future transport 2056

Future Energy Strategy

NSW GOVERNMENT

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Executive Summary

Our Future Energy vision is one where the people of NSW live in a prosperous, sustainable economy, enjoying a world class, sustainable transport system that is efficient and powered by renewable energy.

Future Energy outlines Transport for NSW's commitment to securing our transport energy needs from sustainable sources and supports the transition of the transport sector to net zero emissions by 2050 – consistent with the objectives of the NSW Government's climate change policy framework.

The transport sector accounts for a growing source of greenhouse gas (GHG [1]) emissions. Future Energy is focused on addressing direct emissions from road transport, rail transport and ferries, as well as indirect emissions from the electricity used for road and rail transport.

Transport for NSW plays a key role in leading and influencing the entire transport sector to reduce emissions by:

- transitioning the state's bus fleet to zero emission buses
- increasing the electric passenger vehicle fleet and adopting digital technologies to improve services while achieving operational efficiencies
- moving to local, renewable energy sources for electric trains, light rail and buses.

The benefits of Future Energy go well beyond reducing GHG emissions. They include increased energy security, supporting economic development, improving access to mobility, reducing traffic and parking congestion, saving consumers' money, reducing air and noise pollution and increasing public health and safety.

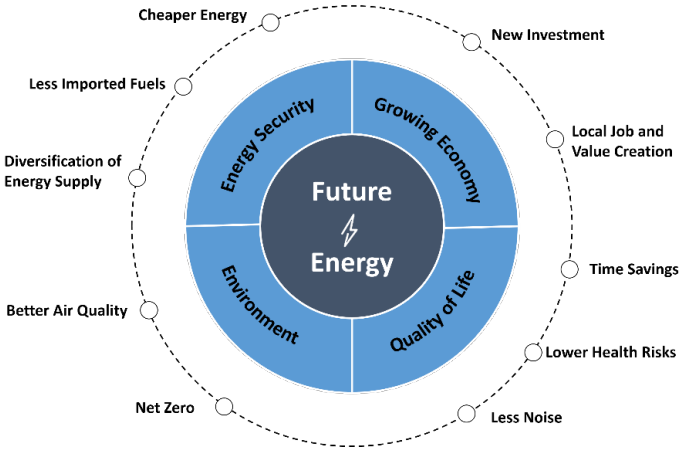

Figure 1 – The benefits of Future Energy

The Future Energy Strategy supports the NSW Climate Change Policy by focusing on the transport sector. It does so through a separate future energy action plan which, in turn, defines the near-term initiatives for achieving the future energy strategy objectives. Transport for NSW will continue to update the Future Energy Action Plan and will monitor and report on our progress in delivering outcomes.

[1] GHG emissions regulated by the 2015 Paris Agreement include carbon dioxide [CO_2], methane [CH_4], hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], sulphur hexafluoride [SF_6], and nitrous oxide [NO_2] – collectively measured in metric tonnes of carbon dioxide equivalent (mtCO2e) and referred to as "GHG emissions". The overwhelming majority of GHG emissions from transport are carbon dioxide – which is also true of GHG emissions across all sectors.

