking, cycling and micromobility as well as car-sharing and ride-sharing.

Image source: Marcel Strauss, Unsplash

CASE STUDY:

Uber

In 2022, Uber announced a $26 million investment into Australia's electric vehicle market. As part of this initiative, Uber is cutting service fees by 50% for driver-partners using battery electric vehicles (BEVs) on the platform until mid-2025 (for the first 2,500 drivers, up to a value of $3,500 per year). This investment is part of Uber's global commitment to becoming a zero-emissions mobility platform by 2040 and follows a 12 month trial to reduce service fees for BEV drivers across the platform.

Uber plans to encourage electric vehicles to join its platform.

Image source: Viktor Avdeev, Unsplash

1.2. Accelerate electric vehicle adoption towards 100% of all sales by 2027

An integrated suite of policies is needed to accelerate EV adoption by overcoming the upfront cost, range anxiety and availability of EVs.

We already have the technology for passenger cars to deliver ~63% gross abatement of transport emissions up to 2030, and ~47% from 2030 to 2050.

However, there are four major barriers to EV adoption:

- upfront cost is significantly higher than the petrol/diesel equivalent
- charging infrastructure is not yet as widely available as petrol stations, making EVs less practical than petrol/diesel cars, and creating range anxiety among purchasers
- low awareness among 'pragmatic' and 'hesitant' resident groups about the benefits of owning an EV
- limited EV model availability.

For these reasons, the NSW Government EV strategy is designed to overcome the three barriers of upfront cost, range anxiety and model availability. The NSW EV Strategy aims for electric vehicles to make up half of all new car sales by 2030, leading to ~15% of the passenger fleet being electric.

Our *Accelerated Net Zero Transition* model shows we need a much faster ramping up: *all* new cars need to be electric by 2027, so EVs make up ~30% of the passenger fleet by 2030 – twice as much as in the *Steady Transition* approach.

Instead of ~470,000 EVs on Sydney's roads, by 2030, there need to be ~850,000 to achieve the modelled passenger vehicle emissions reductions.[7]

Action:

- Accelerate electric vehicle adoption towards 100% of all sales by 2027.

7 The number of EVs in *Accelerated Net Zero Transition* is not twice as much as *Steady Transition*, despite being twice the ratio of total number of cars (30% compared to 15%) as there are fewer cars in the *Accelerated Net Zero Transition* compared to the *Steady Transition* due to more people shifting away from cars.

Image source: J. Dean, Unsplash

EV charging infrastructure is one of the four key barriers to adoption.

Chart 16: Passenger EV car sales need to accelerate fast off a very low base

50,000 EVs

Technology adoption required in steady transition and accelerated net zero transition scenarios, 2030

Scenario	Electric vehicles[1]	Emissions abatement $MtCO_2e$
Baseline 2020	~1,600	
2030: Steady Transition	~470,000	~1.1
2030: Accelerated Net Zero Transition	~850,000	~2.1

EV adoption: 2020 parc penetration of ~1,600; Steady Transition assumes ~15% of passenger car parc as EVs by 2030 based on NSW EV Strategy, Accelerated Net Zero Transition' assumes 'stretch target' of 30% parc as EVs in 2030

Source: Energy Consumer Sentiment and Behaviour Survey 2021, NSW Transport Registrations data, McKinsey Centre for Future Mobility, McKinsey Sustainability Insights, BIS Oxford Economics

1.3. Convert all commercial and government fleets to EVs by 2030

Buying an EV makes financial sense as they are ~40-70% cheaper to run than petrol/diesel cars. Over their projected lifetime, EVs save $380 per tonne of CO_2e emissions compared to petrol/diesel vehicles. For this reason, government and commercial fleet buyers, keen to reduce both costs and emissions, are likely to adopt EVs in large numbers.

Our modelling suggests commercial and government fleets should be converted entirely to electric vehicles by 2030. Fleets make up almost 10% of all passenger cars, so their conversion would put ~200,000–250,000 EVs on the road. Fleets owners replace their vehicles every three to five years,[8] much faster than individual owners (about every 10 years), and base their choice on total cost of ownership rather than upfront price.

The total cost of ownership of a family-size EV is projected to be at parity with an equivalent petrol/diesel car in 2025, or earlier if fuel prices stay high. Accordingly, the NSW Government is planning to convert its whole fleet by 2030, as well as investing $105 million in reverse-bid processes to help business and local government fleets to transition.

Action:

- Set an end date to convert all state and local government fleets to EVs (2030)
- Accelerate private fleet conversion (taxis, corporate etc) through incentives and market leadership.

8 As per NSW Government, "NSW Electric Vehicle Strategy", p. 20, online, consulted April 5 2022.

CASE STUDY:

Origin Energy

In 2021, Origin became a member of EV100, a global initiative that brings together companies around the world to accelerate the uptake of EVs through commitments to transition their fleets. Origin has committed to transitioning all 600 of its passenger and light commercial vehicles to electric vehicles by 2030. Origin also launched Origin 360 EV for fleets, the first full-service EV fleet management program of its kind in Australia. Origin Energy has partnered with Custom Fleet to provide a 'one-stop shop' for EV fleet procurement, management and charging. The idea is to take the stress away from fleet businesses by fully arranging their EV transition, charging infrastructure, load management and carbon neutral travel through carbon offsets.

Drive Day, Image source: Origin Energy

1.4. Establish a nationwide incentive scheme to reduce EV purchase costs

Lower upfront costs for EVs could add 160,000-200,000 more EVs on the road by 2030.

Purchase price is the top concern for Australians when buying a car. While EVs are only a few years away from parity with petrol/diesel cars in total cost of ownership, they do cost more upfront. On average, Australians spend about ~$41,000 on a new car, and an EV currently is 20-25% more expensive.

To close that gap, the NSW Government offers subsidies of about ~$5,000:

- $3,000 rebate for the first 25,000 EVs sold for under $68,750
- stamp-duty exemptions for all EVs up to $78,000 dutiable value.

While incentives in NSW are the highest in Australia, they are much lower than other countries, including France, Canada and Korea.

While international incentives average around $10,000-14,000 per EV, and even range beyond $20,000, there is no specific optimum. Around 13% of potential EV buyers say bringing the EV cost down to a 5-10% premium above the equivalent petrol/diesel car would be enough to get them to switch.

The Federal Labor Government has promised to exempt EVs from the 47% fringe benefits tax that are provided through work for private use and to remove import tariffs. These changes could cut the cost of $50,000 EV by $2,000-9,000.[9]

A national incentive scheme that brings down the upfront cost of purchasing by ~$11,000 would entice another ~200,000 EV purchases.

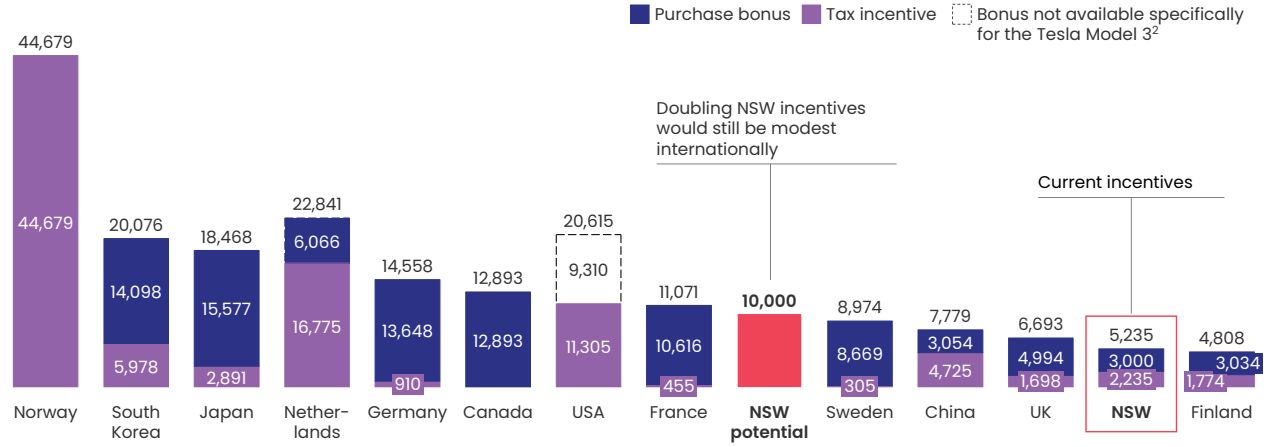
Action:

- Establish a nationwide incentive scheme to reduce EV purchase costs.

9 www.theguardian.com

Chart 17: Subsidies for Sydney drivers are lower than in many other countries incentivising EVs

Monetary incentives[1] for private owners of a Tesla Model 3 SR+ by country, AU$, 2021[3]



1 Converted from USD to AUD using the 2021 average exchange rate of 1.33 AUD for 1 USD
2 n the US, Tesla is no longer eligible for the federal tax credit as already having reached 200,000 sales units (might be increased to 400,000)
3 As of September 2021 for NSW, as of April 2021 for the rest of the world

Source: OEM websites, McKinsey Centre for the Future of Mobility, web and press search

Drive Day, Image source: Origin Energy

1.5. Reduce range anxiety through EV charging infrastructure on highways, in carparks, and by making buildings EV ready

Investment and planning regulations to support charging infrastructure may attract ~105,000-145,000 EV purchases.

Driving range is a strong buying factor for ~30% of Sydney motorists, so they need to know they can charge as easily as they currently top up their tanks. 'Pragmatic' and 'hesitant' consumer groups need charging available when they park at work, retail and tourism destinations. Fast chargers on highways are needed for all motorists to take long trips with confidence.

Our *Accelerated Net Zero Transition* modelling suggests Sydney needs up to ~11,500 fast chargers and ~42,000 destination chargers by 2030[10] – a lot more than currently planned. The NSW Government is investing $131m to roll out ~1,000 fast chargers, and another $40m for destination chargers.[11] The federal government is also financing an estimated ~400 fast chargers in Sydney from a $25m ARENA Future Fuel Funds allocation.[12]

In parallel with public charging, appropriate EV charging infrastructure needs to be provided in all new buildings. Planning regulations should be updated to support this rollout by requiring new build and major renovations include home and destination charging. Building standards should also encourage EV charging in new builds as well as retrofit.

Action:

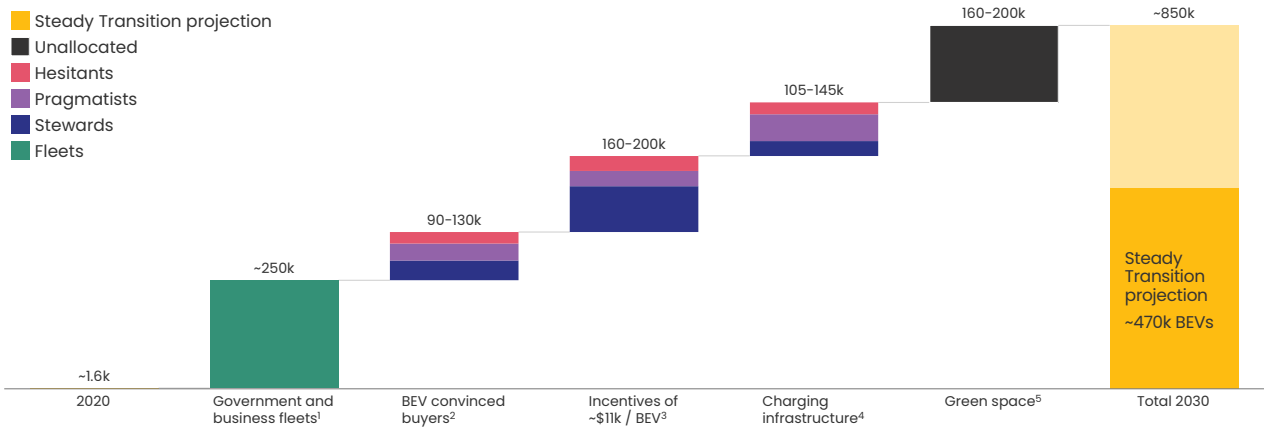
- Extend financial support for charging infrastructure to broaden the on-street network
- Develop and implement best practice standards and consent conditions to ensure appropriate EV charging infrastructure is provided in all new buildings.

10 This ideal-world estimate assumes that public L2 fast charging is the dominant technology, and that motorists from high-income SA2s charge mainly at home, and motorists from lower-income SA2s use public chargers.
11 As per NSW Government, "NSW EV Strategy", p21, online, consulted April 6th, 2022.
12 As per ARENA, "Future Fuels Fund revved up to provide EV charging nationally", online, consulted April 6th, 2022.

Image source: Freepik

Chart 18: Subsidising EVs and charging infrastructure would still leave Sydney ~200,000 cars short of target

Impact of key enablers on EV growth 2020–30,
Number of EVs, 2020–2030



1. Business and govt. fleets represent ~9% of passenger vehicles in NSW, estimated ~250k in Sydney and assuming no parc growth
2. Uptake is modelled based on the proportion of McKinsey ACES survey respondents who say their next car will be a battery electric vehicle
3. Uptake is modelled on the proportion of McKinsey ACES survey respondents who state they will switch to a battery electric vehicle at a given price premium or discount vs. an ICE car. Excludes respondents who state they already plan to buy a battery electric vehicle or would not consider buying a battery electric vehicle. Responses extrapolated to the proportion of sales between 2020 and 2030 at assumed constant car replacement rate with no parc growth
4. Modelled based on proportion of ACES respondents who say that availability of charging is a tipping point for them to buy a battery electric vehicle, extrapolated to sales as described above. Excludes sales that made due to momentum or incentives and ignoring sales that would not consider buying a battery electric vehicle
5. 'Green space' is 'white space' that is missing to reach the target
Note: this model assumes no change in replacement rate of cars and no parc growth

Source: NSW Government EV Strategy, NSW Government RMS data, McKinsey ACES survey n = 3,052 for Australia, n = 1,238 for Greater Sydney, McKinsey Centre for Future Mobility

CASE STUDY

Buildings installing EV charging infrastructure

The Zinc Building in Alexandria, Sydney, illustrates what can be done.[13] Despite being built in 2005, the 45-apartment building now has 10 EV chargers in the basement, with the capacity for more on demand, and 24kW of solar power on the roof, with another 70kW being installed.

The most challenging step was convincing apartment owners to commit to the change, but the process was helped by gadgets that enable an equitable distribution of solar power between the apartments. The Zinc building is now considering battery options and replacing its gas hot water system.

A new apartment complex at Lane Cove, in Sydney's north, also offers residents the opportunity to upgrade their parking space to include an EV charger when ready to go electric. Currently 40 out of the 93 apartment owners have chosen to install a charging unit, which is the first time an apartment development in Australia has included such a comprehensive EV charging infrastructure for current and future EV drivers.[14]

Research published in September 2018[15] showed 78% of apartment owners across Australia would like EV chargers at their homes, while only 12% knew the location of the nearest charging station.

The NSW Government has released a website, 'Making your residential strata building EV ready' that steps through the process of implementing EV charging in residential apartment buildings. It notes that for these types of works to proceed in strata property, a voting requirement would likely be triggered to seek 50% approval to spend the capital. Renters would need to act through their landlord, adding complexity to the process.

13 www.theguardian.com
14 www.eocharging.com
15 www.wattblock.com

Making buildings EV ready needs to start now.

Image source: Michael Fousert, Unsplash

1.6. Invest in a campaign to build awareness of EV availability and benefits

Together with suggested regulations, a clear public information campaign could help add ~160,000–200,000 EVs to the road.

Industry and government should collaborate on information campaigns to overcome people's concerns and promote the benefits of EVs. The NSW and federal governments have already launched some campaigns, with advertising, a total cost of ownership calculator and factsheets on EVs. We recommend investing in more initiatives such as above and below the line media campaigns, phone apps that compare cost, and public debates at car exhibitions and rallies where people can voice their concerns over EVs and have them answered.

Once more EV models are available in Australia these campaigns won't be necessary. When there is competition for sales, brand advertising will switch from petrol/diesel to electric models. To date, car brands have invested little in promoting EVs in Australia, as doing so actually causes headaches in showrooms where they do not have stock to sell.

Action:

- Consumer awareness campaign on the availability and benefits of electric vehicles, recognising different motivations and barriers to switching, and putting the right information in the right places – particularly ensuring the campaign is tailored to Sydney's culturally and linguistically diverse community.

Ausgrid partnered with charging company Jolt to provide roadside EV chargers in Sydney's suburbs.

Image source: Ausgrid

1.7. Introduce CO_2 emissions and fuel efficiency standards for new petrol/diesel vehicles and introduce a future sales ban

The preceding actions, if implemented in full, would still leave 160,000-200,000 short of the target of 850,000 vehicles on the road by 2030. Actions to address the availability of EVs in Australia are key to addressing this shortfall (see Chart 19).

In 2030, in the *Accelerated Net Zero Transition* scenario, ~70% of Sydney's passenger car fleet would still be petrol or diesel. Policy makers can rely on the continued improvements in fuel efficiency to help reduce emissions or can accelerate reductions by introducing CO_2 emission or fuel efficiency standards, as California and Europe have done since the end of the 2000s.

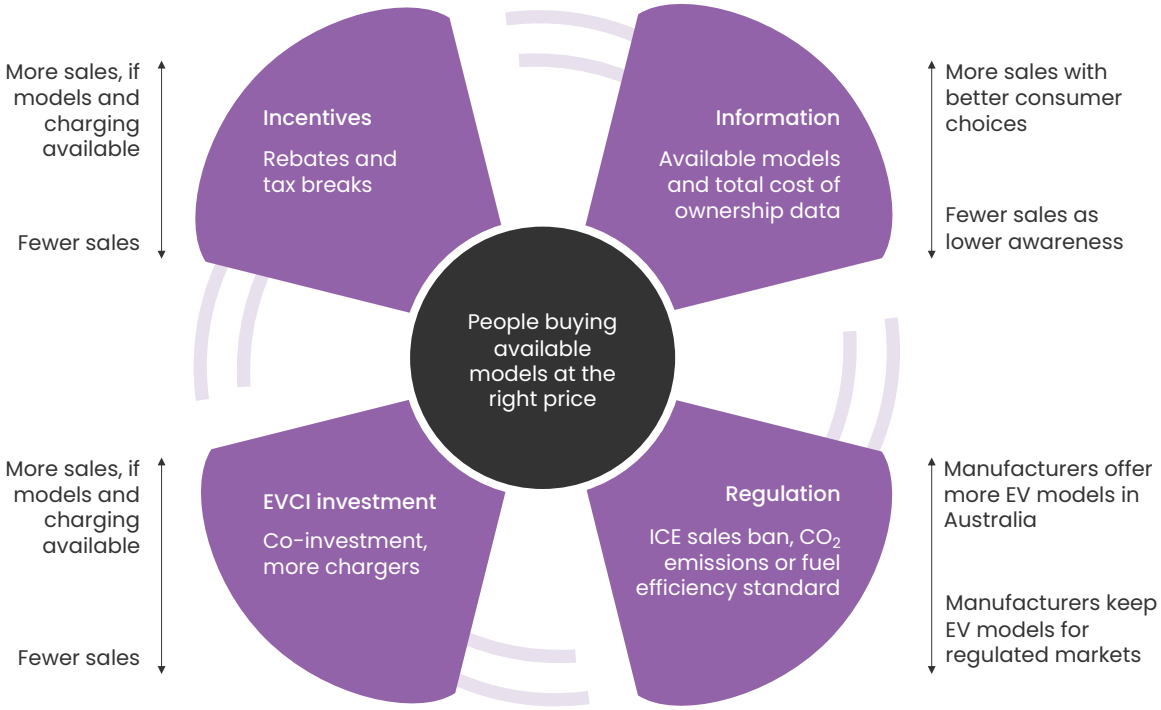
The fuel efficiency (litres of fuel consumed per km travelled) of passenger cars improved by ~11% between 2000 and 2016 and is expected to improve by another ~6% in the decade to 2030, and then ~11% through to 2050. On that improvement alone, fuel efficiency in vehicles with a petrol or diesel engine (passenger cars, trucks, buses and coaches) would reduce CO_2e emissions by ~700kt CO_2e by 2030, or a significant ~17% of road transport abatement in that period.