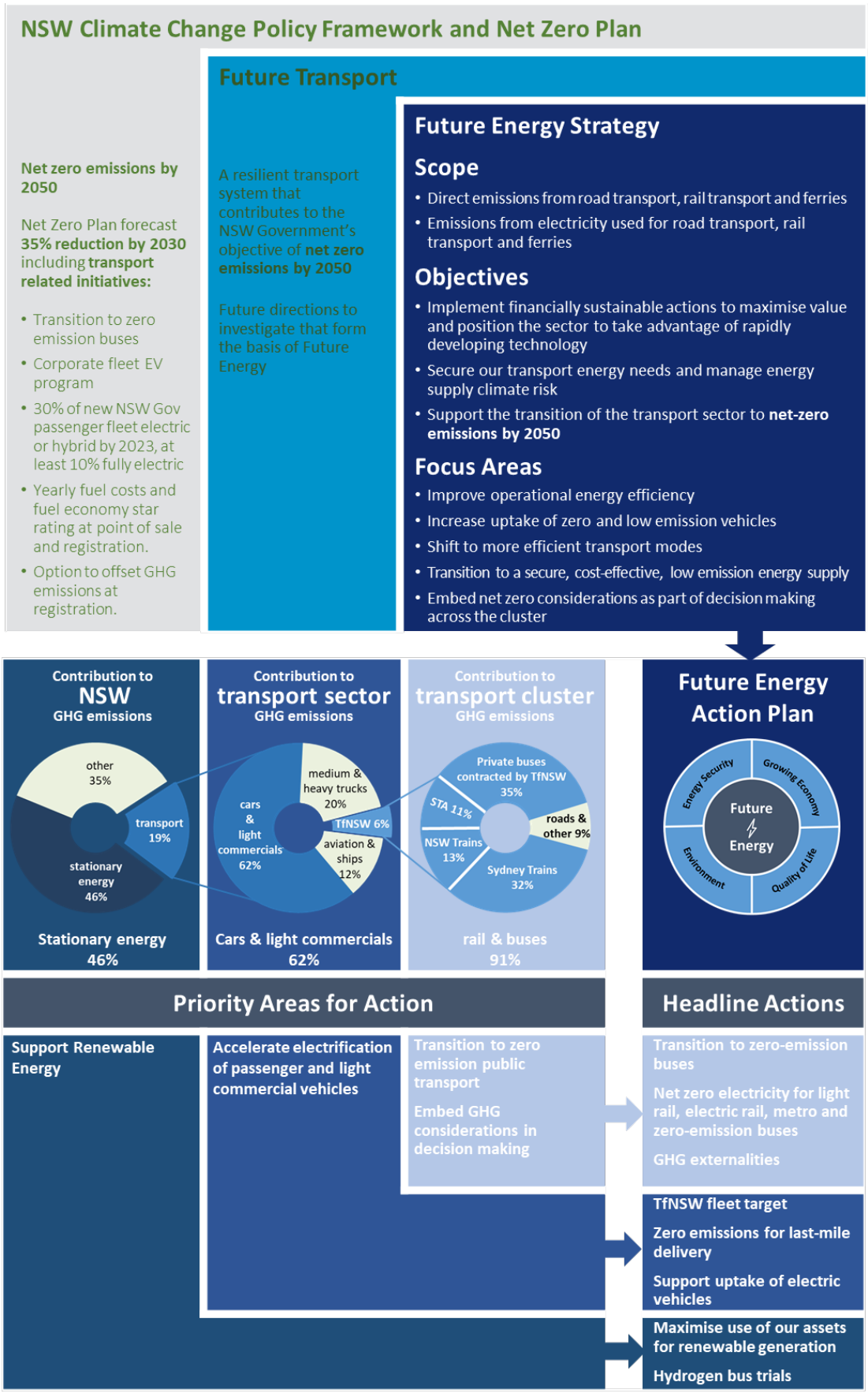

Figure 2 – NSW Climate Change Policy Framework and Net Zero Plan

Contents

Abbreviations and acronyms

Table 1 – Terms and meanings

Term	Meaning
BEV	Battery electric vehicles
EDMS	Energy data management system
EV	Electric vehicles
GHG	Greenhouse gas
GPPA	Green Products Purchase Agreement
HEV	Hybrid electric vehicles
HVAC	Heating, ventilation and air conditioning
ICE	Internal combustion engine
ITS	Intelligent transport system
LED	Light-Emitting Diodes
LGC	Large-Scale Generation Certificate
MaaS	Mobility-as-a-Service
PPA	Power Purchase Agreement
RET	Renewable Energy Target

1. Introduction

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1. Introduction

Transportation is a basic human right. It assists participation in social life and fulfils an essential economic function. Transport enables businesses to reach new markets and attract new investment, while presenting more job and training opportunities. Transport of goods and people is vital to our economic prosperity and wellbeing.

The NSW Government is committed to maintaining a strong economy, improving the quality of life for the people of NSW and protecting the environment. That's why the NSW Government's objective is to achieve net zero emissions by 2050 through creating new jobs, cutting household costs and attracting investment.

The Future Energy vision is one where the people of NSW enjoy a world class, efficient transport system that is powered by renewable energy.

Future Energy sets out the key pillars of the transformation of the transport sector to one powered by net zero energy. This transformation has the potential to support thousands of new jobs, many in regional areas, and deliver billions of dollars in economic growth between now and 2050. We can integrate more low-cost renewable energy into the transport system, reduce dependence on imported fuels, improve quality of life and reduce emissions.

1.1 Emissions and Energy Use

The transport sector uses more energy than any other part of the NSW economy and is second only to the energy industry in greenhouse gas (GHG) emissions.

The transport sector is also a growing source of GHG emissions. Between 2005 and 2017, transport emissions increased by 12 per cent[2], accounting for almost 19 per cent of the state's total GHG emissions.

The growth in transport emissions has been primarily driven by growth in the freight sector, which is reliant on heavy vehicles.

This growth is forecast to continue into the future under a business as usual scenario.

[2] Department of the Environment and Energy 2018, *State and Territory Greenhouse Gas Inventories 2017,* Canberra, p. 4

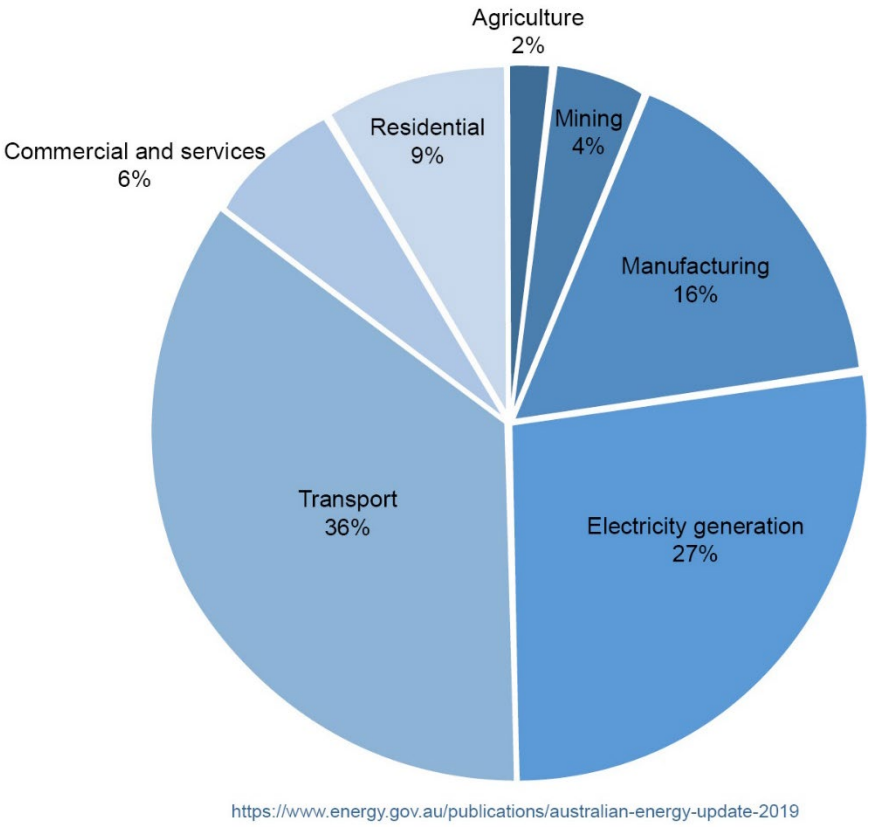


Figure 3 – Contribution of different sectors to energy use in NSW

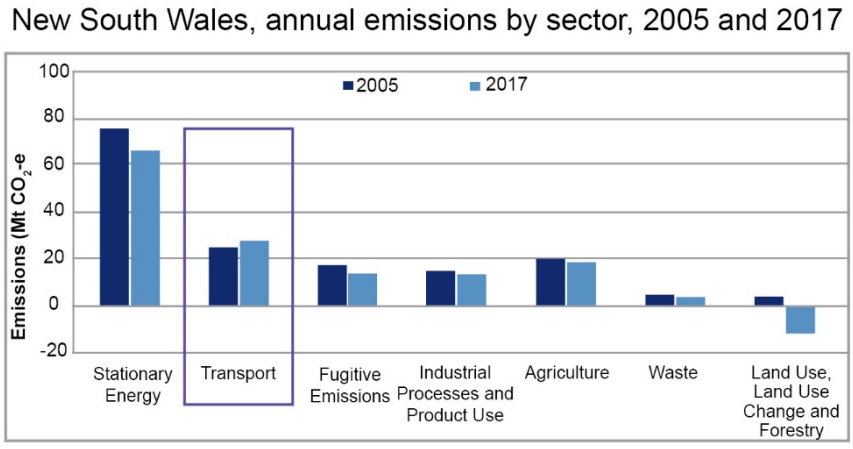


Figure 4 – Changes in greenhouse gas emissions by sector

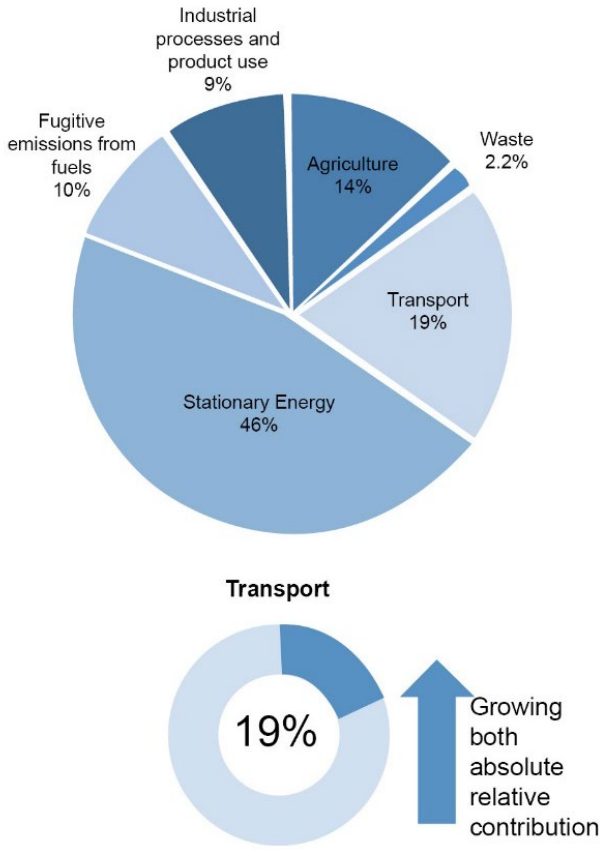


Figure 5 – NSW CO_2 emissions by sector in 2016/2017
(excluding land use, land use change and forestry)