Setting a federal CO_2 emissions standard or a state fuel efficiency standard for new vehicles sold could increase this contribution. It would ensure that carmakers offer not only the best performing low emission petrol or diesel vehicles in Australia, but also a greater range of EVs.

There are only ~30 battery and plug-in electric hybrid models available in Australia compared to ~130 in the UK. Global EV supply is not generally an issue. EV supply is projected to increase by ~30% per annum globally, with some car manufacturers (including Ford, General Motors and Subaru) announcing they will phase out petrol/diesel car production by 2035.

A key reason EV supply is limited in Australia is the lack of fuel standards, along with no future ban on new petrol/diesel vehicles. In Europe, car makers must meet low average CO_2 emissions standards across their whole fleet or face heavy penalties. Each EV sold in Australia is an EV not sold in those other countries, resulting in an opportunity cost for manufacturers who sell EVs in Australia. Many countries have also flagged a total ban on new petrol/diesel car sales, including the UK by 2030, which has meant EV allocation is prioritised for those countries.

Chart 19: Regulation interacts with other key policy actions to drive EV sales



Introducing similar regulation in Australia would remove the opportunity cost for manufacturers and help ensure Sydney gets a global range of EV models. A petrol and diesel car sales ban, announced well in advance, would also send a clear signal to industry that EV charging, servicing and supply chain networks need to be in place.

Action:

- Introduce CO_2 emissions and fuel efficiency standards for new cars sold in Australia or NSW
- Introduce a future ban on petrol/diesel car sales.

Image source: Ben Tofan, Unsplash

CASE STUDY:

ACT Zero Emissions

The ACT Government has created a Zero Emissions Vehicle Strategy that will commit the territory government to phasing out light petrol cars from 2035 and includes new incentives and other programs to encourage people to switch out their old petrol vehicles. The ACT government wants between 80 and 90% of new vehicle sales in 2030 to be zero emission models.

ACT will phase out petrol and diesel cars by 2035.

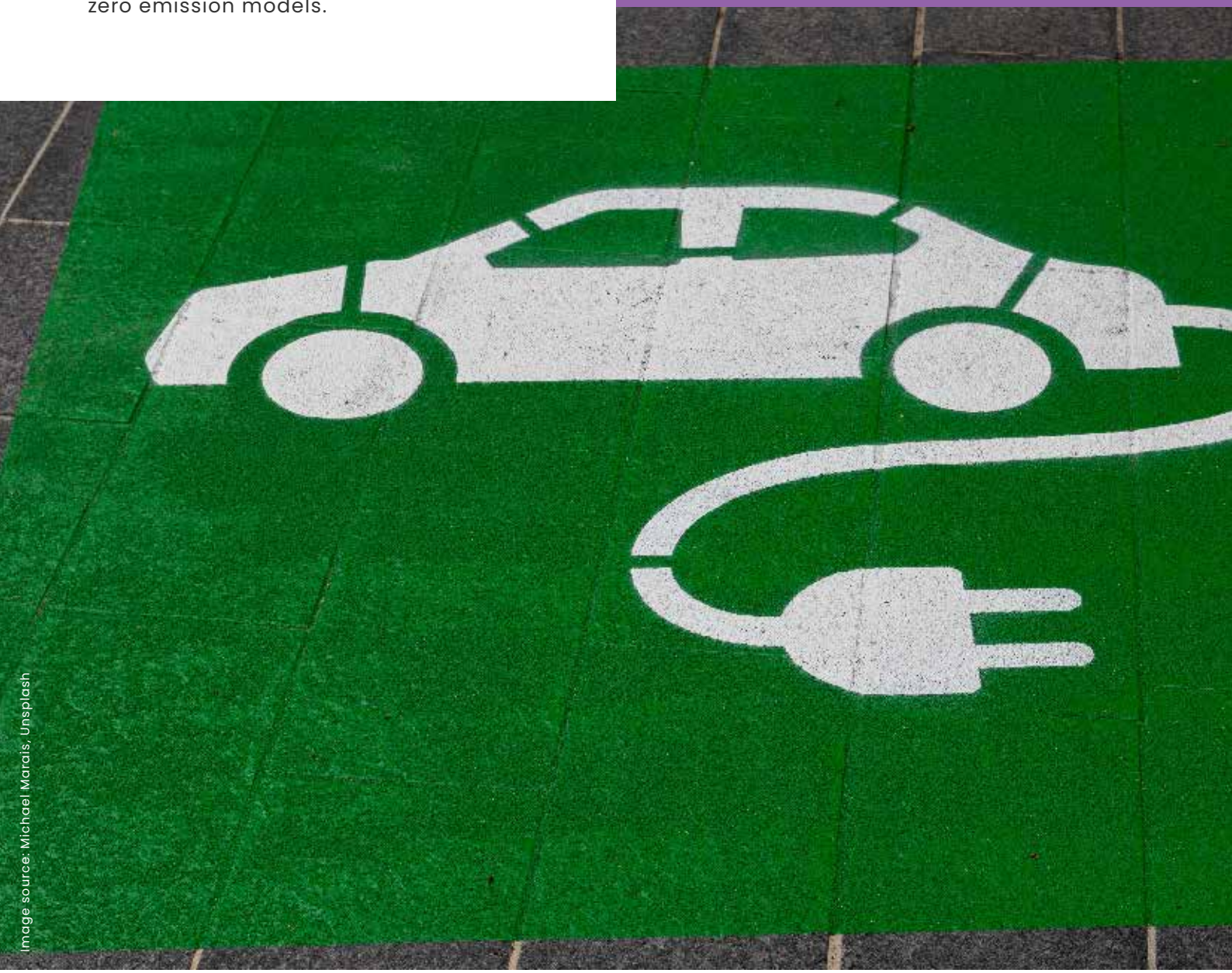


Image source: Michael Marais, Unsplash

1.8. Start planning now for light and heavy truck conversion to accelerate after 2030

While growing the number of passenger EVs is the primary focus of this section, Sydney will also need to convert light and heavy trucks to electric in the near feature.

New light truck sales are likely to be electric if the cost of petrol or diesel is higher than electric equivalents – in total cost of ownership. The total cost of ownership for battery electric light trucks is likely to be at parity with light petrol/diesel trucks from 2025.

Electric trucks would save ~$514 per tonne of CO_2e abated. Due to this cost saving, our *Accelerated Net Zero Transition* model suggests ~30% or ~130,000 of Sydney's light trucks could be electric by 2030 – with all light truck sales being EVs as early as 2026.

Parity on total cost of ownership of heavy trucks is expected around 2030. Nonetheless, ~10% of the fleet is expected to be decarbonised by 2030, with ~5000 EVs and ~1300 fuel cell electric vehicles on the road. As the technology matures after 2030, each tonne of abatement is expected to save $448.

Currently, there are next to no zero emission heavy trucks on the road in NSW – including both battery and fuel cell EVs. Most conversions are likely to happen after 2030, but preparations need to start as soon as possible, with public coordination and potential additional regulation and incentives to help.

Although the technological pathway is still uncertain, batteries are expected to be relied on for short to medium distances, with hydrogen fuel cells used for longer distances. The *Steady Transition* model assumes that ~90% of light trucks and ~60% of heavy trucks would rely on batteries in 2050, but these proportions could turn out to be different.

Truck manufacturers are currently exploring both pathways with the fuel cell electric Xcient truck from Hyundai being demonstrated in New Zealand, and the battery Volvo FL truck being tested by Linfox in Australia.

CASE STUDY

Woolworths and Linfox

In 2021, Woolworths[16] partnered with Linfox to launch a new electric refrigerated truck that will deliver fresh produce to Woolworths supermarkets. As Woolworths Group works towards a significant reduction in emissions by 2030, on the path to becoming net carbon positive by 2050, EV trials are helping lay the groundwork for greener supply chain logistics. The electric truck can carry up to eight pallets of produce, allowing Woolworths to transport an average of around four tonnes in each trip. The EV can travel up to 200 kilometres on a single charge and has regeneration capability, allowing the battery to recharge each time the truck travels downhill or brakes and it is significantly quieter than diesel alternatives.

16 www.woolworthsgroup.com.au

Light and heavy truck conversion is expected to ramp up after 2030.

Image source: Wolfgang Hasselman, Unsplash

Barriers to adopting zero-emission trucks (light and heavy) are similar to those for passenger EVs, however, the specifics are quite different so require tailored solutions.

Further investment and incentives may be needed to accelerate charging infrastructure. Charging is even more problematic for zero emission trucks than for passenger EVs. On the road charging infrastructure does not exist yet at scale, while depot charging is expensive due to grid upgrade costs, and coordination with the network providers will be needed to support the grid. On hydrogen, the NSW Government is investing $175 million to set up low carbon industries, such as green hydrogen, and part of this investment will fund four to five scalable H2 refuelling stations along a trial corridor, supporting ~25-50 fuel cell electric trucks.[17]

Incentives may also be needed to overcome the upfront conversion cost. Despite total cost of ownership parity by ~2030, the upfront cost of conversion might slow adoption by small and medium companies with limited cashflow: ~70% of trucking operators in Australia only have one truck.[18]

Bulk orders may be needed to increase supply. The electric light truck segment is currently experiencing shortages with supply, making it difficult to scale up to meet global demand. The situation is different for heavy trucks, of which battery models are only just starting to be manufactured, and fuel cell models are mostly produced by small players. These shortages are expected to be resolved by 2025, but by then trucking companies would have little time to adopt zero emission trucks at the rate needed for Sydney's net zero pathway. Therefore, public coordination is essential to align a strategy ready to be implemented in 2025.

A clear NSW or Australia-wide strategy for zero emission trucks needs to be developed. Governments, freight companies, truck manufacturers and charging providers should collaborate to help big first movers switch as soon as possible and assist smaller followers to do so later.

Actions:

- Create a state or national strategy with logistics companies and local manufacturers to convert truck fleets aided by a consumer awareness campaign
- Group zero-emission light truck orders to secure bulk supply
- Introduce a petrol/diesel truck 2035 sales ban
- Widen truck width standards to improve model availability
- Introduce financial incentives for truck purchase and depot charging infrastructure
- Group zero-emission truck orders to secure bulk supply
- Introduce a CO_2 emissions or fuel efficiency standard for new trucks sales.

17 NSW Government, "NSW Hydrogen Strategy", p50, online, consulted April 5th 2022.
18 Electric Vehicle Council and Australia Truck association, "Electric trucks: keeping shelves stocked in a net zero world", p5, online, consulted April 5th 2022.

II. Enhance residential and commercial building sustainability

Image source: Unsplash

Image source: Abir Hiranandani, Unsplash

As transport emissions are reined in by the switch to electric vehicles, similar thinking can now turn to building emissions. The largest remaining source of emissions across Sydney's power system is the ~30PJ of gas for space heating, water heating and cooking. About ~70% of this gas is used in residential settings, the rest in government and commercial settings.[19] Replacing gas with electricity will reduce emissions and energy costs as more cheap renewables enter the grid.

This section recommends:

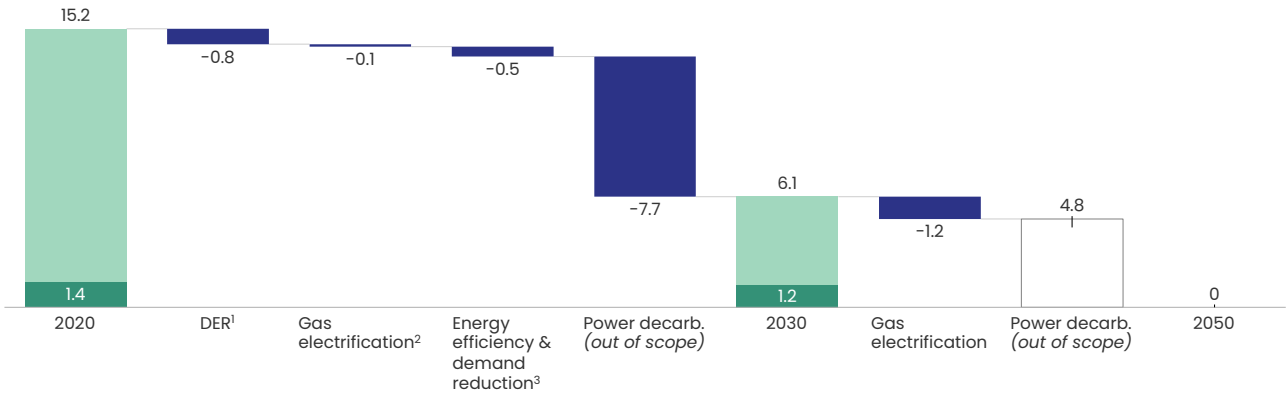
- Policies are introduced now to get on the pathway to completely replace gas appliances by 2045
- Business and government electrify their buildings, and convert their appliances early, given the emissions and cost advantages
- Require disclosure of energy efficiency in homes to help deliver transformation and mobilise market forces
- Implement awareness campaigns, incentives and planning regulations to accelerate consumer adoption.

Switching from gas to electric appliances will be accelerated by any increase in residential or commercial rooftop solar and storage (see Section 4), as cheap renewable energy will then be readily available. Together with the decarbonised power grid and improvements in efficiency, these two types of investment could reduce building emissions to net zero by 2050 (see Chart 20).

19 Excludes industrial gas use.

Chart 20: With the power grid decarbonising, distributed energy resources and gas-to-electricity switching will reduce building emissions

Breakdown of levers contribution to buildings decarbonisation, Buildings emissions 2020–2050, Mt CO_2e



1. DER = distributed energy resources. Key actions include installation of solar PV and battery storage.
2. Includes transition of water heating, space heating, cooking, and other appliances to electricity from gas or LPG
3. Includes continued improvement of energy efficiency across the appliance fleet, improved insulation of buildings, and measure to reduce demand energy demand in buildings (e.g., reducing standby time, reducing heating temperatures)

Note: numbers do not add exactly due to rounding

Source: NSW emissions from 2019 AGEIS UNFCC emissions report, adapted to Greater Sydney; McKinsey Sustainability Insights

RECOMMENDATIONS

2.1. Set a target for no new gas connections from 2025 and no new gas appliances by 2030

Electric appliances are mostly likely to be chosen when an old gas system is near end-of-life, so the transition may take until ~2045 without further interventions.

There are three levers for reducing emissions from household energy use:

- using them less
- using energy more efficiently[20]
- switching to electricity.

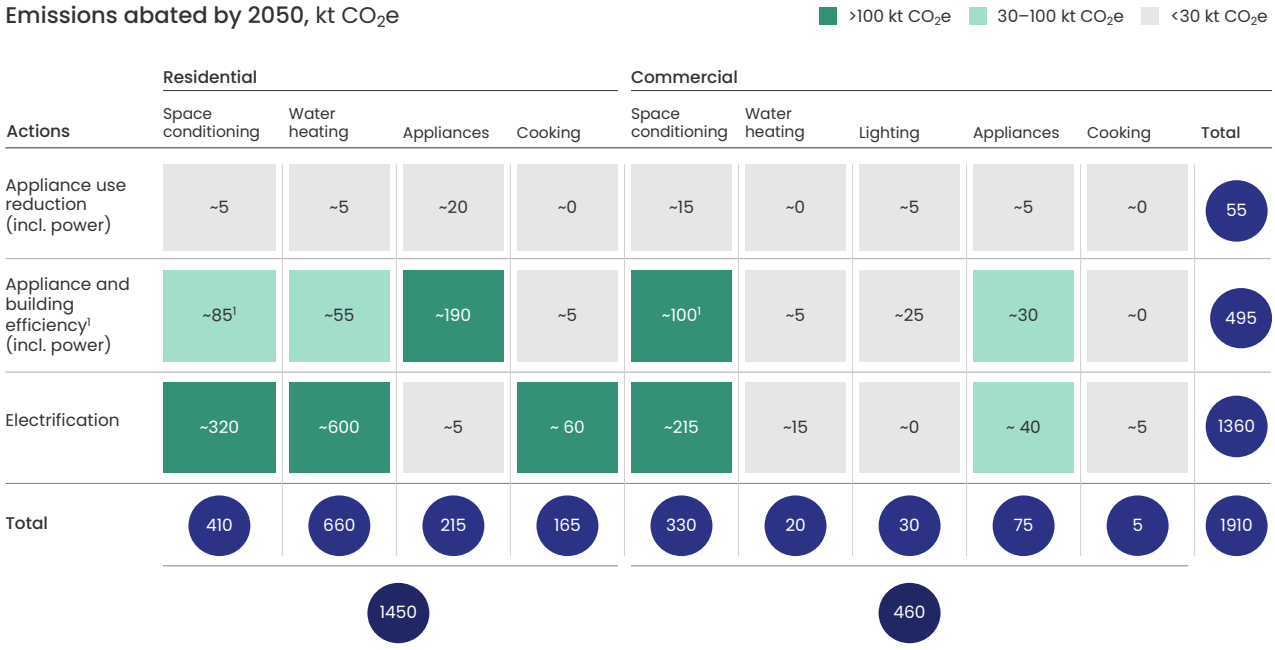
Of these, switching to electricity is likely to abate the most emissions by 2050, about ~1.4Mt.[21] Increasing the efficiency of space heating and cooling will also be a major contributor. While energy efficiency makes a ~0.5Mt CO_2e abatement contribution to 2030, as the grid decarbonises and gas use is electrified, it will have a smaller impact after 2030.

Programs to improve Sydney's energy efficiency are important to continue – near term decarbonisation gains and saving money – but are not a focus of this report. We also understand that while energy efficiency can reduce demand in large commercial buildings – shopping centres and office buildings – any reductions are likely to be offset to an extent by increasing demand from EVs being charged onsite by consumers and employees.

A ban on new residential and commercial gas connections from 2025 could result in ~200,000 additional households being all electric from 2025-2030. This is already the case in other countries, for example, the UK's program to retrofit gas heating includes grants for low and middle-income households but is complemented by a ban on gas boilers in new buildings from 2025. A ban on new gas connections could be followed by a ban on the sale of new gas appliances from ~2035. The UK's active program to retrofit gas heating includes a ban on installing new gas boilers in existing buildings from 2035.

20 Includes buying more efficiency appliances as well as insulating buildings to improve the thermal efficiency of the building.
21 ~1.4Mt CO_2e abatement consists of ~0.1Mt CO_2e abated to 2030, and ~1.2 Mt CO_2e from 2030 to 2050. Sum of abatements do not reconcile to the total 2020-2050 abatement due to rounding.

Chart 21: Replacing gas with electricity remains the biggest source of potential emission reductions from appliances



1. Includes insulation

Source: NSW emissions from 2019 AGEIS UNFCC emissions report, adapted to Greater Sydney; McKinsey Sustainability Insights, Energy use in the Australian Residential Sector 1986-2020, web search, expert interviews

In the *Accelerated Net Zero Transition* scenario, all gas consumption in buildings would be replaced by electricity by ~2045. Appliance replacements are likely to happen when a heating or cooking system is being installed in a new build, or at the end of the system's economic life – about 10 to 15 years for most appliances. For that reason, many current gas applications will be 'sticky,' with an estimated 90% of gas-to-electric switching to occur after 2030. To overcome the 'stickiness' of gas, stronger policies are required to prompt consumers to choose to install an electric appliance instead of a gas one at each opportunity. Canterbury Bankstown is already proposing to ban new gas connections in apartment buildings in return for higher densities (see Chart 21).

Actions:

- Set a date for banning gas connections in new buildings (e.g. 2025)
- Ban the sale of new gas appliances by 2030
- Increase energy efficiency standards and labelling (including minimum energy performance standards).

CASE STUDY

Canterbury-Bankstown Council

Canterbury-Bankstown Council is proposing a suite of sustainability measures for new residential, commercial and mixed-use developments in two key precincts in a green initiative it hopes will be a precedent for other councils to adopt.

The proposal aims to deliver high performing buildings through mandatory sustainability measures, including electric only buildings, ensuring at least 40% of roof space is covered by solar panels and mandating a minimum amount of EV parking.

As well as baseline measures, developers can opt into a sustainability incentive scheme and receive additional floor space for achieving higher water and energy efficiency standards.

The move is part of the new masterplans for Bankstown and Campsie, which will help them transform into vibrant hubs of jobs, housing and activity across of a range of low, medium and taller building typologies.

Appian Way Arterial.
Image source: City of Canterbury Bankstown

2.2.Electrify all government owned buildings – hospitals, schools, public housing and office buildings

There is strong momentum with many commercial and government buildings switching to electric appliances – primarily for heating, which accounts for most of the gas use in buildings. Standards such as the NABERS emissions intensity ratings are changing to favour electrification, and buildings seeking a six-star rating under the Green Building Council Australia standards must be all electric. Property developers and asset owners are seeking these ratings to attract higher rents and to meet their own emissions targets.

This momentum is overcoming the fact that many electric conversions have a high upfront cost. Retrofitting infrastructure in commercial buildings often faces steep cost and technical constraints: for example, heat pumps require larger plant rooms and reach lower temperatures than gas boilers. Such constraints can weaken the business case for retrofitting gas boilers with heat pumps, which typically make sense for building owners, given the lower running costs.

Government should lead the way by electrifying all its own buildings, signaling the shift for commercial buildings and fostering an ecosystem of gas retrofit suppliers to service the broader market and reduce costs. Replacing all gas use with electricity in hospitals, schools, public housing and public commercial buildings could reduce Australia's gas consumption by ~10%. Local governments in Sydney are already acting, with the City of Sydney strengthening building performance standards.

Action:

- Introduce incentives and public procurement rules to encourage electrification of public sector buildings including social housing and commercial by 2035
- Introduce incentives and public procurement rules to encourage development of higher performing commercial heating.

WORK UNDERWAY:

Planning for net zero energy buildings

This City of Sydney report looks at how Sydney councils can embed optimum energy efficiency, on-site renewable energy and off-site renewable energy to set a path to net zero in the planning and design process for larger buildings. The report:

- identifies the most appropriate performance standards (or targets) that, if met, can achieve high-performing, net zero energy office, shopping centre, hotel, multi-unit residential, and mixed-use developments (including new and major refurbishments) and that could be incorporated into planning controls. The performance standards are step change improvements in energy performance to transition to net zero energy developments
- summarises the evidence base, including stakeholder engagement and a building scale cost benefit analysis, as well as a broader cost benefit analysis
- recommends approaches to implement the performance standards within the NSW planning system.

Governments can lead the way by electrifying their own commercial and residential buildings.

Image source: Abhiroop Vengal, Unsplash

2.3. Strengthen building performance standards for commercial and residential buildings

Embedding electrification into energy ratings and planning requirements for commercial buildings would add visibility to building emissions and could help to reduce commercial gas use by ~25% by 2030.

Planning requirements such as NABERS and local government development control plans should be strengthened to require buildings use less gas – building on the success of these measures in driving energy efficiency.

Councils including the City of Sydney and Parramatta are already strengthening building performance standards, while the commercial sector is also innovating to reduce carbon emissions in construction and operation.

As with commercial buildings, extending building standards (e.g. NCC, BASIX, local government LEPs and DCPs) would help encourage electrification of existing residential buildings. These standards would impose energy intensity of gas use requirements, particularly if comparisons between gas and electric appliance included the future energy intensity of the grid (which they don't currently).

Strengthening building codes and guidelines, such as the National Construction Code, would also need to improve their focus on passive heating and cooling – and reduce reliance on electricity where possible.

Actions:

- Extend NABERS and BASIX to incentivise electrification of existing buildings (e.g. including the future energy intensity of the grid when comparing gas to electric appliance)
- Strengthen building codes and guidelines for focus on passive heating and cooling – and reduce reliance on electricity where possible
- Update planning instruments (e.g. Exempt and Complying Development, DCP and LEP) to encourage electrification of buildings including provision of incentives.

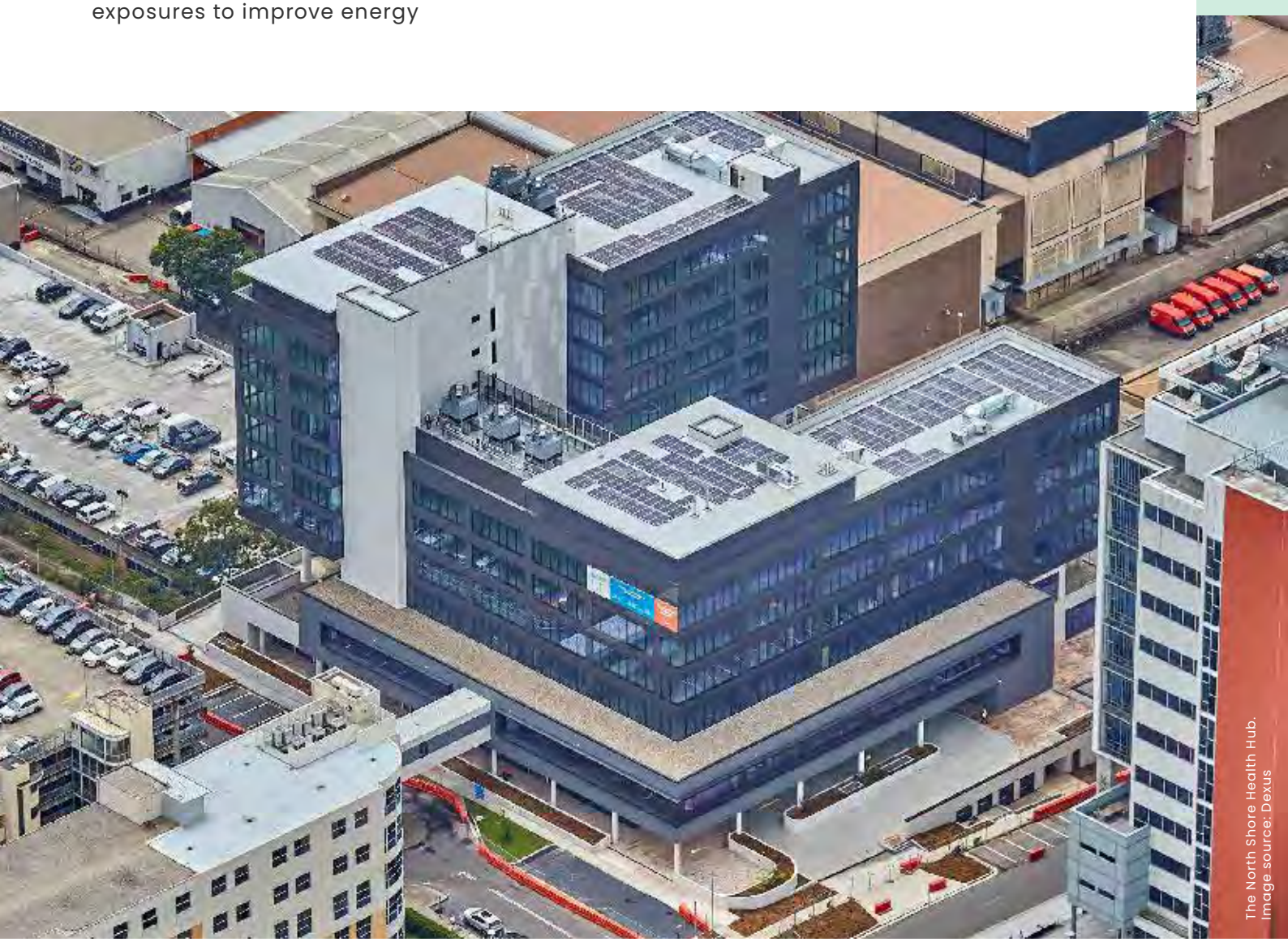
CASE STUDY:

North Shore Health Hub

The Dexus Healthcare Property Fund seeks to accelerate Australia's healthcare property sector to net zero emissions. The North Shore Health Hub has been awarded a 6-star Green Star As Built rating and is designed to achieve a 40% reduction in operational energy usage and greenhouse gas emissions against the 2015 National Construction Code (NCC) baseline.

Passive design features include high performance, low emittance double glazing, specific for different façade exposures to improve energy efficiency. Low emissions transport options integrated into healthcare facilities, such as EV charging and end of trip cycling facilities, are also intended to yield long term energy and environmental benefits.

The North Shore Health Hub's electricity requirements are sourced from 100% renewable sources through a 160kW rooftop solar array together with off-site renewable electricity via a long-term renewable energy power purchasing agreement.



The North Shore Health Hub.
Image source: Dexus

2.4. Mandate disclosure of energy performance of residential homes and apartments at point of sale from 2025

Stronger information, subsidies and regulation are needed to persuade consumers who are reluctant to change from gas to electricity despite long-term cost savings.

Consumers interviewed for this research stated their preference for gas cooking, instantaneous hot water, and gas fire heating, as they reportedly provide a 'nicer' experience and are also 'cheaper'. In fact, heat pump hot water systems and other electric appliances will save money for consumers over their lifetime use and are healthier to use.[22]

A ratings system, similar to the Energy Star rating for appliances, could help residents factor in energy efficiency and gas use into their purchase choices. This is already in practice in other countries, for example, the EU requires an energy performance certificate for any new building, for existing ones that are offered for sale or rent (including renewals), and for all public buildings.

Action:

- Introduce an 'energy star rating' for homes to disclose at sale and rental to accelerate residential switching combined with a targeted awareness campaign.

22 See abatement cost curve Chart 29: negative costs for heat pumps, water heating etc.

WORK UNDERWAY:

Trajectory for Low-Energy Buildings

The NSW Government is working with national, state and territory governments to deliver the Trajectory for Low-Energy Buildings. The trajectory commits to:

- changes to the National Construction Code energy efficiency performance requirements
- implementation of a NatHERS (Nationwide House Energy Ratings Scheme) rating for existing homes
- a Home Energy Performance Disclosure Framework to empower purchasers at the point of sale
- a Minimum Energy Efficiency Requirements Framework for rental properties.

Implementation of the Disclosure Framework will be the responsibility of the states and territories.

The major banks are reportedly interested in providing financial incentives and services, which leverage the data from home energy ratings, and some have already created discounted financial products in this area. However, uptake of home energy ratings must be supported by market capacity to implement home upgrades, as there is a capacity risk that energy assessors and skilled trades cannot meet demand in the market.

Disclosure of home energy ratings can drive energy efficiency investment across the market.

Image source: Endeavour Energy

2.5. Design point of sale incentive for new electric appliances supported by a consumer information campaign

A combination of measures could play a role to encourage home retrofits:

- A direct subsidy at the point of sale, for example a rebate of 10% of the purchase price, could accelerate the retrofit of ~250,000 hot water systems at a subsidy of ~$100, and ~200,000 space heaters at ~$200 subsidy. These subsidies would facilitate carbon abatement at a relatively low cost, estimated at below $10/t CO_2e, while also saving consumers money in the long run (e.g., a heat pump could save consumers ~$400 p.a. on a total cost of ownership basis).[23]
- The NSW Energy Saving Scheme provides financial incentives to install energy efficient equipment and appliances. The rules governing this scheme can be updated to reward more energy efficiency, by considering the future greening of the grid. This would mean that electric appliances would generate less and less carbon emissions over time, while gas appliance would remain largely stagnant. This scheme would require greater knowledge from the consumer to be aware of, and then navigate this scheme.
- Information campaigns could also accelerate residential switching. Information campaigns would help consumers, installers and retailers appreciate the financial, environmental, and health benefits of replacing gas appliances with electric, and the incentive schemes available to consumers.

All these investments would become more attractive to consumers as they install more rooftop solar and batteries in their homes, as discussed in Section 4.

Actions:

- Design point-of-sale incentive for new electric appliances supported by a consumer information campaign, and education campaigns
- Update NSW Energy Saving Scheme rules to reward more energy efficiency (considering the future greening of the grid)
- Incentives for installers and retailers to accelerate gas-to-electric conversions.

23 Calculated considering all upfront and ongoing costs of owning the appliance. The capital cost is spread over the life of the appliance using a discount rate of 4% and is added to running costs of the appliance (e.g., fuel costs).

CASE STUDY:

Energy Bill Buster program

Around a third of NSW households currently receive an energy rebate to help with their energy bills.

The Energy Bill Buster program will allow eligible households to receive the equivalent of up to 10 years' worth of rebates in an upfront lump sum contribution towards a free solar system or home appliance upgrade.

Eligible households can apply to get a free solar system that can save them up to $600 each year, instead of the annual $285 Low Income Household Rebate.

The Energy Bill Buster program follows the NSW Government's efforts to increase the number of vouchers available under the Energy Accounts Payment Assistance scheme by 25% to $400 per transaction for 30,000 households struggling to pay their electricity and gas bills.

Low-income households can install rooftop solar and batteries through a NSW Government subsidy.

Image source: Ausgrid

III. Increase adoption of distributed energy resources

Image source: Endeavour Energy

Distributed energy resources (DER) include rooftop solar, batteries and storage, as well as demand management technologies. DER has the potential to play a strong role in decarbonising household power use, especially while grid-scale power remains relatively emissions-intensive. Until 2030, up to 10% of building-related emissions reduction will come from the uptake of DER in the *Accelerated Net Zero Transition* scenario.

Three forms of related technology make up the package of DER available for a residential or commercial site – rooftop solar, storage, and smart meters – and each has its own set of benefits and adoption challenges:

- Rooftop solar currently provides ~1GW of zero-emissions electricity across Sydney, or ~5% of the metropolitan area's electricity needs. Australia has the world's highest adoption of residential rooftop solar. Across Sydney, about 18% of dwellings now have a rooftop solar system, and over the last decade, rooftop solar installed capacity has grown by ~35% per year. Installing rooftop solar is essential to reduce peak demand in the summer heat – on very hot days, air-conditioners can double residential peak demand. While rooftop solar is becoming more common in commercial and standalone residential buildings, we need to increase uptake in apartments and rental properties.
- Storage technologies make electricity available when it is needed. On days where demand is less than the solar energy being generated, battery storage is needed to soak up excess supply so it can be used when the sun goes down and demand goes up. By reducing peak demand on the distribution network, battery and hot water storage also reduce the need for network capacity upgrades (see Section 4).
- Batteries are the best known and highest capacity storage technology, but off-peak electric and heat pump hot water systems can also use daylight solar energy to heat water for use in the evening peaks. Both have high upfront costs, but low running

costs and emissions when used with rooftop solar. While battery costs have stalled or even gone up again after a decade of falling rapidly, for most private purposes there is still no clear financial case to buy a system large enough to go 'off-grid.' That case could be improved with subsidies, changes to tariffs, or shared resources such as community batteries. Without such reforms, the community as a whole risks over-investing in rooftop solar and under-investing in batteries. The more rooftop solar we have, the more batteries and storage technologies will be required to shift the rooftop solar supply to help meet evening demand, when the distribution network is close to its peak and wholesale electricity costs are higher.

- Smart meters and other 'demand response' tools help optimise the use of rooftop solar-generated energy, with benefits to both the system owner and the distribution network. Smart meters also help users track the efficiency of these large energy appliances, and the best time to use them.

Together, distributed energy resources can have a positive impact on the distribution grid, provided investment in rooftop solar is matched by investment in storage and smart meters. By increasing how much energy is generated and used locally, Sydney can accelerate the use of clean energy, and reduce how much distribution infrastructure is needed as both population growth and electrification increase the demand for energy over coming decades.

Alongside DER, energy efficiency will continue to reduce the volume of electricity and gas consumed, especially in peak times, helping consumers save on their energy bills.

By reducing peak demand on the distribution network, battery and hot water storage could reduce the need for network capacity upgrades.

RECOMMENDATIONS

3.1 Support energy export by integrating large rooftop solar output with local electricity networks

The capacity of rooftop solar on commercial buildings has risen by ~43% per year in the last five years, and strong growth is likely to continue. Rooftop solar is ideal for commercial buildings with plenty of roof space relative to their floorspace – shopping centres, carparks, warehouses, industrial sheds, manufacturing plants and other low-rise commercial buildings.

This is already occurring at scale in Australia, for example, IKEA is installing large scale solar systems on all its Australian stores and intends to meet 100% of its energy needs by 2025, and Sydney Water is targeting the production of 16.5GW of electricity through solar power (see Chart 22).

As panel costs continue to fall, owners and long-term renters of commercial buildings are finding the financial case more compelling, particularly in the common case when rooftop generation aligns with the working day energy use in the building underneath. Long-term commercial lessees can negotiate an agreement with the property owner to take electricity 'behind the meter,' alongside an agreement with the distribution network/ retailer to sell excess power.

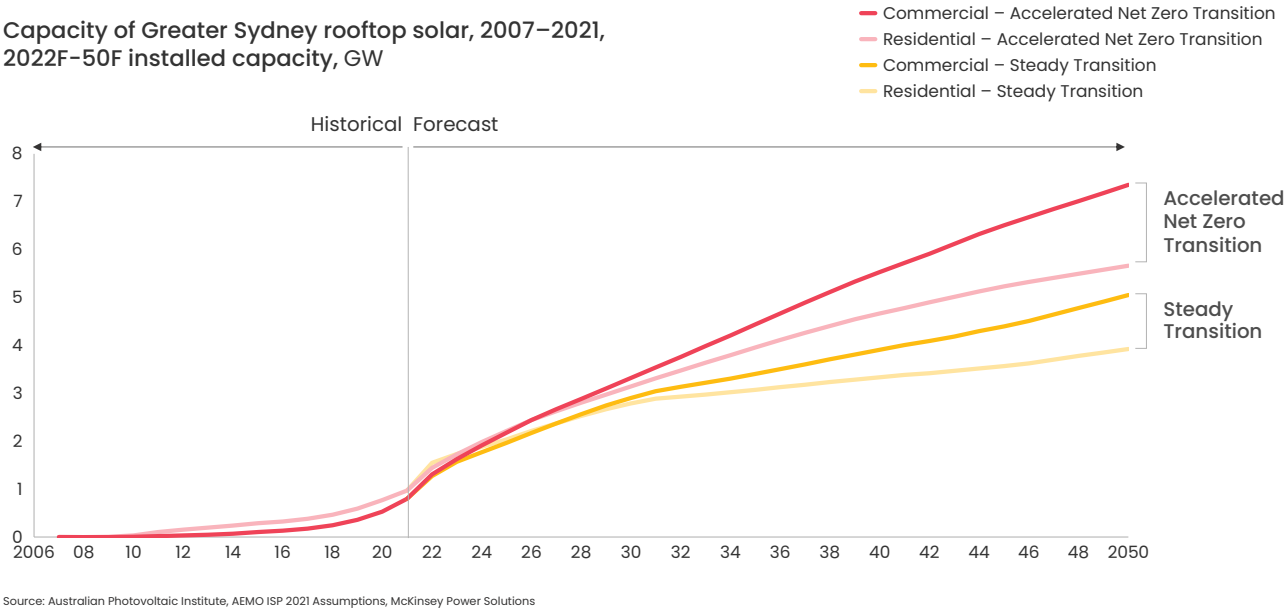
However, electricity that exceeds the building's requirements needs to be paired with battery storage to create local microgrids and virtual power plants (VPPs), and prevent solar production being turned off.