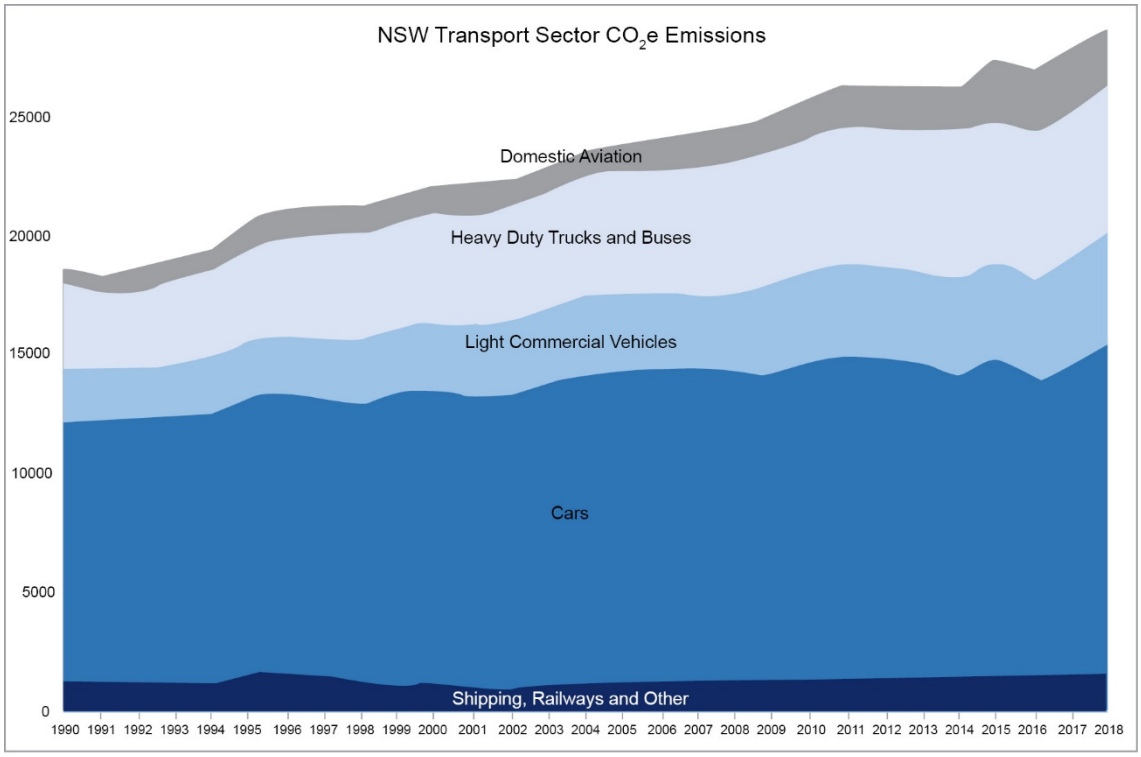
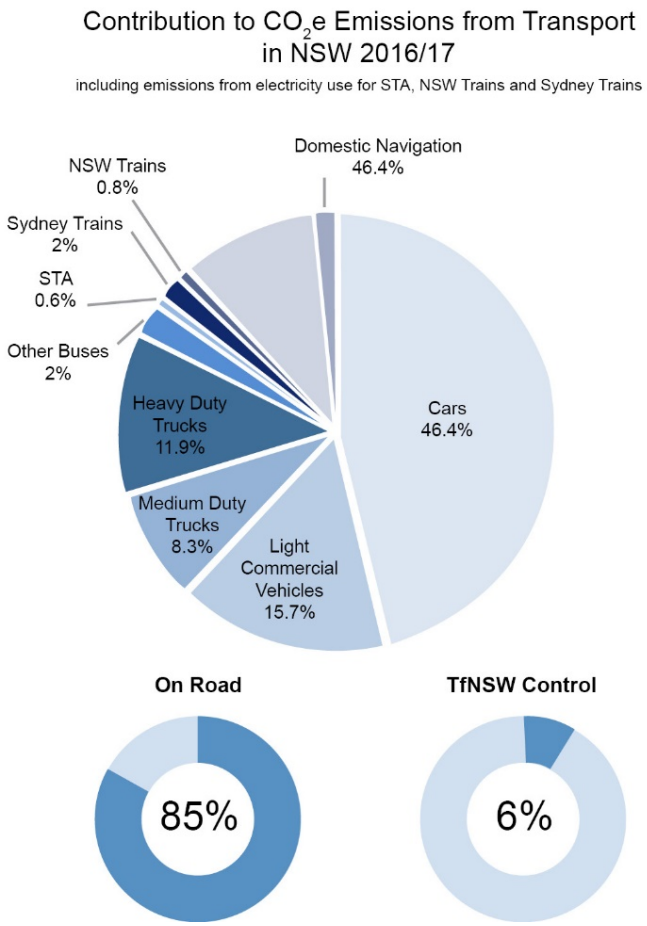


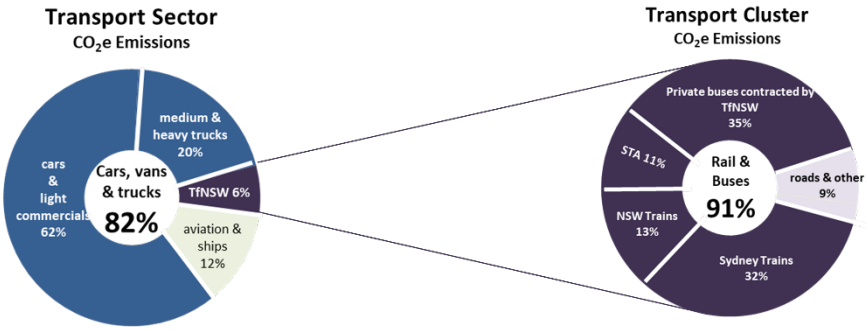
Figure 6 – NSW transport sector CO_2e emissions



On-road transport (cars, light commercial vehicles, trucks, buses and motorcycles) make up 85 per cent of total transport emissions.

Public and freight transport under the responsibility of Transport for NSW accounts for 6 per cent of transport sector emissions. These include on-road sources such as diesel buses, the electric Sydney train and light rail network and the diesel regional train network. Private cars, light commercial and heavy vehicles account for the majority of transport sector emissions.

Figure 7 – NSW transport emissions in 2016/17



Sector priorities

- Support electrification of passenger cars and light commercial vehicles
- Support development of low and zero technologies for medium and heavy freight

Cluster priorities

- Electrify buses and net zero electricity for buses and rail
- Embed carbon considerations in decision making and culture
- Support new renewable electricity generation

Figure 8 – Sector and cluster priorities

Transport for NSW recognises the opportunity to lead and influence and support the movement of the entire transport sector through actions taken within the cluster via the adoption of new technologies, implementation of operational efficiencies and a shift to renewable energy sources.

Under Future Energy, Transport for NSW will commit to the electrification of buses, powering of buses and rail with net zero electricity, supporting new renewable electricity generation and embedding GHG emission considerations in decision making and culture. By setting low and zero emission targets for its vehicle fleet and charging infrastructure, Transport for NSW will lead the uptake of electric vehicles for the transport sector as a whole. Similarly, by supporting hydrogen bus trials, we can demonstrate hydrogen's potential as a low emissions technology for heavy vehicles. This has wider implications and possibilities for the entire transport sector.

1.2 Technology

Humans have always used technology to solve their transport and energy problems, whether through the horse and cart, steam train, internal combustion engine, coal-fired power plant, car or aeroplane.

A major global transformation is taking place in transport and energy. In transport, the shift from traditional cars, buses and trucks using petrol, diesel and gas in internal combustion engines to electric, hybrid and hydrogen fuel cell vehicles is evident. In energy, a similar shift is occurring away from traditional fossil fuels to renewable sources such as solar and wind.

People are looking for – and finding – alternatives to private vehicles. Digitalisation and communication technologies have helped this shift, with innovative smartphone apps allowing users to switch seamlessly between modes of transport.

Digital technologies, and in particular the use of mobility data to direct traffic and improve services, is also rapidly evolving, allowing for operational energy efficiencies to be achieved without the need to build additional infrastructure.

1.3 Challenges and Opportunities

The next 10 years are critical. The NSW Government's Future Transport 2056 strategy provides a glimpse of the large economic and societal shifts we will see in the future – from the emergence of new technologies and mobility solutions to changing expectations from customers and communities about how they want to live, work and travel.

Transport for NSW is committed to making decisions that balance the needs of customers, communities and the people of NSW. We are developing the right set of policy tools to ensure emerging battery and fuel cell technologies and the transition to renewable energy are an opportunity to reduce our emissions, not a barrier. Meeting this challenge will require innovation, agility and adaptability in a rapidly changing environment.

The economics of today's technologies are driving the greatest transformation of Australia's energy system since the 1950s. Wind and solar are now the cheapest forms of new electricity generation. These technologies do not emit GHGs during operation. When paired with firming technologies such as batteries or pumped hydro, they can reliably supply renewable electricity when the sun is not shining and the wind is not blowing. They are the lowest cost option to replace coal fired power stations as they reach the end of their economic life.

Transport for NSW is undergoing a period of transition, with a move towards the preferential purchase of low and zero emission car fleet and bus vehicles, increasing the provision of electric vehicle charging stations and installing solar panels on existing infrastructure.

The Sydney Metro commitment to 100 per cent renewable energy for its operation includes the procurement of electricity from a new solar precinct, as well as Power Purchase Agreements (PPAs) to buy renewable electricity at competitive rates and protect against future volatility in electricity prices.

Reducing emissions from road freight transport is a significant challenge. Low and zero emission technology is arriving at market for light commercial vehicles and medium duty urban freight, although the technology is not yet as mature as for passenger vehicles. Greenhouse gas emissions from heavy duty vehicles are predicted to continue to grow in Australia and throughout the world.

Hydrogen fuel cell technology is anticipated to be the most likely means of enabling deep cuts in emissions from heavy vehicles in the medium to longer term. Fuel cell electric vehicles have a longer range, lighter batteries and use similar fuel pumping infrastructure to diesel. However, these emerging technologies are at the developmental stage rather than the market ready stage and so their implementation will lag behind the uptake of battery electric light vehicles.

2. The international, national and state policy context

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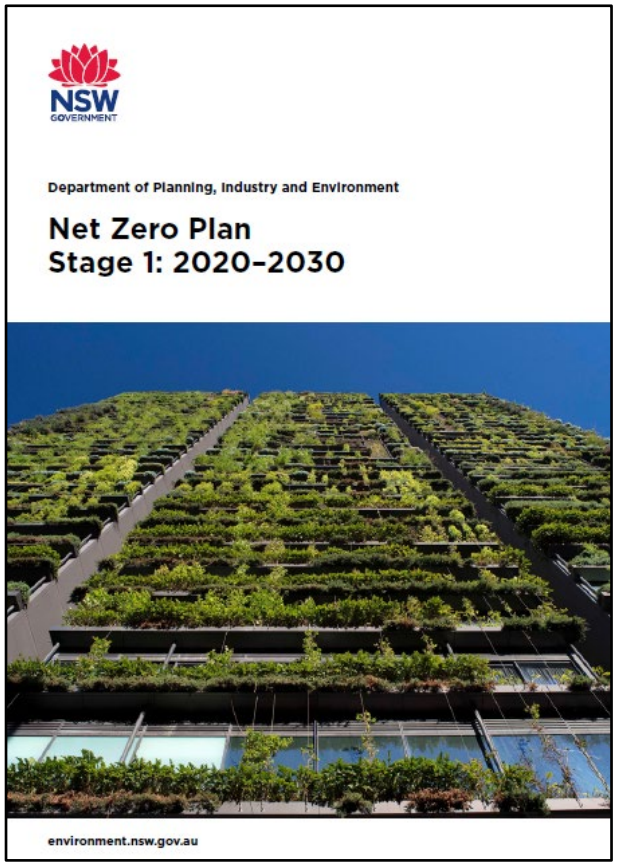
2. The international, national and state policy context

Australia has committed to reduce its GHG emissions by five per cent on 2000 levels by 2020, and to between 26 and 28 per cent below 2005 levels by 2030, in line with the 2015 United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement. This intends to keep global warming below two degrees Celsius and pursue limiting the rise to 1.5 degrees Celsius. The Paris Agreement, agreed to by 195 countries, has an objective of achieving net zero emissions[3] globally by 2050. The agreement includes a review of emission reduction targets every five years from 2020.