The key issue for commercial buildings, therefore, is the need to ensure the large rooftop solar output is integrated with local electricity networks to support energy export. Approaches such as peer to peer trading can provide a mechanism to allow the excess production of one consumer to be traded with another nearby consumer.

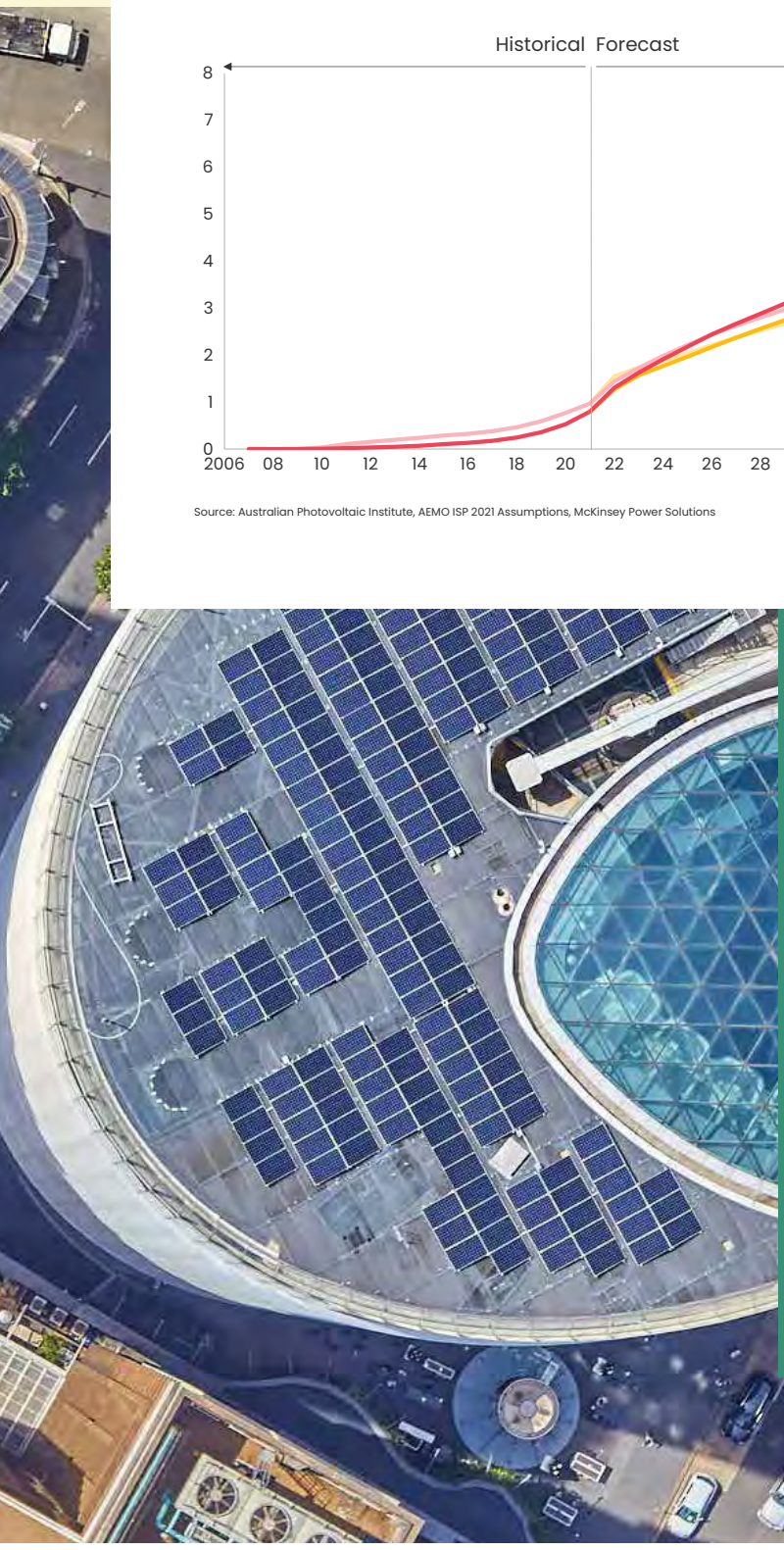
Action:

- Ensure large rooftop solar output is integrated with local electricity networks to support energy export.

Chart 22: Rooftop solar adoption needs to increase ~45% to meet net zero targets



Source: Australian Photovoltaic Institute, AEMO ISP 2021 Assumptions, McKinsey Power Solutions



As panel costs continue to fall, owners and long-term renters of commercial buildings are finding the financial case more compelling, particularly in the common case when rooftop generation aligns with the working day energy use in the building underneath.

CASE STUDY:

Sydney Water

Sydney Water is continuing to increase its renewable energy generation capacity with the installation of more than 800 solar panels at two treatment plants in the Illawarra – at the Wollongong Water Recycling Plant (631) and the Shellharbour Wastewater Treatment Plant (250).

Combined, these panels will produce 630KW of power to supply the plants, making this the largest roll-out of solar panels to date across Sydney Water's network. The addition of this solar power is another way Sydney Water is continuing to integrate renewable energy generation into its operations, which includes a target to produce 16.5GW of electricity through solar power.

Electricity that exceeds the building's requirements needs to be paired with battery storage to prevent solar production being turned off.

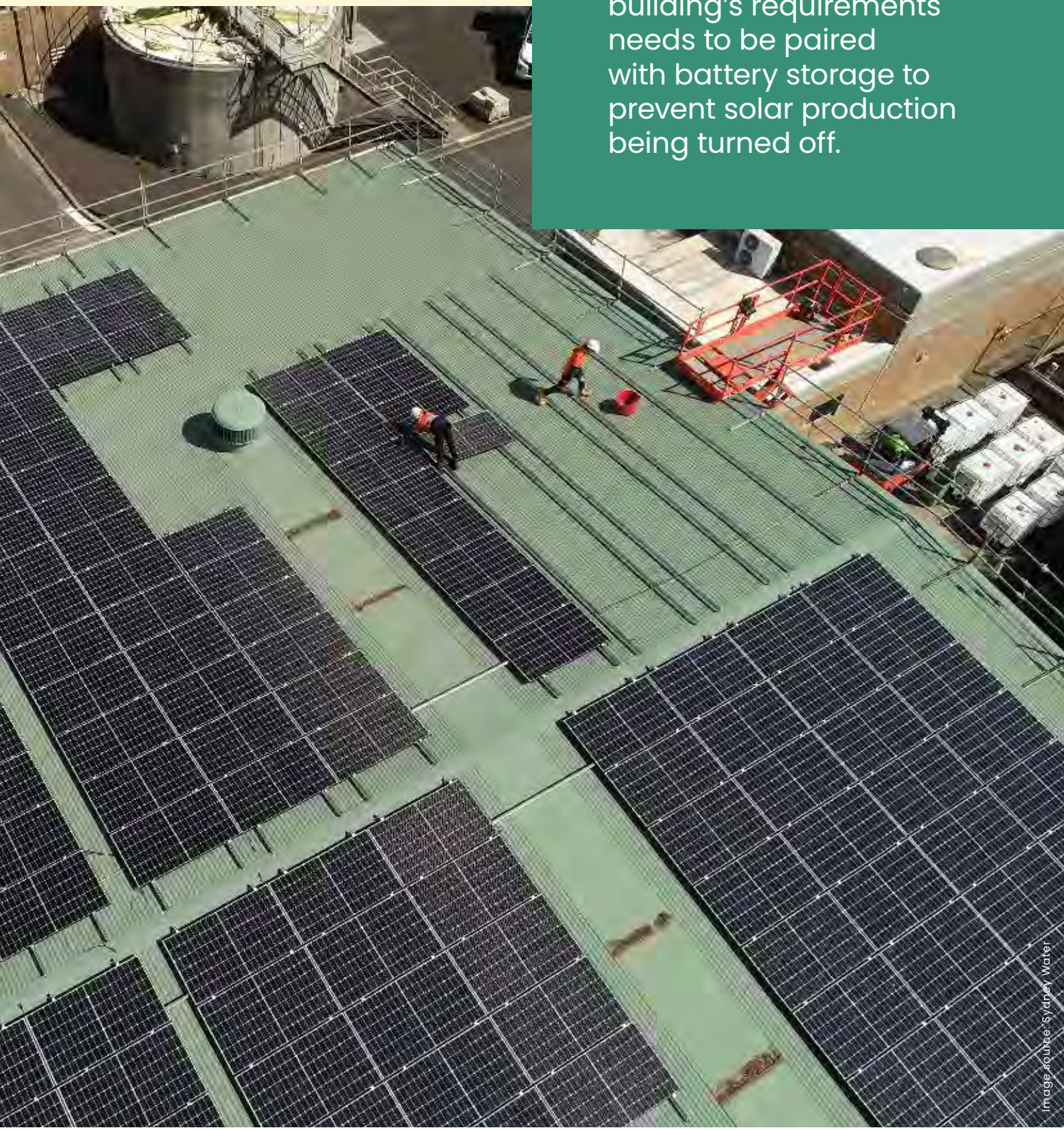


Image source: Sydney Water

3.2 Expand rental and apartment access to rooftop solar and battery storage

With ~18% of Sydney's dwellings already having rooftop solar, the goal of reaching ~22% by 2030, as the *Accelerated Net Zero Transition* scenario proposes, should be achievable. This adoption would be reached by continuing installations on freestanding owner-occupied dwellings, for which the financial case is very strong.

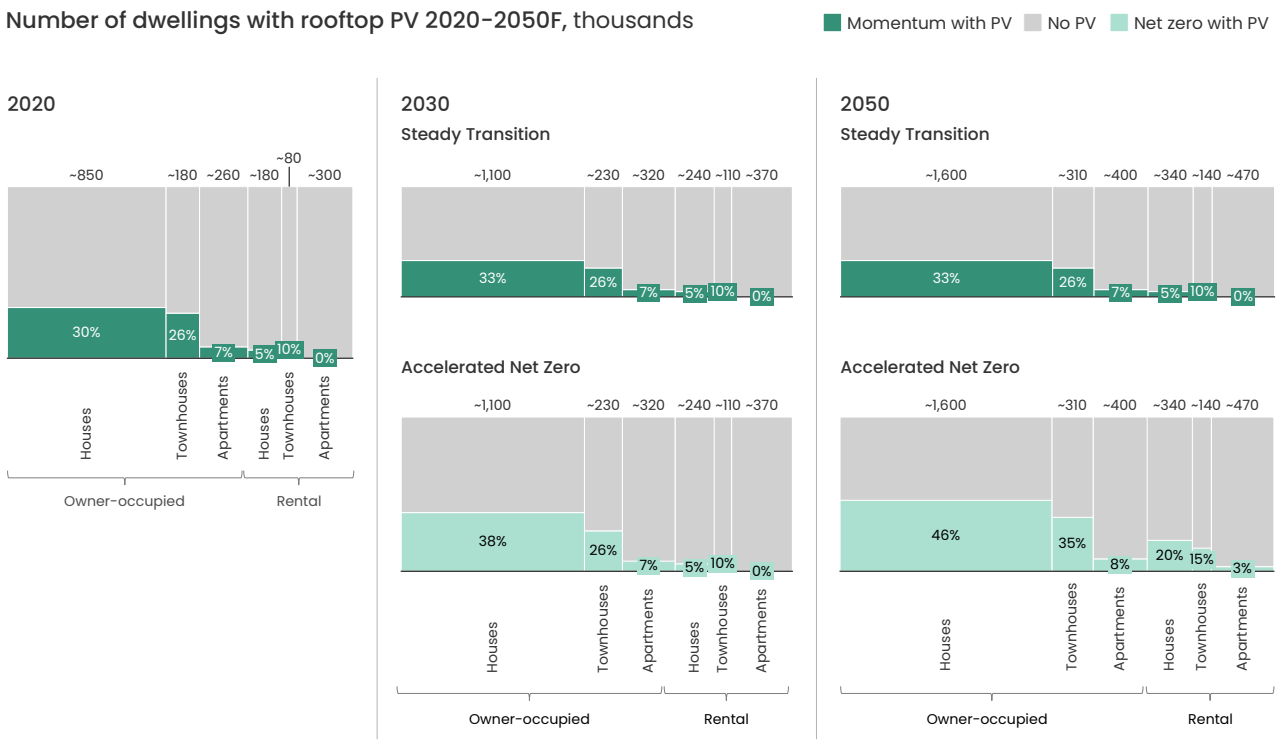
The challenge will be to add enough rooftop solar for Sydney to reach net zero by 2050. For that, more rooftop solar is needed on rented dwellings and apartments. In the *Steady Transition* scenario, ~30,000 rental dwellings would add rooftop solar, but ~100,000 are needed for the *Accelerated Net Zero Transition*. Similarly, about 25,000 rooftop solar systems are projected for apartment buildings in the *Steady Transition*, but 50,000 would be needed by 2050, of which ~15,000 would be rental (see Chart 23).

One barrier to overcome for installing rooftop solar on rented dwellings is property owners typically incur the capital cost of installation while tenants reap the savings. Another challenge to increase rooftop solar is the limited space on residential apartment rooftops.

Potential solutions to overcome these barriers and challenges include:

- Financial packages for rebates or interest-free loans for property owners tied to rental agreements that include electricity use
- Incentives to solar installers and property managers for sourcing those agreements between property owners and their tenants
- Accessing community batteries on low-rise commercial or public buildings, which would also help lower income households access solar
- Regulation that stops strata bodies from being able to prevent solar installations under reasonable circumstances.

Chart 23: To achieve rooftop solar adoption in Accelerated Net Zero Transition scenario, higher proportions of rented properties will likely need solar



Source: McKinsey customer interviews (n=16, of which 3 had rooftop PV installed), ABS 2016 census data; ECSS Behaviour Survey, Australian Photovoltaic Institute, AEMO ISP 2021 Inputs and Assumptions, NSW DPE Population and Dwelling Forecast

Actions:

- Expand solar for low-income housing program to increase uptake and complement with energy efficiency incentives to reduce energy costs
- Use incentives to accelerate the uptake of rooftop solar and distributed battery storage, including through the NSW Government Peak Demand Reduction Scheme
- Introduce mechanisms to encourage property owners to install rooftop solar in rented properties (e.g. rights for tenants to access rooftop solar, incentives for installers to install panels in rented dwellings)
- Update strata rules to make it easier to install apartment solar systems
- Coordinate with government on grid requirements for EV charging infrastructure and rooftop solar/ storage installation.

3.3 Set a target for battery storage adoption to reach ~2.7 GWhs by 2030

Key remaining barriers to the adoption of home batteries are cost and awareness. Of the Sydney residents interviewed, most were unaware of home battery technology and its benefits. Those who were aware consider it too expensive, with an upfront cost >$10,000 and a long payback period (likely more than 10 years) depending on home energy use and configuration.

Community batteries are an alternate to the household battery. Community batteries allow a much larger storage resource to be accessed by multiple households, which minimises the system cost, as the same service can be provided to the consumer at a lower cost.

In the *Accelerated Net Zero Transition* scenario, Sydney accelerates its adoption of both private and community batteries. To date, adoption of residential storage has lagged far behind the adoption of rooftop solar: in 2020 less than 4000 or ~0.2% of homes had batteries, with a total capacity of <0.1 GWh. For an *Accelerated Net Zero Transition*, that needs to rise to ~2.7 GWh, which is equal to ~10% or ~180,000 dwellings by 2030. By 2050, this will need to accelerate further to ~12.3 GWh, about 170% more systems than would need to be installed in a *Steady Transition*.

Therefore, a commitment to distributed battery storage as part of the energy transition should be a focus for action:

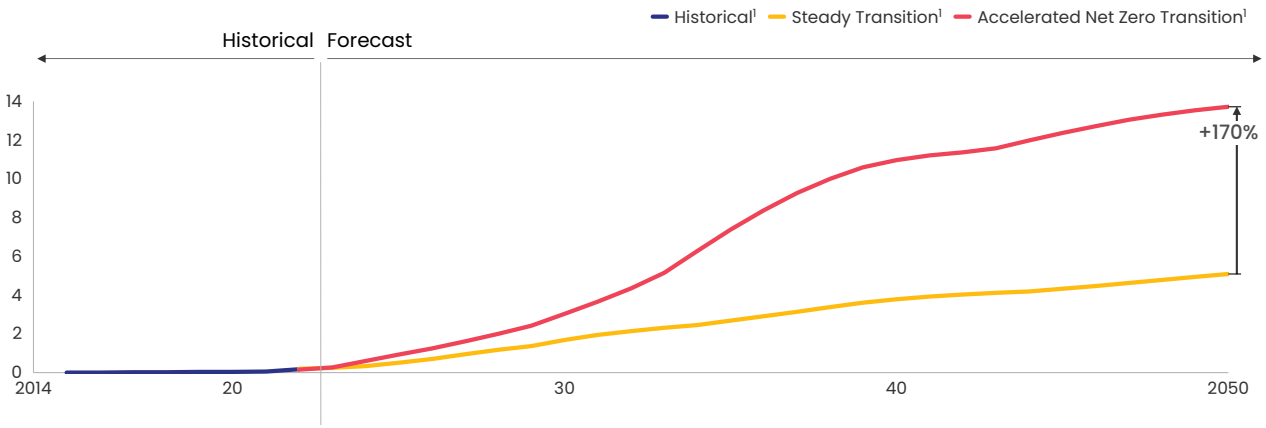
1. Set a clear target for the capacity of installed batteries, combined with a development roadmap that balances cost considerations, technological maturity and commitment to the solution
2. Incentivise local battery manufacturing capabilities to increase supply and help overcome cost and supply chain issues
3. Reduce regulatory barriers to cost-efficient deployment and operation of shared battery capacity with retailers, networks, and residential and business consumers
4. Develop the domestic software and energy management capabilities needed to manage the transition to a more volatile energy system with resilience to cyber-attacks.

Action:

- Set a target and roadmap for battery storage adoption to reach ~2.7GWhs by 2030.

Chart 24: Battery installations would have to ramp up to 17% per year (compound annual growth rate) to reach 40% of dwellings by 2050

Storage capacity of small-scale battery systems in Greater Sydney, 2007–2021, 2022F–50F installed storage capacity, GWh



1. 2014-2021 historical installs from Clean Energy Regulatory and forecast storage capacity from AEMO ISP 2021 Steady Progress (for Steady Transition) and Step Change (for Accelerated Net Zero) scenarios. Assumes regional allocation as per AEMO scenarios, and average system size of 13.5kWh in 2021, growing by 1% p.a.

Source: AEMO ISP 2021 Assumptions, Clean Energy Regulator

Image source: Ausgrid

Community batteries allow a much larger storage resource to be accessed by multiple households.

CASE STUDY:

Ausgrid community battery program

Ausgrid worked with the community to design a battery program to provide tangible benefits for households, with and without rooftop solar.

Ausgrid rolled out three batteries in Beacon Hill, Bankstown and Cameron Park, which allow households with solar to virtually store up to 10KWhs of electricity for which they receive a credit, reducing electricity costs. The areas chosen have a high adoption of rooftop solar, meaning these batteries can assist with grid stability, providing a flexible alternative to traditional network investments.

Given the potential six-fold increase in rooftop solar, community batteries can support an increase in renewable energy by playing a valuable role in maintaining the stability of the grid, while providing benefits for all users.

Community batteries can support an increase in renewable energy.

Image source: Ausgrid

3.4 Accelerate adoption of electric solar hot water through direct purchase subsidies, tariffs and operating incentives

Beyond batteries, other DER technologies can increase the utilisation of electricity produced by rooftop solar during the day, referred to as 'solar soaking.' While these technologies are not able to store electricity to directly offset electricity use when the sun is not shining (like a battery), they shift the use of energy from night to day. These technologies include solar hot water (described below) and demand management (often facilitated through a home energy management system) to move evening loads to the daytime. As such, they offer some of the benefit of a battery at a much lower cost.