The Australian Government has implemented a number of market-based schemes and initiatives, such as the National Energy Productivity Plan (NEPP), Emissions Reduction Fund, Renewable Energy Target, ClimateActive, National Climate Resilience and Adaptation Strategy and the Clean Energy Finance Corporation to support action on climate change and drive investments in energy efficiency and emission reduction activities.[4]

In 2016, the NSW Government announced its aspirational target to achieve net zero emissions by 2050, which was outlined in the NSW Climate Change Policy Framework.[5] The framework aims to maximise the economic, social and environmental wellbeing of NSW in the context of a changing climate, and current and emerging international and national policy settings and actions to address climate change.

The NSW Government is making efforts to reduce GHG emissions, increase climate change resilience, maximise renewable energy use and improve energy productivity and efficiency through policies and initiatives, such as the NSW Climate Change Fund, NSW Renewable Energy Action Plan and other clean energy initiatives, NSW Government Resource Efficiency Policy, NSW Energy Savings Scheme and the Electric and Hybrid Vehicle Plan.



In March 2020, the NSW Government released the Net Zero Plan Stage 1: 2020–2030, which sets out how the NSW Government will achieve net zero emissions by 2050 by creating jobs, cutting household costs and attracting investment. The Plan focuses on the next decade as rapid changes in technology present both challenges and opportunities in identifying the least cost path to net zero. A bilateral memorandum of understanding between the NSW and Commonwealth governments provides support for the Net Zero Plan.

[3] Net zero carbon emissions means no emissions occur at all or any emissions that do occur must be captured and stored or offset.
[4] See list of Australian Government initiatives here: https://www.environment.gov.au/climate-change/government
[5] The NSW Climate Change Policy Framework does not have any targets for the reduction of GHG emissions in individual sectors of the economy.

Future Transport 2056 sets the 40-year vision, directions and outcome framework for customer mobility in NSW. Future Transport 2056 outlines six state-wide customer outcomes to guide investment, policy, reform and service provision. These provide a framework for planning and investment to harness rapid change and innovation to support a modern, innovative transport network. One of Future Transport 2056's outcomes is for a transport system that is economically and environmentally sustainable, affordable for customers and supports emission reductions.