Electric solar hot water has the potential to expand low-cost access to energy storage. These systems use electricity generated in rooftop solar during the day to heat water, and then store this heat to be used overnight. As such, they can maximise the soaking of solar during the day and reduce a household's peak consumption. There are ~500,000 electric storage hot water systems installed across Sydney.

To accelerate adoption, a combination of incentives and regulatory changes are required.

Direct purchase incentives. Point of sale rebates that make electric hot water cheaper than its gas equivalents would support the installation of the up to 2.7GWhs of battery storage needed through to 2030 (in the *Accelerated Net Zero Transition*). Any incentives should also target community batteries to expand the benefits to rental or low-income residents.

Tariffs and other operating incentives. The financial case for electric hot water is improved when paired with solar to encourage more self-consumption. The economics of batteries is improved by reducing feed-in tariffs, curtailing rooftop solar generation in periods of low demand, and increasing peak tariffs.

Targeting high value consumers such as those with controlled load hot water. Electric water heaters are one of the largest electricity using appliances in a typical home and present one of the biggest opportunities for peak demand reductions in the residential sector. Electric storage water heaters can be heated in off peak times and then stored in an insulated tank for usage at peak times, which creates a significant opportunity when water heating is paired with rooftop solar during the day. As more hot water heating shifts from gas to electric, the need to manage peak demand will grow.

Planning regulations to mandate distributed energy resources (DER). Changes to the BASIX framework might mandate batteries and smart meters in new freestanding homes, apartment blocks and other favourable use settings.

Actions:

- Use incentives to accelerate the uptake of electric hot water, and other storage options including through the NSW Government Peak Demand Reduction Scheme
- Update BASIX to recognise the value of Distributed Energy Resources.

CASE STUDY:

Ausgrid hot water trial

Hot water accounts for at least a quarter of an average Australian's household energy use.

Ausgrid manages some 450,000 customer hot water tanks, generally charged over night at low off-peak rates, saving money for the customers and avoiding additional peak load for the network. This has traditionally worked well, but with rapid changes in the energy mix from large-scale renewable generation and more customers becoming generators via rooftop solar – we need to find more flexible solutions.

Ausgrid and their partner PLUS ES conducted a trial that used customers' hot water tanks as a solar soak for their excess solar generation. This involved switching on the tanks mid-morning and switching off in the early afternoon to coincide with solar generation. The tanks were managed via the household smart meter.

Electric solar hot water can save consumers money on energy bills.

Image source: Freepik

3.5 Require all new homes to install distributed energy resources

Post-2025, Sydney should mandate rooftop solar, solar hot water and smart meters in new freestanding homes, apartment blocks and other favourable use settings. A household or community battery connection should also be required. One finding from this report is that if households implement managed demand, energy efficiency and DER, the impact of EV charging will only increase a typical residential peak by 10% (see Chart 25).

In California, which has ~85% of America's battery capacity,[24] new single-family homes must include rooftop solar, and new multi-family buildings must include rooftop solar and batteries. These requirements are based on the floor area of the home and the climate zone, and there may be exceptions to the mandate, like a property being too shaded or having too small a roof to install solar panels.

Shellharbour City Council on the NSW south coast has proposed to become the first local government area in Australia to mandate rooftop solar on all new buildings constructed in the region.

Sydney could adopt similar policies and extend them to include hot water electrification, demand response tools, and access to battery storage. All these initiatives could be drawn on to accelerate DER uptake across Sydney's building stock to support management of peak and minimum demand.[25]

Actions:

- Require all new homes to install solar from 2025
- Require all new apartment buildings to have rooftop solar and storage from 2025
- Actively promote demand management in all its forms, including incentives to accelerate take-up of best practice energy conservation approaches.

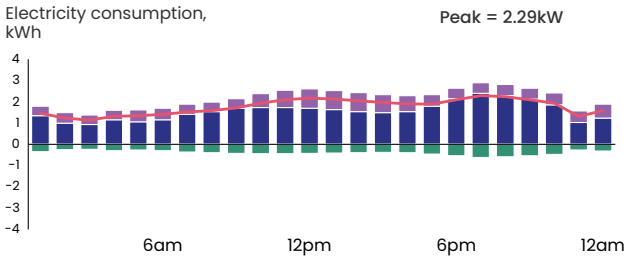
24 Source: California Distributed Generation Statistics
25 These enablers have been considered to support the uptake of ~13 GW of rooftop PV and ~12 GWh of battery capacity by 2050, however, the impact individual enablers has not been sized.

Chart 25: The combined effect of managed demand, energy efficiency and DER mean that EV charging will only increase a typical residential peak by ~10%

Typical household winter load profile, with the impact of energy efficiency, heating, rooftop solar, EV charging and storage

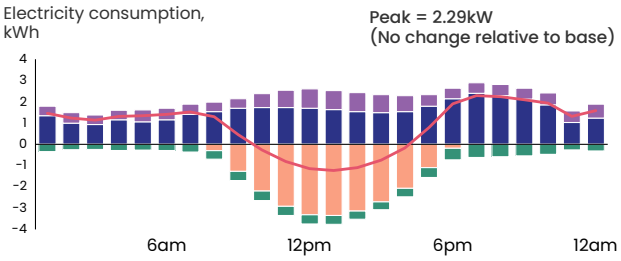
Base · Heating · EV · Grid[1]
EE · Distributed solar · Storage

1. Base (electricity consumption with EE[2] and heating)
Total consumption: 38kWh/day



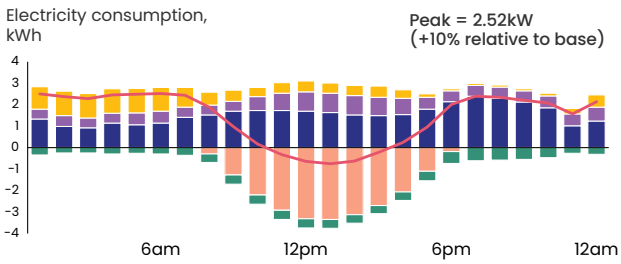
Dwellings consume **~38kWh daily**[3]
Energy efficiency measures can decrease consumption by up to **25%**
Space heating and water heating on a cold day can increase daily consumption by **30%**

2. Base + rooftop PV
PV: 7kW



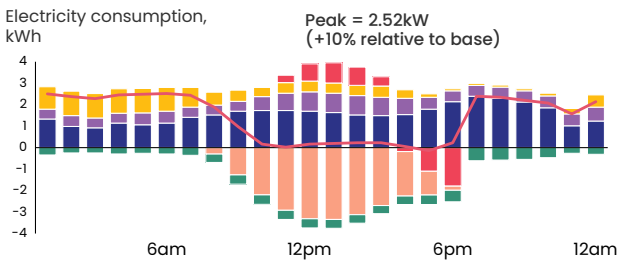
Rooftop PV can absorb **~60%** of energy demand
Excess energy is resold to the grid during the middle of the day

3. Base + rooftop PV + EV charging[4]
EV: 40km/day



EV charging can absorb part of the solar generation
Managing EV charging reduces peak household demand by **1.1kW**

4. Base + rooftop PV + EV charging[4] **+ home storage**
Storage : 10kWh (inc. battery and hot water storage)



By pairing battery storage with distributed rooftop PV, excess production can be used in the evening, reducing feed-in and reduces grid dependency

1 Net electricity consumption, positive means demand from the grid, negative means export to grid
2 EE = energy efficiency
3 Assume three-person dwelling
4 Assumes managed EV charging, as per AEMO 2021 ISP Step Change Assumptions

Source: Ausgrid, AEMO 2021 ISP, Australian PV Institute, McKinsey Power Solutions

3.6 Implement controlled charging and explore vehicle to grid technology to enable EVs to become DER assets

A recent trial showed electric cars could increase demand on the power grid during the evening peak by at least 30%. This means that controlled or 'smart' charging will be needed to ensure EVs don't have a significant impact on peak demand.[26]

EV charging during the solar peak is another great option for households looking to maximise the benefits of their excess generation. The development of vehicle to home and vehicle to grid options will play a key role on both the demand and supply side of energy, and help reduce the potential impact of EV charging on peak demand. By the time Sydney has 850,000 EV passenger vehicles on the road, there could be approximately 6GW of additional flexible storage capacity in those EV batteries.

Vehicle to grid (V2G) is not modelled but could also play a role in DER. Vehicle to grid presents the potential to reduce peak demand as electric vehicles are used to supply electricity into the grid from their batteries. While this opportunity presents upside, the technology pathway is still uncertain and payback to consumers is unknown given need for payment to vehicle owners needing to offset the potential for battery degradation.

Action:

- Implement controlled charging and explore vehicle to grid technology to enable EVs to become DER assets.

26 www.abc.net.au

Vehicle to grid: electric vehicle battery services

Similar to residential batteries, electric vehicle batteries have the potential to power homes and provide grid services. Customers need to install a special home charger that can draw electricity from the battery to supply it elsewhere. A great example is using solar to charge the vehicle during the day and then discharge it at night to your home.

It is early days with EV battery services, but there is promising news from overseas. In the UK, a three-year trial for over 300 households had the following main findings:

- Customers could earn as much as AUD$1250 per year by keeping their cars plugged in when not in use
- Vehicle to grid has the potential to save AUD$6 billion per year because of the support it offers during periods of increased demand
- By 2030, the UK could have 22TWhs of flexible EV discharging capacity that could provide ~16GWs of daily flexible power to the grid.

Australia is at the beginning of adopting this technology, with the first V2G charger going on sale in February 2022. Despite the slow start, several trials are now underway, the largest of these in the ACT is similar in scope to the UK trial. As more vehicles and compatible equipment come to market, V2G is likely to be a realistic option for Australian households.

Vehicle to grid is an emerging technology.

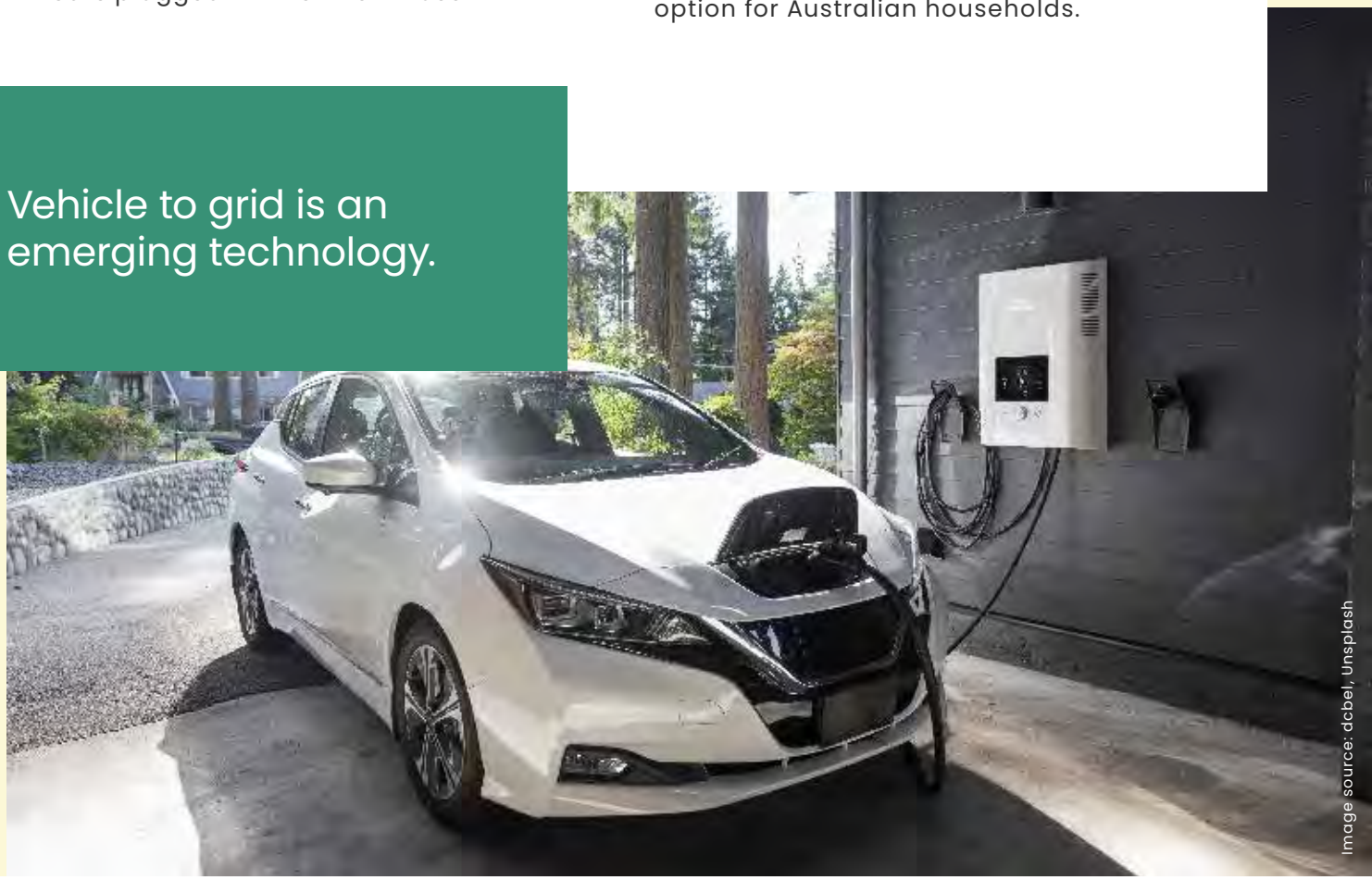


Image source: dcbel, Unsplash

IV. Invest in distribution to handle the transition

Image source: Ausgrid

In an *Accelerated Net Zero Transition*, both total electricity demand and peak electricity demand are projected to grow.

Historically, the distribution network has expanded poles and wires to ensure that the supply of electricity can meet Sydney's growing demand.

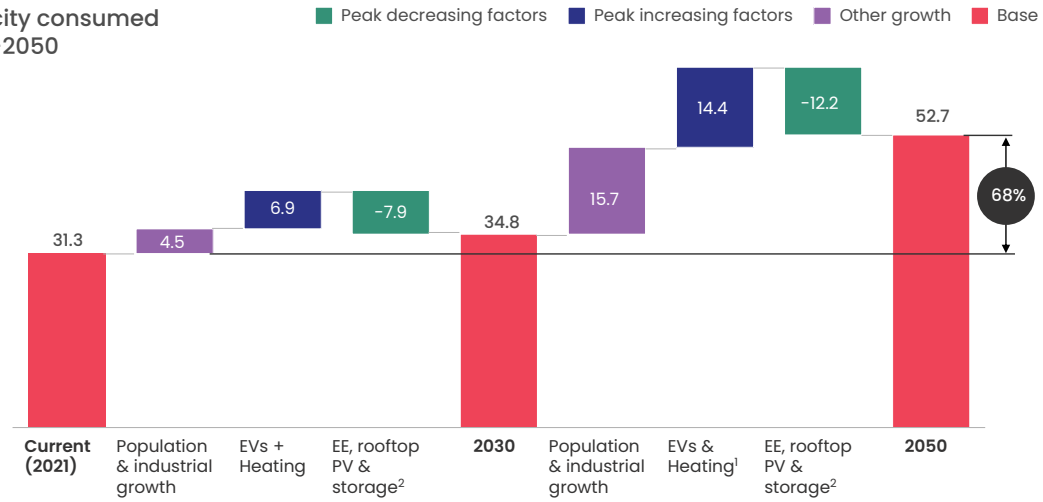
In the future, the more of Sydney's electricity demand that can be met by decentralised energy resources – through the accelerated rollout of rooftop solar and battery storage, continued energy efficiency and managed demand strategies – the less additional electricity needs to be brought in from large scale energy generators.

In an *Accelerated Net Zero Transition* total demand is forecast to grow ~10% by 2030 (a 35TWh increase), and ~68% by 2050 (a 53TWh increase). Total demand will increase due to:

- population growth
- use of electricity for industrial processes
- electrification of vehicles and building appliances (especially heating)
- and will be offset by rooftop solar, battery storage and energy efficiency (see Chart 26).

Chart 26: Total electricity consumption is projected to rise by ~22TWh (68%) in the Accelerated Net Zero Transition

Projection of electricity consumed from the grid, 2030–2050
Grid volume, GWh



1. EVs include electric passenger vehicles, Light commercial vehicles, trucks, buses, coaches. Heating include electric water heating and electric space heating; 2. EE: energy efficiency from building

Source: Ausgrid, Endeavour, McKinsey Net-zero Trajectory, McKinsey Center for Future Mobility, McKinsey Power Solutions

Image source: Endeavour Energy

Equally, demand for electricity at peak times is set to grow faster than total demand as this additional demand (from population increases, EV charging, and heating), coincides with existing demand peaks in the early evening. With efforts to manage demand (from rooftop solar, battery storage and energy efficiency), the *Accelerated Net Zero Transition* projects peak demand is forecast to grow by 24% in 2030, and then double (103%) to 13.4GW in 2050 (see Chart 27).

However, growing rooftop solar can also bring its own challenges for distribution networks. As rooftop solar provides more and more electricity during the middle of the day, the demand for energy from the grid at that time is falling. This falling daytime minimum demand creates challenges for the stability of a grid that was originally designed to distribute energy from centralized power plants. Networks designed for one way flows of energy may now need to manage complex two-way flows as rooftop solar flows back into the grid.

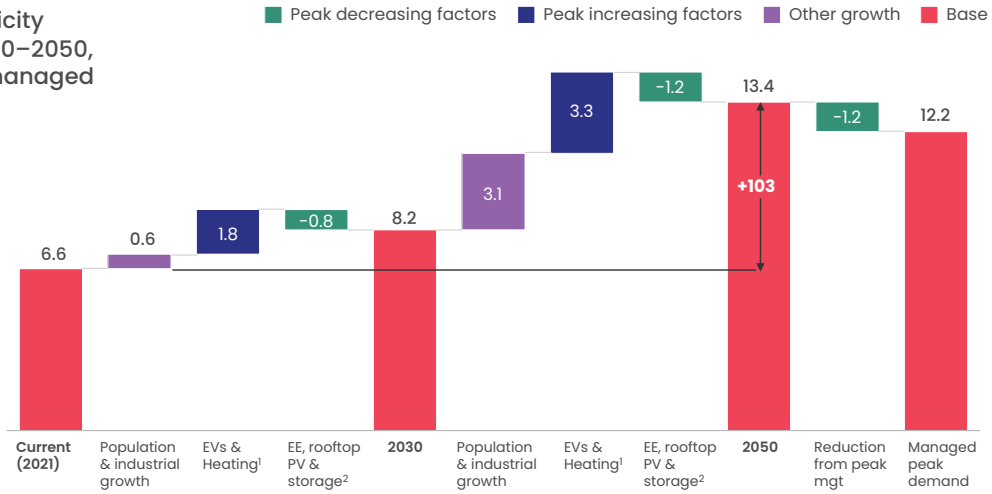
The adoption and successful integration of decentralised energy resources (discussed in Section 3) can potentially reduce customer costs, provided there is adequate investment in the technology itself and the distribution network's capability to manage it.

This section sets out the priorities ahead for Sydney's distribution network, and the investments needed to manage both peak and minimum demand, and the growing adoption of distributed energy resources.

Chart 27: In the Accelerated Net Zero Transition, demand management could reduce peak demand by 1.2GW (9%) in 2050

Projection of peak electricity demand on the grid, 2030–2050, both managed and unmanaged demand

Grid peak demand, GW



1. EVs include electric passenger vehicles, Light commercial vehicles, trucks, buses, coaches. Heating include electric water heating and electric space heating; 2. EE: energy efficiency from building

Source: Ausgrid, Endeavour, McKinsey Net-zero Trajectory, McKinsey Center for Future Mobility, McKinsey Power Solutions

Networks designed for one way flows of energy may now need to manage complex two-way flows as rooftop solar flows back into the grid.

Image source: Ausgrid

RECOMMENDATIONS

4.1 Develop innovative tariffs to encourage and reward customers, and increase demand response

Image source: Nicolas Gonzalez Unsplash

Demand management can reduce the 2050 peak electricity demand by at least 1.2GW (9%). Savings from managed demand are critical but will not be easy to secure and will required a coordinated response and buy-in from consumers.

Keeping peak demand to a minimum is critical to keeping network upgrade costs low. Consumers are offered time-of-use tariffs as an incentive to shift their electricity use off the peaks, and benefit in lower electricity costs if network costs are lower.

Network operators already collaborate with consumers to manage peak demand, through off-peak hot water as well as off-peak tariffs. Once a consumer signs up for off-peak hot water, the operator controls the appliance for that to occur. Networks are currently running trials to expand the use of hot water tanks to absorb excess solar generation.

CASE STUDY:

Endeavour Energy's PowerSavers

Peak demand only happens a few days a year, which means the extra infrastructure required to respond to the peak remains unused the rest of the time.

Rather than building and maintaining additional electricity network to accommodate infrequent peak demand, a more sustainable approach is to seek ways to reduce demand for electricity during peak periods.

Endeavour Energy has developed this demand flexibility program to help customers explore how they can unlock value of their DER. The program allows participation of a wide range of DERs, including smart thermostats for split air conditioners, EV chargers, hot water systems, rooftop solar and residential batteries to support the network. PowerSaver helps Endeavour Energy work with its customers to lower energy consumption, save money and reduce emissions.

Programs like PowerSavers are being trialed across Sydney to lower energy consumption, save money and reduce emissions.

Image source: Endeavour Energy

There are further opportunities for households and businesses to shift their electricity demand away from the morning and evening peaks, supported by a change in the way networks operate:

- Controlled electric vehicle charging: peak demand would be reduced by 0.8GW if electric vehicles were charged around midday when rooftop solar is generating an energy surplus (or other periods with ample supply, e.g. windy nights), rather than plugging vehicles into the grid at the end of the working day.
- Retail demand response programs: peak loads can be further reduced via retail demand response programs such as managing customers air conditioners.
- Distributed System Operator model: development and implementation of a Distributed System Operator (DSO) model will be needed to increase access to renewables and the emerging market for demand response and flexible services.

While managing demand is essential for keeping network costs and electricity bills low, implementation cannot be taken for granted. All the changes discussed in this and preceding sections are needed: customer behaviour change, tariff reform, smart meters, continuous data exchange between consumers and operators, and network upgrades.

Actions:

- Develop innovative tariffs to encourage and reward customers (e.g., dynamic tariffs)
- Create the right settings and standard to increase access to the emerging market for demand response
- Support the development of Distribution system operator models for networks to maximise the use of renewables and network infrastructure.

Centralised to decentralised via 'distributed system operator'

Distributed system operators' can dynamically manage and operate the network.

The distributed system operator' or DSO model recognises an important transition of distribution networks from a simple one-way flow of energy (where large coal, gas or renewable generation send power through the grid to homes and businesses) to a more complex system of bi-directional flows (where the users of energy, millions of households and businesses across the city, can now generate and store their own power, and send any excess generation back into the grid). Experience from the UK suggests coordinating these millions of distributed energy resources will require distributed approaches. To facilitate this, distribution network service providers are transitioning to 'distributed system operators' to dynamically manage and operate the network, while optimising value to customers.

This new model can also help defer traditional network costs, for example, the DSO procures flexible services rather than building out the network in constraint areas. The Australian Energy Market Operator (AEMO) is currently considering reform in this area.

Image source: Endeavour Energy

4.2 Plan and implement grid upgrades to manage peak demand in population growth corridors

The biggest growth in peak demand is forecast in the population growth corridors through the city's northwest, west and southwest, as well as the Parramatta CBD.[27] Distribution networks will need to work with state and local governments to plan and implement grid upgrades, particularly in areas where peak demand will grow significantly, such as west and southwest Sydney, and where peak demand will be highest across the Sydney and Parramatta CBDs (see Chart 28).

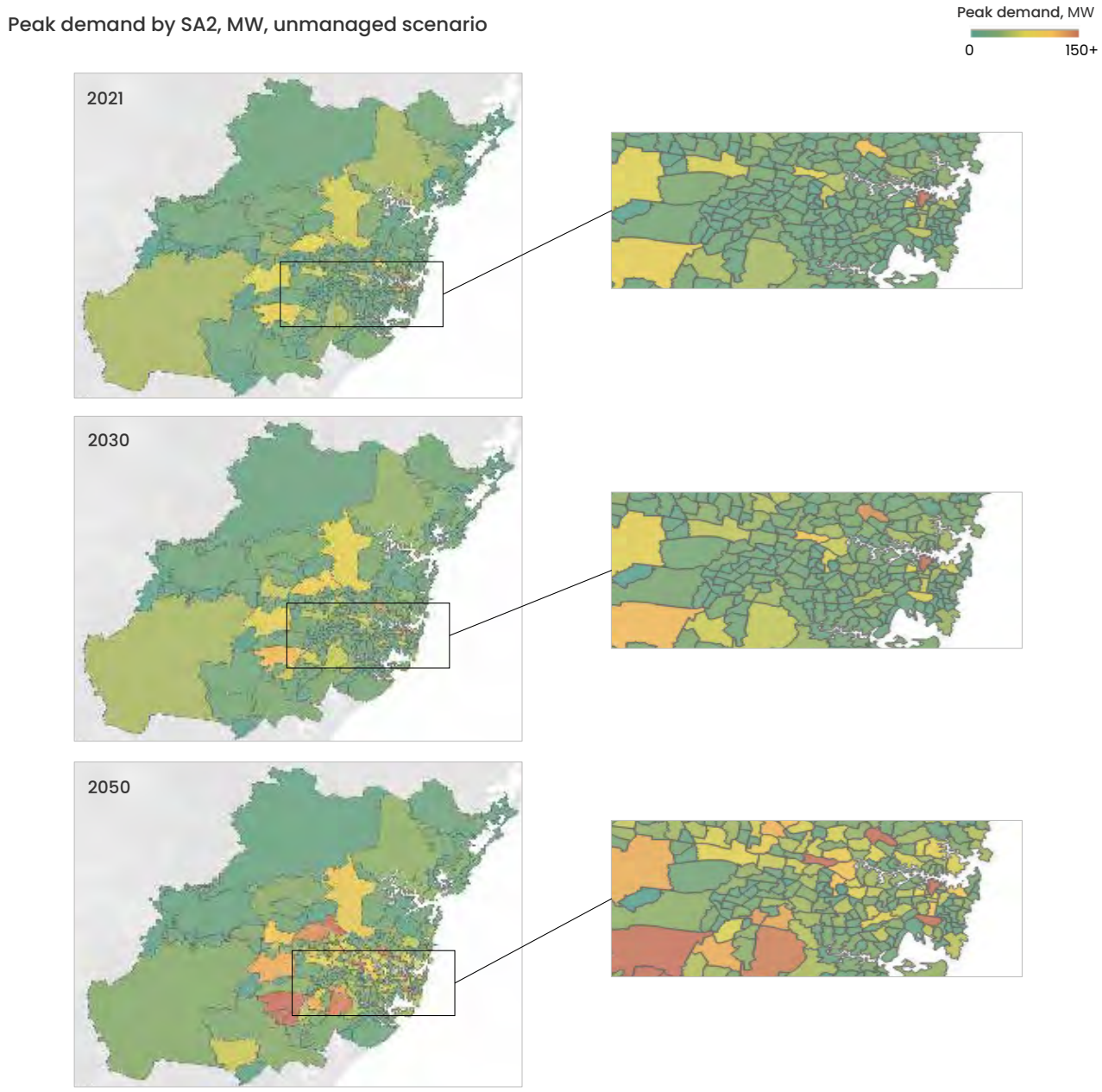
In relatively low density, established residential areas in Sydney's north and south, grid demand growth is expected to be lower. Population is not expected to grow as much in these areas, however, there will still be significant growth due to early switching to EVs and home electrification, with less offset opportunities from rooftop solar.

Action:

- Plan and implement grid upgrades, and reform the regulatory process to enable the energy transition.

27 The modelling analyses SA2s, the commonly used area unit for energy system planning. There are 312 SA2 areas in Greater Sydney, larger than suburbs and smaller than local government areas.

Chart 28: Peak demand will grow significantly in west and southwest Sydney, and be highest in the Sydney and Parramatta CBDs



Source: Ausgrid, Endeavour, McKinsey Net-zero Trajectory, McKinsey Center for Future Mobility, McKinsey Power Solutions

CASE STUDY:

E-Bus electric bus charging trial

In Penrith, a smart charging bus trial aims to avoid increasing peak demands on the grid by feeding real-time demand data into the bus depot control algorithms that help determine the optimal time to charge. The system uses sophisticated software tools and real-time energy monitoring to connect the depot to the wider distribution network, communicating directly with the energy provider's assets. The solution also enables direct integration between Endeavour Energy's distribution network and Busways' depot to optimise electric bus charging in tune with grid use.

Funded under Transport for NSW's Zero Emissions Bus program, the project stems from a cross-industry consortium including bus operator Busways, software and advisory company Evenergi and electricity distributor Endeavour Energy.

The smart charging bus trial aims to avoid increasing peak demands on the grid.

Image source: Endeavour Energy

4.3 Limit the growing cost of network upgrades through rooftop solar and battery storage, continued energy efficiency and managed demand strategies

Sydney's distribution network is forecast to grow due to population, electrification and DER adoption until 2030. After 2030, stronger adoption of EVs and DER is forecast to require a higher-than-historical average spend to ensure security and reliability.[28] However, costs will rise for both network operators and consumers if demand is not well managed to suppress peak demand by the modelled 2.2GW through to 2050.

The modelling only examined large-scale capacity upgrade costs incorporating distribution substations, zone substations and associated conductors. Detailed location-based modelling would be required to estimate the additional costs of down and upstream upgrades in the low and high voltage, sub transmission networks, feeder rating issues, protection control and integrating DER and managing power quality.

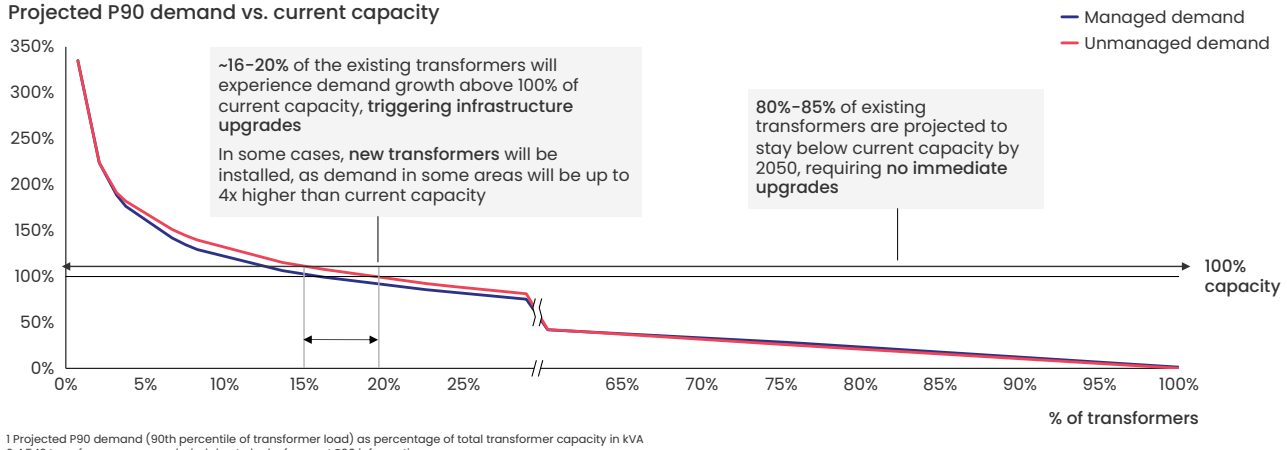
Distribution network upgrades will be required to cater for Sydney's growth, changes in peak and minimum demand, and the management of more rooftop solar and battery storage and managing complex two way powerflows.

Accelerated rollout of rooftop solar and battery storage, continued energy efficiency demand management and efficient pricing strategies could limit the extent of major network upgrades through to 2030. Most transformers have the capacity to accommodate growth in base demand, with peak demand the ongoing and future challenge for energy networks. The network upgrades required would span about two-thirds of the network's SA2 areas (statistical areas equivalent to a suburb) and cost an estimated $40-50 million annually, up from $35 million a year from 2016 to 2020[29] (see Chart 29).

28 This includes ensuring real-time balancing of electricity supply and demand, keeping system frequency within operating standards, and keeping voltages on the network within acceptable limits.
29 Note these costs are ~5% of a utility's total operating budget and do not include large-scale capacity upgrade costs incorporating distribution substations, zone substations and associated cabling. Detailed location-based modelling would be required to estimate the additional costs of down and upstream upgrades in the low and high voltage, sub transmission networks, feeder rating issues, protection control and integrating DER and managing power quality.

Chart 29: The majority of distribution substation transformers in Sydney can absorb the projected demand growth

Projected distribution transformer capacity required1, 2050
As percent of current installed capacity of each transformer, n = 30,6862



1 Projected P90 demand (90th percentile of transformer load) as percentage of total transformer capacity in kVA
2 4,542 transformers were excluded due to lack of current P90 information

Source: Endeavour Energy transformer data, McKinsey Power Solutions

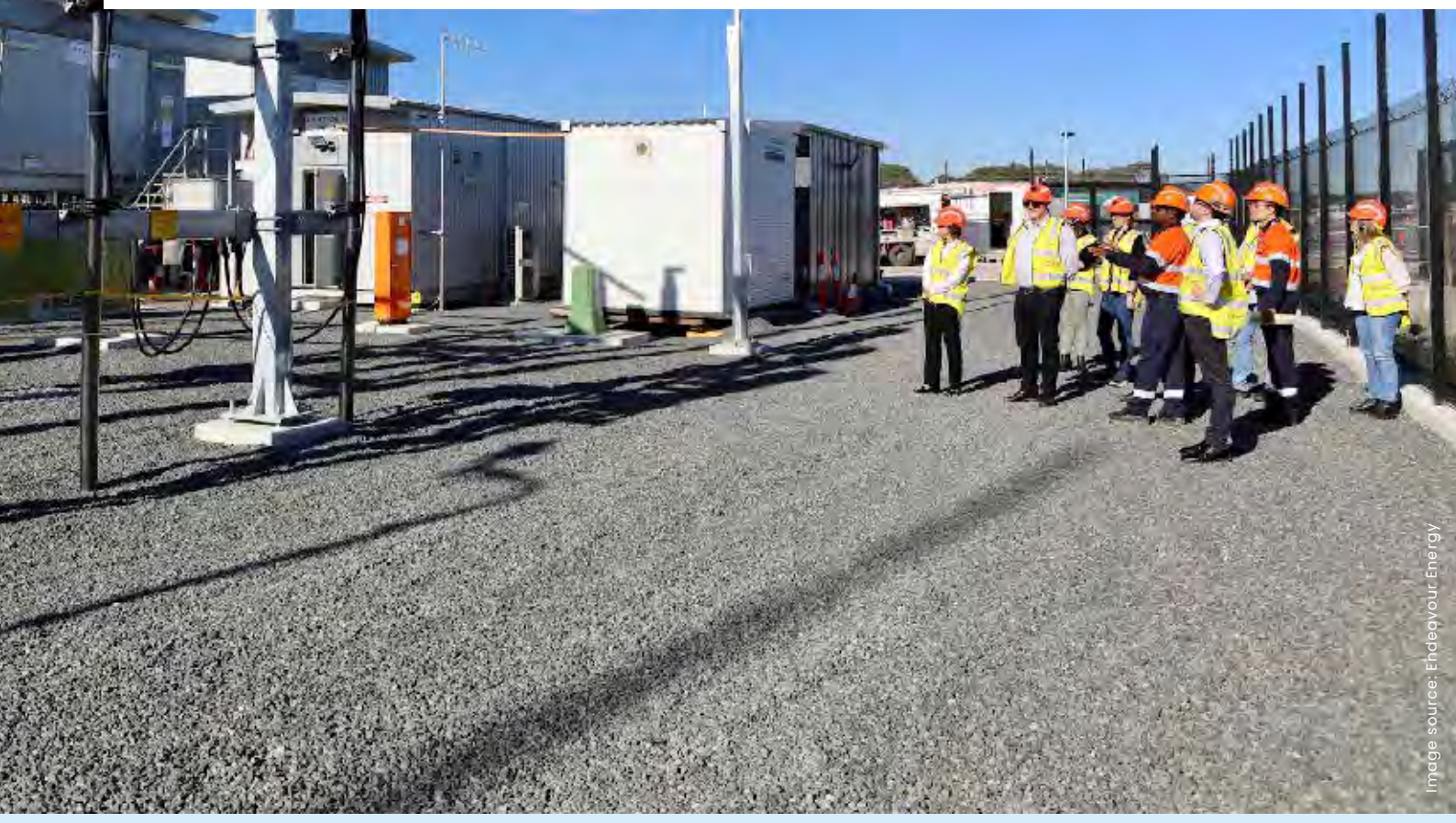


Image source: Endeavour Energy

From 2030 to 2050, network upgrade spend is forecast to double.

By 2050, about 15% of transformers would need to be upgraded, spanning almost all SA2 areas, rising to 20% of transformers if demand is not well managed. On these assumptions, the annual spend would rise to $100–120 million. However, this is part of the investment needed to make clean electricity available for EVs and electric appliances, enabling households to save an average $1,900 per year in total energy costs (see Chart 30).

Action:

- Increase energy efficiency standards and labelling (including minimum energy performance standards)
- Use incentives to accelerate the uptake of rooftop solar and distributed battery storage, electric hot water, and other storage options including through the NSW Government Peak Demand Reduction Scheme
- Set a target and roadmap for battery storage adoption to reach ~2.7GWhs by 2030
- Actively promote demand management in all its forms, including incentives to accelerate take-up of best practice energy conservation approaches.

Sydney will need to expand the distribution network to keep up with population growth, electrification and DER.

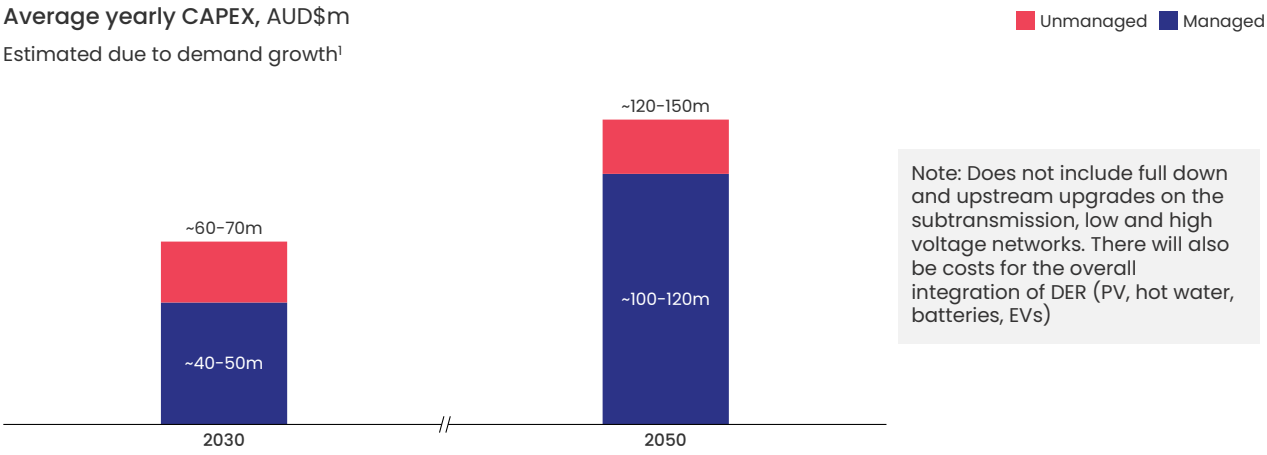
Image source: Endeavour Energy

Chart 30: Distribution and zone substation network strengthening costs will increase to 2030 and double by 2050

Excludes low and high voltage and subtransmission upgrades and overall DER integration

Average yearly CAPEX, AUD$m

Estimated due to demand growth[1]



Note: Does not include full down and upstream upgrades on the subtransmission, low and high voltage networks. There will also be costs for the overall integration of DER (PV, hot water, batteries, EVs)

1. Assumes average number of households are: 2.1m in 2021; 2.37m in 2021-2030 and 2.86m in 2030-2050

Source: Ausgrid, Endeavour RIN reports, Endeavour Energy transformer data, McKinsey Power Solutions

4.4 Accelerate a national smart meter rollout and upgrade home circuitry to enable electrification

To realise the full benefits of Australia's large and small-scale distributed energy resources, smart meters and other software and system tools can optimise rooftop solar and storage use. Smart meters communicate pricing information to the consumer for greater clarity of consumption behaviour, and to electricity suppliers for system monitoring and customer billing.