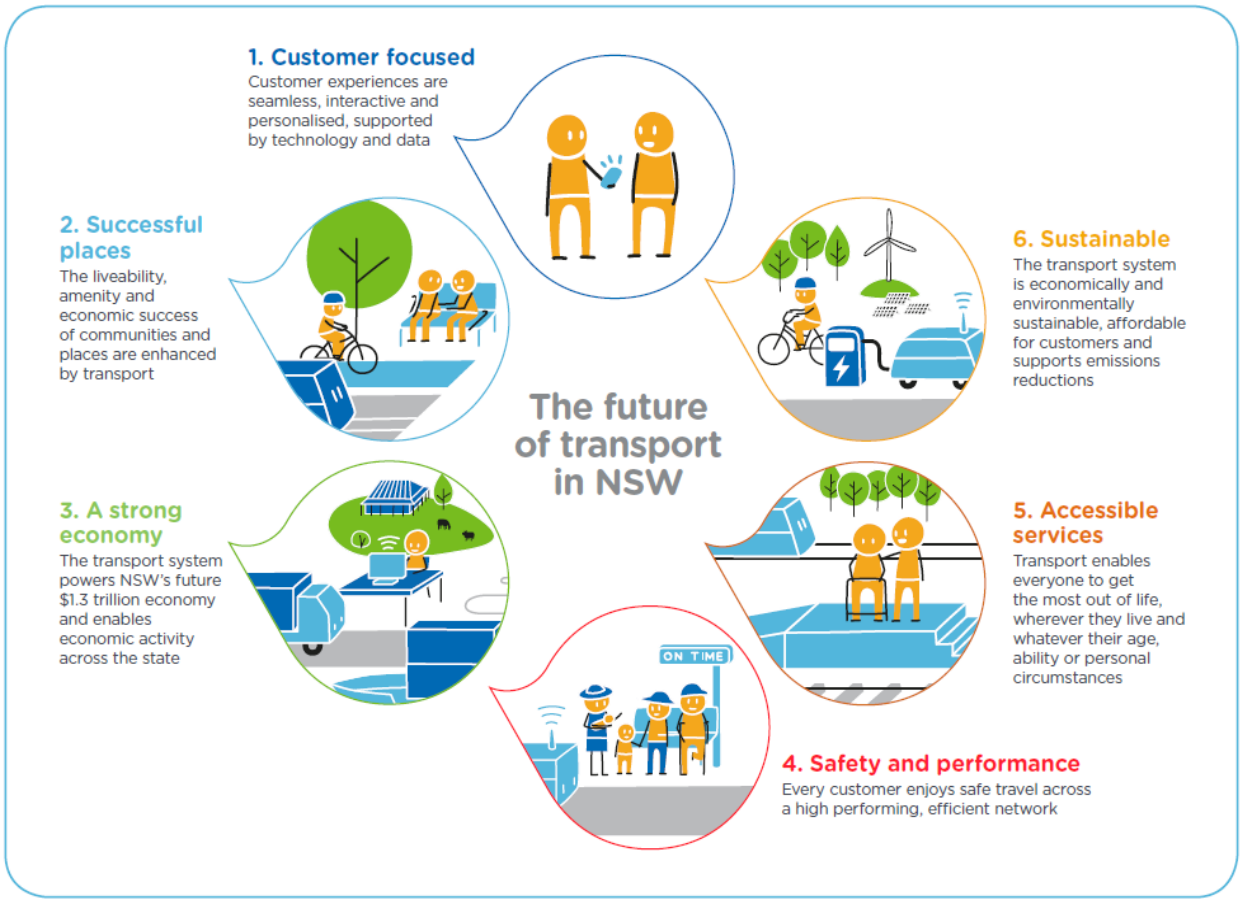


Figure 9 – Future Transport 2056 customer outcomes

3. How this Strategy operates

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3. How this Strategy operates

Future Energy is an enabling and supporting framework comprising:

- the Future Energy Strategy, which describes the key pillars needed for the transformation of the transport sector to net zero emissions
- an Action Plan, which sets out priority actions across the Transport cluster. Implementation of Future Energy will be adaptive, collaborative and flexible. We will respond to changes and learn from experience, delivered through Action Plan annual updates.

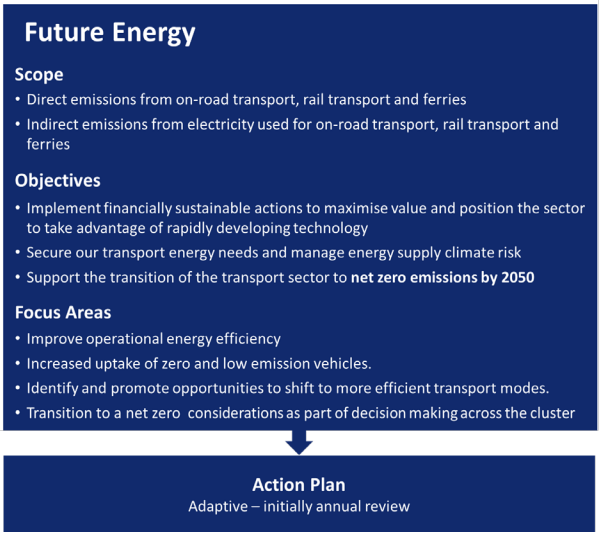

Figure 10 – Future Energy Strategy

Figure 11 – Sydney Metro

4. What does the Strategy address?

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Direct emissions from road, rail and ferry transport.

Indirect emissions from electricity used for road, rail and ferry transport.

Future Energy addresses both direct and indirect emissions from road, rail and ferry transport.

Direct emissions are from the use of fossil fuels in internal combustion engines of transport vehicles. They also include emissions from vehicles used for construction and maintenance activities.

Indirect emissions are from the use of fossil fuel generated energy to power transport vehicles, as well as emissions from construction and maintenance activities.

The National Greenhouse and Energy Reporting (NGER) scheme follows international conventions and classifies emissions into scopes at a facility or business level. Although not strictly applicable at a sector level, it is useful to think of the direct emissions from transport as Scope 1, and the indirect emissions from electricity generation as Scope 2.

- **Scope 1** emissions are the direct result of an activity or series of activities. For example, emissions from the exhaust of NSW diesel trains are Scope 1 emissions for Transport for NSW. Scope 1 emissions are required to be reported under the NGER scheme.
- **Scope 2** emissions are from the indirect consumption of energy. Scope 2 emissions from one facility are part of the Scope 1 emissions from another facility. For example, the emissions from the generation of electricity to run the train network are scope 2 missions for Transport for NSW, and Scope 1 emissions for the electricity generator. Scope 2 emissions are required to be reported under the NGER scheme.
- **Scope 3** emissions are indirect greenhouse gas emissions other than Scope 2 emissions generated in the wider economy. They occur as a consequence of activities of a facility, but from sources not owned or controlled by that facility's business. Scope 3 emissions are not required to be reported under the NGER scheme. Scope 3 emissions from one facility are part of the Scope 1 emissions from another facility. For example, the emissions from electricity used to manufacture a train would be Scope 3 emissions for Transport for NSW, Scope 2 emissions for the train manufacturer, and Scope 1 emissions for the electricity generator.