Smart meters and other 'demand response' tools help optimise the use of rooftop solar generated energy, with benefits to both the system owner and the distribution network. They also help users track the efficiency of these large energy appliances and the best time to use them.

Smart meters are relatively low-cost items; however, installation costs can sometimes be high in older properties, discouraging installation. There is also little consumer awareness, and adoption remains very low (~25% in NSW[30]), despite smart meters being required for households with solar rooftop and/or home batteries. Increasing the adoption of smart meters is important to manage rooftop solar and battery storage installed in Sydney and make the most of these investments.

At the same time, government could work with distribution networks to coordinate the upgrade of home circuitry in existing buildings to facilitate electrification. This might look like a one stop shop for electrification, including the fuse box, induction circuitry, and change from 1 to 3 phase if needed.

Action:

- Accelerate rollout of smart meters, including targeting high value customers such as those with controlled load hot water
- Coordinate upgrade of home circuitry in existing buildings to facilitate electrification.

30 Australian Energy Market Commission (AEMC).

Increasing the adoption of smart meters is important to manage rooftop solar and battery storage.

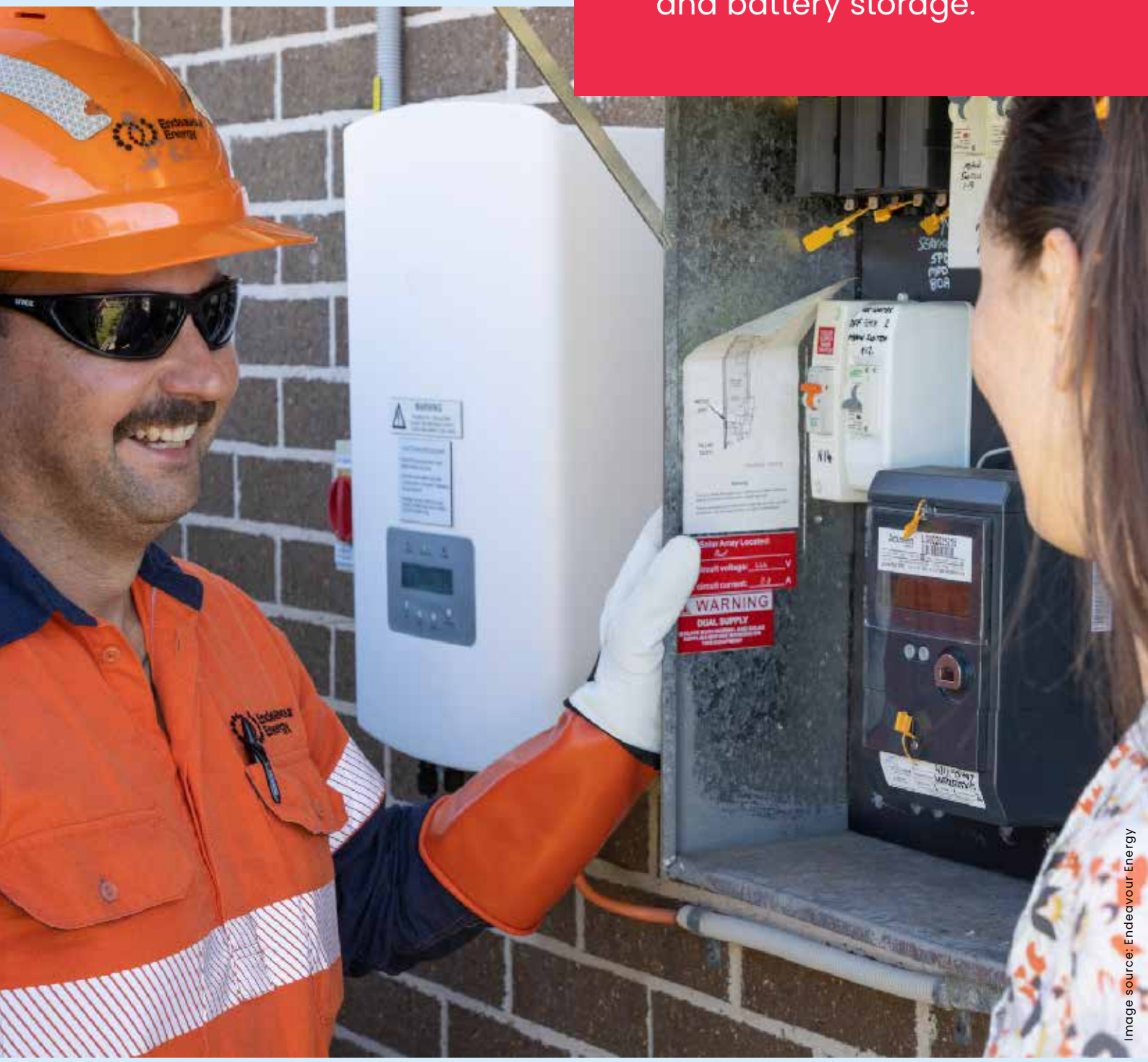


Image source: Endeavour Energy

4.5 Prepare for the future grid

AEMO predicts half the customers nationwide will use at least one form of DER by 2030, increasing the complexity of operating electrical networks. While Sydney is unlikely to reach these levels by 2030, the growth will still be considerable. Cost-effectively managing this growth and the electrification likely to accompany it is a crucial building block of the net zero future.

This future will require changes to how distribution networks manage their network, interact with customers, and support the electrical grid's stability. Network constraints will be solved through innovative solutions in place of traditional network augmentation. Getting this right ensures DER can be better managed and that customers benefit most.

At the same time, customers have expressed a need for:

- greater choice of lower cost and cleaner energy options, and increased accessibility to the benefits of distributed energy resources for all customers
- an understanding of their role in the energy transition
- rewards for supporting lower network costs and clean energy investments.

To meet customer and stakeholder needs, networks need to be active participants in Sydney and NSW's energy transformation. Networks will need to be actively manage to maximise the value of distributed energy resources and provide a cost-efficient network. Identifying and solving regulatory barriers to this transition will be critical to preparing for the future of the grid.

Action:

- Identify key regulatory barriers to enabling Sydney to prepare for a distributed energy future, and create a collaborative problem solving approach to accelerate the transition.

AEMO predicts half the customers nationwide will use at least one form of DER by 2030.

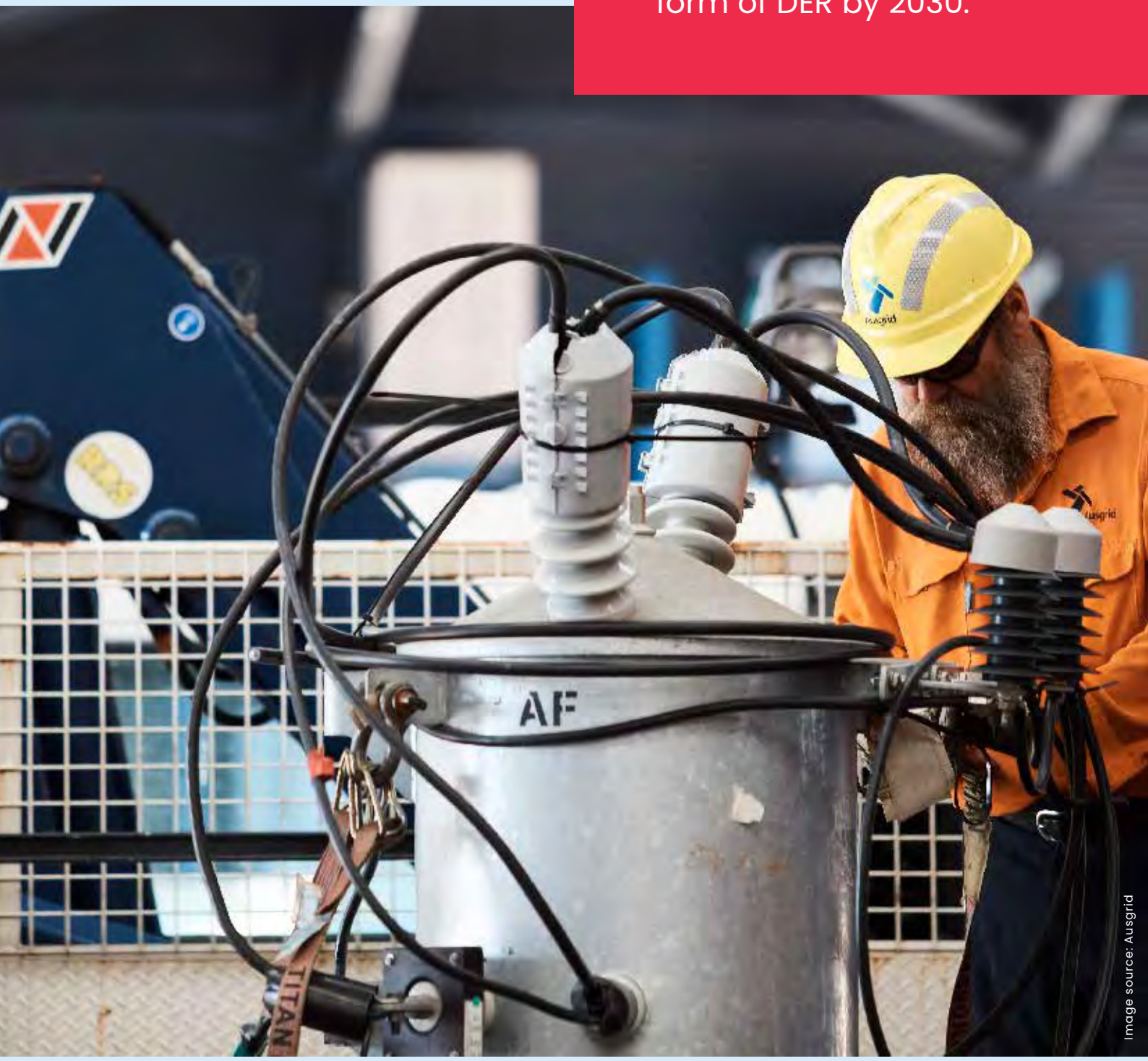


Image source: Ausgrid

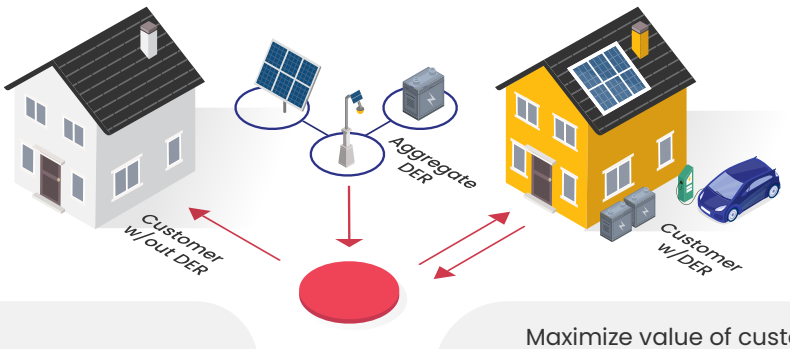
Integrating distributed energy resources (DER)

There are three main components to integrating DER:

1. **Dynamic network management:** invest in technology capable of dealing with the complexity of two-way power flows and share the benefits of DER with all customers
2. **Service innovation:** improvements to systems and communication platforms to enhance connections, customer incentives and greater power of choice
3. **System support:** increasing DER as a form of generation, particularly at a large scale, including Renewable Energy Zones (REZ), will bring on the retirement of central coal-powered generation. Networks will respond to system stability requirements as regulators require increased reporting requirements for local DER.

Successful DER integration enables customers' net zero ambitions by improving network hosting capacity. This is the headroom for the network's ability to accept more significant volumes and utilise zero-emissions DER. Greater electrification is enabled through higher network utilisation, increasing the scalable benefits of DER.

Long-term, distribution networks could be utilised as platforms to enable DER and provide customers with clean, safe, low-cost electricity.

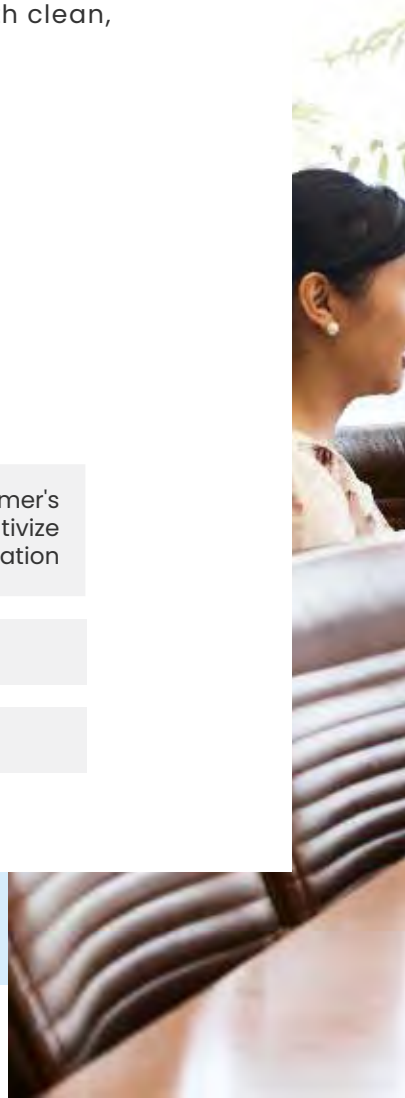


Reduced bills through greater network efficiency

Maximize value of customer's investment and incentivize coordination

Improved access cheaper, zero-emissions generation mix

Improved quality of supply and access to alternative energy sources



Networks and customers need to be active participants in Sydney's energy transformation.

Image source: Ausgrid

V. Accelerate coal closures and enhance collaboration mechanisms

Image source: Vardan Papikyan, Unsplash

As outlined in Section 1, reaching net zero by 2050 will have numerous benefits to Sydney and its residents, including cheaper energy, climate resilience, health and energy security. Grid-scale power generation and industrial energy are being decarbonised as asset owners and operators realise the economic benefits of renewable energy. The next single biggest opportunity for reducing emissions, by far, is in transport, with most of Sydney's motorists needing to buy an EV when they next upgrade or replace their cars and light commercials, or move to using public and other transport options.

However, only two approaches are large enough to ensure emission reductions are on track by 2030: incentives and regulation for EV adoption; and accelerating the exit of coal from the grid, supported by accelerated build-out of renewables, storage, transmission and DER.

Achieving either approach will require close collaboration between consumers, government, distribution companies, property developers and other stakeholders to ensure it succeeds.

Laying down this pathway would take bold action and minimise the friction and costs of transition for residents and businesses.

Only two approaches are large enough to ensure emission reductions are on track by 2030: faster EV adoption; and accelerating the exit of coal generation from the grid.

Image source: Karl Hornfeldt, Unsplash

RECOMMENDATIONS

5.1 Reduce the use of coal in NSW's generation mix

The *Accelerated Net Zero Transition* scenario models EVs to make up ~30% of the Sydney's passenger vehicles by 2030, abating ~2.5Mt CO_2e.

If this target is not met, which is highly likely despite positive state and federal government policy settings, it will fall to other sectors to compensate. For example, if EVs were to reach only ~20%, there would be a shortfall of ~0.8 Mt CO_2e, or if EVs reached just ~15% (as projected by objectives set in the existing NSW EV strategy) the shortfall would rise to ~1.2Mt CO_2e.

The potential options for Sydney to make up that shortfall are limited (see Chart 31).

Reducing the use of coal in NSW's generation mix more quickly is the only lever large enough to close the gap. All other levers are either too small (e.g. gas replacement), the underlying technology is immature (e.g. heavy trucks), or buyer behaviour too unlikely (e.g. all truck sales being zero emission vehicles by 2030).

Accordingly, decision makers may seek to optimise the extent of EV adoption and grid decarbonisation, with the best mix of the following pathways:

- **Pathway 1: Electrify Sydney's road transport.** This is the single biggest opportunity to accelerate decarbonisation. Regulations, such as emissions standards or a petrol/diesel vehicle sales ban, would make it as difficult for car makers to sell petrol/diesel vehicles in Australia as it already is overseas. That would prompt more availability of models to suit the needs of diverse Sydney motorists, a more competitive market, greater EV awareness and greater sales.
- **Pathway 2: Grid decarbonisation acceleration.** If the *Accelerated Net Zero Transition* EV target of ~30% by 2030 is not met, then 4-5TWh more coal capacity would need to exit, at least three years earlier than currently announced, to reach the emissions reduction aspiration. Yet if the *Steady Transition* represented by the NSW EV strategy is pursued (EVs reaching ~15% of all cars by 2030), the coal exit figure increases by half again to 6-7TWh.[31]

31 This energy from coal generation (in TWh) would functionally be removed by varying capacity factor of the fleet and retiring/mothballing units (typically in increments of 500-750MW).

Chart 31: Only faster elimination of coal in power generation could achieve the abatement of passenger EVs

NOT EXHAUSTIVE

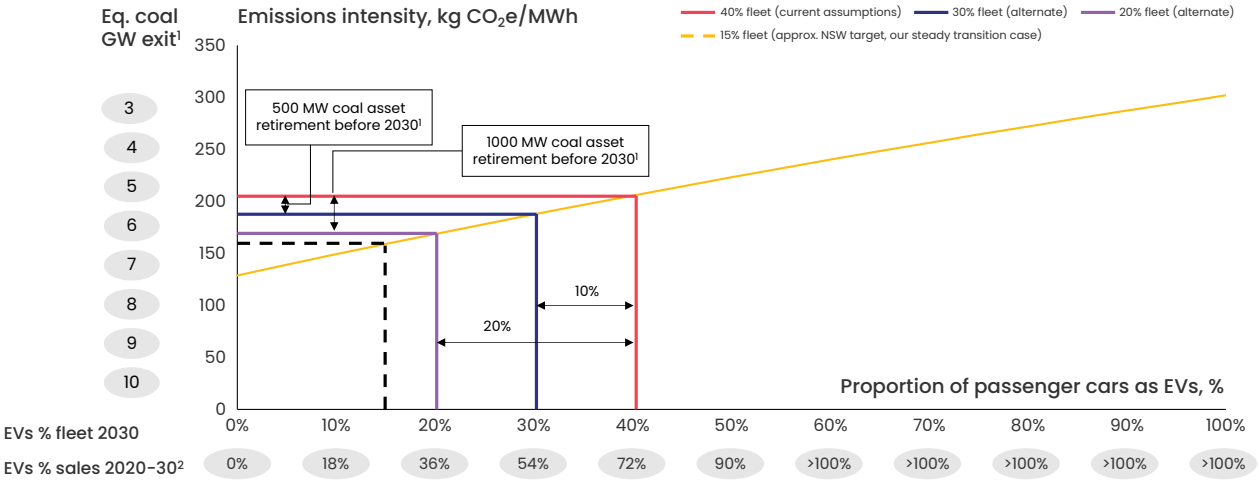
Sensitivity analysis of additional decarbonisation opportunities and risks, $MtCO_2e$

Sector	Scenario	Marginal emissions abated Mt CO_2e, 2030	What would need to happen
Power generation	Coal generation units close ahead of schedule, with less than 17 TWh remaining in 2030 (vs. ~60 TWh today, and 17 TWh in the net-zero scenario)	Up to ~7.6	Renewables, storage and trans-mission developments accelerated
DER	DER uptake accelerates 1.5x (solar PV and supporting storage), generating ~10,500 GWh in 2030 (vs. 3,000 GWh today and ~7,000 GWh in net-zero scenario)	~0.6	Solar on ~30% of dwellings and equivalent growth in commercial
Light trucks	Electric LCVs enter market 30% more quickly, making up 40% of LCVs in 2030 (vs. 0% today, and 30% in the net-zero scenario)	~0.5	100% LCV sales are EVs from 2025-30
Heavy trucks	Zero-emissions heavy trucks enter the market 2x as quickly, making up ~20% of trucks in 2030 (vs. 0% today, and 10% in the net-zero scenario)	~0.4	100% HDT sales are EVs from 2026-30
Commercial gas	All public buildings are all electric by 2030	~0.1	All hospitals, schools and public buildings electrified in next 8 years
Industrial gas	Electrification of industrial low-temperature heating accelerates 2x, with 25% retrofitted by 2030, vs. 15% in the net-zero scenario	~0.1	No new gas from 2025, ~5% of boilers replaced each year
Residential gas	Electrification of residential gas use 2x accelerates, with 20% retrofitted by 2030, vs. 10% in the net-zero scenario	~0.1	No new gas from 2025, ~30k homes or ~4% of gas use replaced each year
Commercial gas	Electrification of commercial gas use 2x accelerates, with 40% retrofitted by 2030, vs. 20% in the net-zero scenario	~0.1	No new gas from 2025, ~10% of boilers replaced each year
Gas blending	10% green hydrogen is blended with natural gas in the gas grid (does not occur today)	<0.1	Jemena announced pilot scales up >5000x
Passenger EVs	EVs fall short of the 2030 target, making up 20% of cars, vs. the 30% required in the net zero scenario	~-0.8	-

Source: McKinsey Sustainability Insights, AEMO ISP 2021 Inputs and Assumptions, Jemena gas use CY20, IEA, DISER baseline of commercial buildings GHG emissions and energy use

Chart 32: An Accelerated Net Zero Transition could trade off additional power decarbonisation for slower EV uptake

Sensitivity analysis between contribution of passenger EVs vs. power sector to decarbonise Sydney



1. Assumes modelled coal capacity factor of 50-60% form 2025-2030 and replacement with renewables and storage. Bayswater's modelled capacity over this period of time is 60-75%, each of its 4 units has a capacity of 660MW; 2. Proportion of new car sales from 2020 to 2030 that would need to be EVs in order to reach 2030 fleet penetration

Source: Power modeling based on AEMO ISP 'Step Change' assumptions and outputs of Australia Net zero decarbonization model, McKinsey Sustainability Insights

Pathway 2 would need significant additional investment and acceleration in renewables, storage and transmission infrastructure, which would challenge the economic viability of coal generators, and likely move forward their closure date. Further power system modelling would be needed to determine the level of investment needed, alongside recognition of the need to keep the lights on and household energy costs as low as possible.

As detailed in AEMO's Integrated System Plans, there are two material constraints on the development of additional grid capacity: securing the social license needed for the expansion of transmission lines across NSW farming land and environmental reserves, and securing the additional development capital, project management capacity and labour needed. These challenges would need to be overcome to support reliance on further coal-fired plant closures.

Choosing the appropriate mix between these pathways is a difficult yet essential task for decision makers, however, to meet its net zero targets, NSW will need to enable coal closures to happen as fast as practical.

Action:

- If Sydney risks missing the 2030 target, accelerate the build-out of renewables, storage, transmission and DER.

Electrifying Sydney's road transport is the single biggest opportunity to accelerate decarbonisation.

Image source: Ed Harvey, Unsplash

5.2 Set mechanisms to collaborate, monitor and review accelerated progress to achieve 2030 targets

Achieving 2030 emission reduction targets is critical to avoid carbon build up and set NSW on the pathway to net zero by 2050. NSW has set targets and already implemented policies that will support Sydney's transition, including the Electricity Infrastructure Roadmap and Net Zero Plan Stage 1.

The actions outlined in this report to achieve the *Accelerated Net Zero Transition* call on keen collaboration between decision makers across the government, energy and property sectors — and a positive response from businesses and households.

- The **state and federal governments** can decide on the bold policies that could be taken to accelerate decarbonisation across the power, transport and building sectors, either through incentives or stronger regulation or both. **Local governments** could look to favour electric appliances in their planning requirements, working with peers to enact change at scale, and advocate for action by other government levels.
- **Businesses** can lead the change by switching to lower cost, low-emission alternatives for the energy, heating, cooling and transport, as well as testing their business models to ensure they will thrive in a net zero Sydney. Business leadership would help inform customers and make it as easy as possible for them to switch to more sustainable products. It would also meet the expectations of their investors, who are increasingly active in pushing for lower emissions and business resilience in the face of climate change, and the now rising expectations from customers.
- **Consumers** can understand the impact their collective purchase decisions will have on the city's carbon footprint, as well as the savings and health benefits available to them. They may actively explore new technologies increasingly available to them, and decide what is best for them long term, so they can either upgrade or avoid a rushed decision when their current car, hot water or space heating system has failed.

Collaboration across government, business and consumer groups has already commenced – including in the preparation of this report — and must continue and strengthen to ensure actions are coordinated and reinforce each other. Examples of collaboration include where:

- Government strengthens its EV policies, including incentives for chargers, so local government and infrastructure developers can optimise the placement of fast chargers, and developers and investors can allocate the capital and space to futureproof their buildings
- Government offers incentives for electric hot water, batteries and other smart DER, leading to greater installation, more aggregation services, additional installations, demand response and grid stability benefits
- Government tightens its gas use policies, which are mirrored in building standards, supporting investor demands for higher standards, leading developers to innovate to achieve high star ratings at sensible cost, and ultimately creating scale and proof points for the innovations to spread to smaller commercial properties and to housing.

An important part of collaboration is to **set mechanisms to monitor and review progress towards regular milestones on the path to 2030**. This would monitor both the net behaviour change achieved, and the relative effectiveness of policies and incentives intended to drive that change.

Action:

- Set mechanisms to monitor and review progress towards regular milestones on the path to 2030. This would monitor both the net behaviour change achieved, and the relative effectiveness of policies and incentives intended to drive that change.
- Set up an Electrification Taskforce to bring together state and local government, EV charging companies, distribution networks, researchers and relevant business leaders.

Collaboration will be critical to achieving decarbonisation.

Image source: Endeavour Energy

Appendix A: A detailed roadmap to decarbonise Sydney

PASSENGER TRANSPORT		Key Actor/s
Short term (2022-23)	• Set an electric vehicle adoption target of 30% of the passenger fleet by 2030	• NSW Treasury
	• Consumer awareness campaign on the availability and benefits of electric vehicles, recognising different motivations and barriers to switching, and putting the right information in the right places – particularly ensuring the campaign is tailored to Sydney's culturally and linguistically diverse community	• Local government • OEMs • EV Council • Transport for NSW • Fleet owners • Federal government
	• Extend financial support for charging infrastructure to broaden the on-street network	• Federal government • Transport for NSW • Local government
	• Develop and implement best practice standards and consent conditions to ensure appropriate EV charging infrastructure is provided in all new buildings	• NSW Department of Planning and Environment • Local government
	• Set an end date to convert all state and local government fleets to EVs (2030)	• NSW Treasury • Local government
	• Accelerate private fleet conversion (taxis, corporate etc) through incentives and market leadership	• NSW Treasury • Market
	• Establish a nationwide incentive scheme to reduce EV purchase costs	• NSW Treasury • Federal government
Medium term (2023-25)	• Introduce a 2030 modal shift target of 40% with supporting policies and programs to encourage increased active travel, public transport use, car sharing etc	• Transport for NSW • Local government
	• Implement controlled charging and explore vehicle to grid technology to enable EVs to become DER assets	• Federal government (AER) • NSW Treasury • Energy retailers • Ausgrid/Endeavour Energy
	• Introduce CO_2 emissions and fuel efficiency standards for new cars sold in Australia or NSW	• Federal government • NSW Government
Longer term (2025–)	• Strengthen the CO_2 emissions/fuel efficiency standard for new car sales	• Transport for NSW • Federal government
	• Introduce a future ban on petrol/diesel car sales	• NSW Treasury • Federal government

GAS APPLIANCE ELECTRIFICATION		Key Actor/s
Short term (2022-23)	• Introduce an 'energy star rating' for homes to disclose at sale and rental to accelerate residential switching combined with a targeted awareness campaign	• NSW Treasury • Federal government
	• Set a date for the banning of gas connections in new buildings (e.g. 2025)	• NSW Department of Planning and Environment • Local government
	• Design point-of-sale incentive for new electric appliances supported by a consumer information campaign, and education campaigns	• NSW Department of Planning and Environment • OEMs
	• Update planning instruments (e.g., Exempt and Complying Development, DCP and LEP) to encourage electrification of buildings including provision of incentives	• NSW Department of Planning and Environment • Local government
	• Extend NABERS and BASIX to incentivise electrification of existing buildings (e.g including the future energy intensity of the grid when comparing gas to electric appliance) and strengthen building codes and guidelines for focus on passive heating and cooling – and reduce reliance on electricity where possible.	• NSW Department of Planning and Environment • NSW Treasury
	• Incentives for installers and retailers to accelerate gas-to-electric conversions	• NSW Treasury • OEMs
Medium term (2023-25)	• Update NSW Energy Saving Scheme rules to reward more energy efficiency (taking into account the future greening of the grid)	• NSW Treasury
	• Introduce incentives and public procurement rules to encourage electrification of public sector buildings including social housing and commercial by 2035	• PropertyNSW
Longer term (2025–)	• Ban the sale of new gas appliances by 2030	• NSW Department of Planning and Environment
	• Introduce incentives and public procurement rules to encourage development of higher performing commercial heating	• NSW Department of Planning and Environment • PropertyNSW

DISTRIBUTED ENERGY RESOURCES		Key Actor/s
Short term (2022-23)	• Update BASIX to recognise the value of Distributed Energy Resources	• NSW Department of Planning and Environment
	• Expand solar for low-income housing program to increase uptake and complement with energy efficiency incentives to reduce energy costs.	• NSW Department of Planning and Environment
	• Use incentives to accelerate the uptake of rooftop solar and distributed battery storage, electric hot water, and other storage options including through the NSW Government Peak Demand Reduction Scheme	• NSW Treasury • Federal government (+Arena, CEFC) • Ausgrid, Endeavour Energy
	• Set a target and roadmap for battery storage adoption to reach ~2.7GWhs by 2030	• NSW Treasury • Federal government (+Arena, CEFC)
	• Increase energy efficiency standards and labelling (including minimum energy performance standards)	• NSW Treasury • Federal government • OEMs • Local government
	• Actively promote demand management in all its forms, including incentives to accelerate take-up of best practice energy conservation approaches	• NSW Treasury • Federal government • OEMs • Local government
Medium term (2023-25)	• Introduce mechanisms to encourage property owners to install rooftop solar in rented properties (e.g. rights for tenants to access rooftop solar, incentives for installers to install panels in rented dwellings)	• NSW Treasury • NSW Department of Planning and Environment • Local government
	• Update strata rules to make it easier to install apartment solar systems	• NSW Department of Planning and Environment
Longer term (2025–)	• Consider requiring all new homes to install solar	• NSW Department of Planning and Environment
	• Consider requiring all new apartment buildings to have rooftop solar and storage	• NSW Department of Planning and Environment

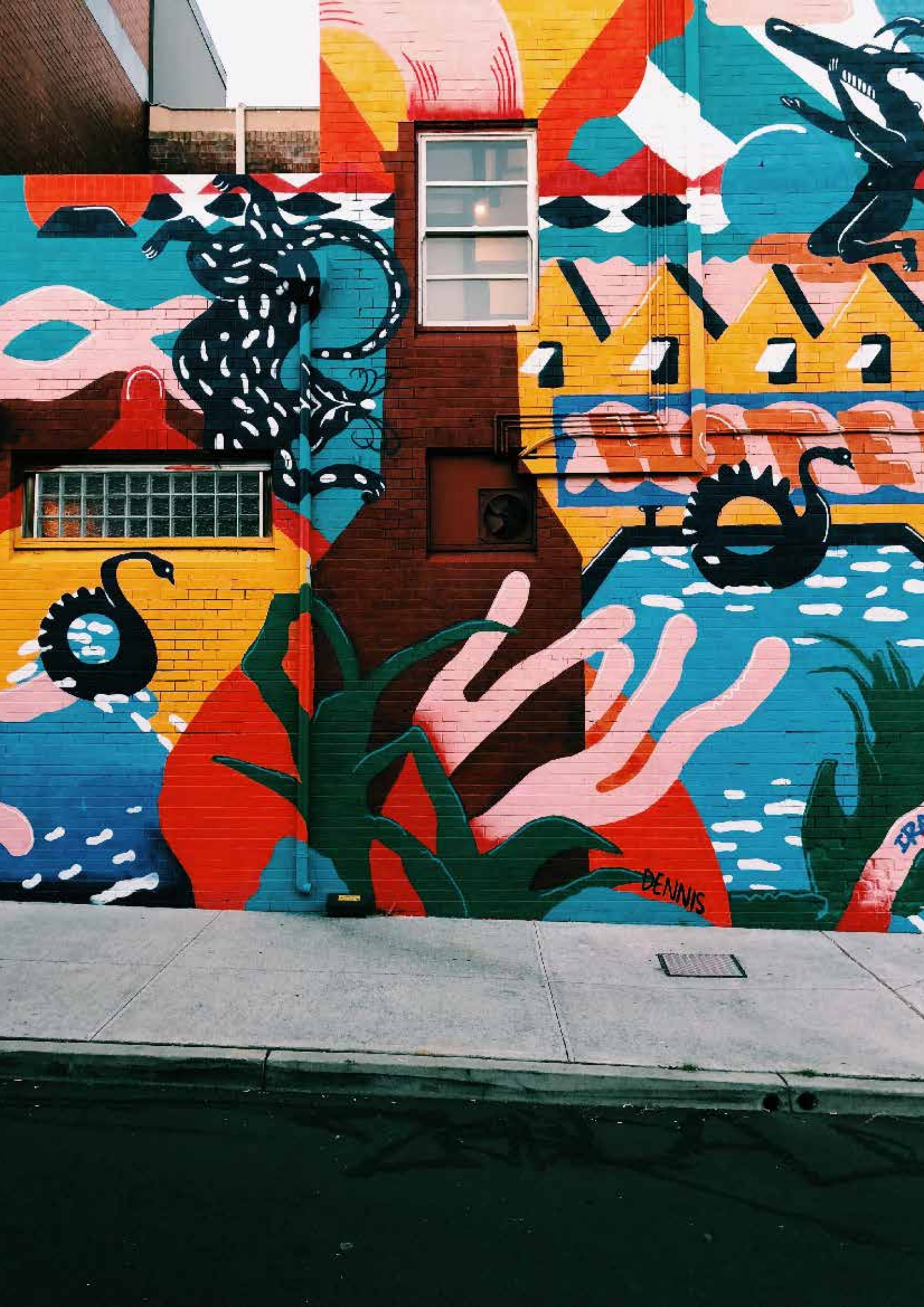
ENERGY INFRASTRUCTURE		Key Actor/s
Short term (2022-23)	• Coordinate with government on grid requirements for EV charging infrastructure and rooftop solar/storage installation	• Federal government (AER) • Transport for NSW • NSW Treasury • Ausgrid/Endeavour Energy
	• Identify key regulatory barriers to enabling Sydney to prepare for a distributed energy future, and create a collaborative problem-solving approach to accelerate the transition	• AER • NSW Treasury • Energy retailers • Ausgrid/Endeavour Energy
	• Ensure large rooftop solar output is integrated with local electricity networks to support energy export	• Market • Transport for NSW • NSW Treasury • Ausgrid/Endeavour Energy
Medium term (2023-25)	• Develop innovative tariffs to encourage and reward customers (e.g. dynamic tariffs)	• AER • Ausgrid/ Endeavour Energy
	• Accelerate rollout of smart meters, including targeting high value customers such as those with controlled load hot water	• Federal government (AER) • NSW Treasury • Energy retailers • Ausgrid/Endeavour Energy
	• Create the right settings and standard to increase access to the emerging market for demand response	• AER • Energy retailers • Ausgrid/Endeavour Energy
Longer term (2025–)	• Plan and implement grid upgrades, and reform the regulatory process to enable the energy transition	• Ausgrid/ Endeavour Energy • AER
	• Support the development of distribution system operator models for networks to maximise the use of renewables and network infrastructure	• Federal government (AER) • NSW Treasury • Ausgrid/Endeavour Energy
	• Coordinate upgrade of home circuitry in existing buildings to facilitate electrification (e.g. one stop shop for electrification – fuse box, induction circuitry, change from 1 to 3 phase if needed)	• Federal government • Ausgrid/ Endeavour Energy

ZERO EMISSION TRUCKS		Key Actor/s
Short term (2022-23)	• Create a state or national strategy with logistics companies and local manufacturers to convert truck fleets aided by a consumer awareness campaign	• Transport for NSW • Federal government • Market
	• Group zero-emission light truck orders to secure bulk supply	• Transport for NSW • Market • Local government
Medium term (2023-25)	• Introduce an internal combustion truck 2035 sales ban	• Federal government
	• Widen truck width standards to improve model availability	• Federal government
	• Introduce financial incentives for truck purchase and depot charging infrastructure (if required)	• NSW Treasury • Transport for NSW
Longer term (2025–)	• Group zero-emission truck orders to secure bulk supply	• Transport for NSW • Market
	• Introduce a CO_2 emissions or fuel efficiency standard for new trucks sales	• Transport for NSW • Federal government

POWER GENERATION		Key Actor/s
Longer term (2025–)	• If Sydney risks missing the 2030 target, accelerate the build-out of renewables, storage, transmission and distributed energy resources	• NSW Government

COLLABORATIVE ACTION		Key Actor/s
Short term (2022-23)	• Set mechanisms to monitor and review progress towards regular milestones on the path to 2030. This would monitor both the net behaviour change achieved, and the relative effectiveness of policies and incentives intended to drive that change	• NSW Treasury • NSW universities
	• Set up an Electrification Taskforce to bring together state and local government, EV charging companies, distribution networks, researchers, and relevant business leaders	• NSW Government • EV charging companies • Ausgrid/Endeavour Energy • Energy retailers • Market

1. EV = electric vehicle; 2. ICE = internal combustion engine; 3. BASIX = Buildings Sustainability Index;
4. DER = distributed energy resources; 5. PV = photovoltaic, i.e., solar panels; 6. NCC = National Construction Code;
7. NABERS = National Australian Built Environment Rating System; 8. ESS = Energy Saving Scheme;
9. AER = Australian Energy Regulator; OEM = original equipment manufacturer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Resilience Program Partners

We would like to thank our Resilience Program Partners for supporting the Committee for Sydney's work to drive solutions to our most pressing resilience challenges.

Our Resilience Program Partners are leaders in their respective fields, embracing the transition to a decarbonised future, and adapting to a changing climate.

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