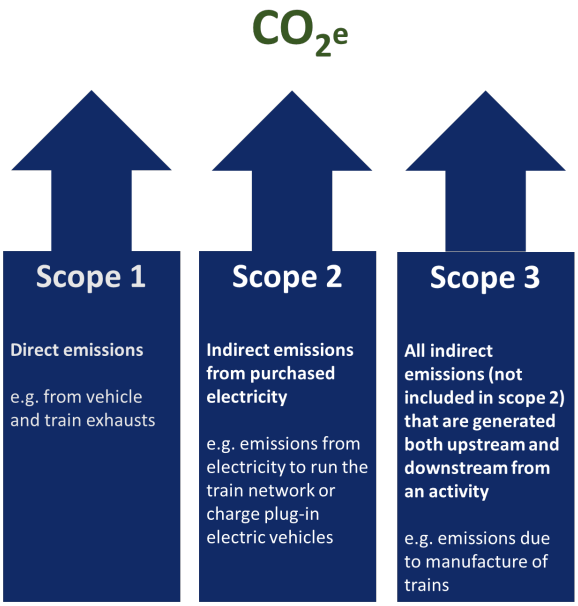

Figure 12 – Direct and indirect emissions

The broader, economy-wide indirect emissions – or Scope 3 – are not covered by this strategy, as state, national and international initiatives are working to reduce Scope 1 and Scope 2 emissions at a state, national and international level. As Scope 1 and Scope 2 emissions reduce, Scope 3 emissions will fall naturally as a consequence.

5. What are the objectives of the Strategy for Transport for NSW?

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Implement financially sustainable actions to maximise value and position the sector to take advantage of rapidly developing technology.

Secure our transport energy needs and manage energy supply climate risk.

Support the transition of the transport sector to net zero emissions by 2050.

The NSW Government is embracing advances in technology and renewable energy to deliver emissions reductions while providing economic opportunities.

There are significant opportunities for the transport sector to increase uptake of electric vehicles, embrace innovations in hydrogen fuel cell technology and shift towards renewable energy sources. Actions by Transport for NSW during this period of transformation will contribute to the state-wide transition to a net zero economy while securing energy needs, maintaining a strong economy and protecting the environment.

Implement financially sustainable actions to maximise value and position the sector to take advantage of rapidly developing technology

There are four major global technology trends shaping the future of transport and innovation at a rapid pace. They are automation, connectivity, electrification and sharing.

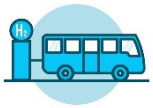
The transport sector's transition to a low emissions environment will need to leverage new technologies, in particular electric batteries, fuel cell technology and the use of renewable energy sources.

Low and zero emissions technologies are becoming cost competitive as global demand for low emissions products and services continues to grow and mature. Since 2010, the cost of solar generation has fallen by more than 73 per cent, while electric vehicle battery prices have decreased by more than 85 per cent[6].

As prices continue to fall, there will be opportunities to support economic growth, jobs and lower long-term energy costs for transport. Investing in proven technologies now will position NSW to rapidly access these benefits. For Transport for NSW this includes:

- Growing the pool of electric vehicles and charging infrastructure used by Transport for NSW, sending a clear demand signal to the market for vehicles which will ultimately have lower fuel and maintenance costs

- Undertaking hydrogen bus trials. Hydrogen fuel cells are a strong contender for heavy freight, and bus trials can play a key role in incubating this technology by demonstrating the use case and building capability and expertise.



Secure our transport energy needs and manage energy supply climate risk

Moving from imported liquid fuels to domestically generated electricity improves energy security and can produce significant cost savings. Currently, the average driver can save about $1,300 on fuel costs and about $300 on maintenance costs[6] a year by switching to an electric vehicle.

Over the coming decades, NSW coal fired generators will approach the end of their operational life and are expected to be retired. New renewable generation (such as wind and

6 Net Zero Plan Stage 1

solar) supported by energy storage technology (such as pumped hydro, batteries and thermal storage) is expected to replace most of the retiring coal fired power stations.

Transport for NSW is well placed to lead the market through how it sources electricity to operate the Sydney train network, electric buses and other infrastructure such as office spaces and depots.

Support the transition of the transport sector to net zero emissions by 2050

As a significant emitter of greenhouse gases, the transport sector plays a key role in operating in a more sustainable way to limit environmental impacts and contribute to the NSW Government's target of achieving net zero emissions by 2050.

Transport for NSW is well placed to be a leader and innovator in reducing emissions from the transport sector to net zero by increasing the electric passenger vehicle and bus fleet, adopting digital technologies to improve traffic flow, investing in the incubation of hydrogen fuel cell technologies for heavy duty vehicles and moving to local, renewable energy sources for electric trains, light rail and buses.

Transport for NSW recognises that greenhouse gas emissions from heavy vehicles are predicted to increase in Australia and globally. While the NSW Government does not run a significant heavy vehicle fleet, Transport for NSW will work with private logistics and freight companies who are best placed to identify the barriers and opportunities for emission reductions from freight.

Figure 13 – Increasing the number of electric vehicles in the TfNSW fleet

6. Focus areas

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6. Focus areas

Identify and promote opportunities to shift to more efficient transport modes.
Improve operational energy efficiency.
Support and enable increased uptake of zero and low emission vehicles.
Transition to a secure, cost-effective, low emission energy supply.
Embed low carbon considerations as part of decision making across the cluster.

6.1 Energy hierarchy and transport transformation

The Future Energy focus areas reflect the energy hierarchy. Transport will be 'lean' (minimising energy demand), 'clean' (energy-efficient and low emission) and 'green' (intelligent use of renewable energy and technologies).

The transformation of the transport sector to net zero emissions rests on two pillars:

1. The mobility transformation is about changing how people get around. The goal is efficiency – decreasing overall energy consumption in the transport sector without restricting individual mobility by reducing demand and improving efficiency.

2. The energy transformation is about the energy used to fuel transport. One of the simplest and most effective ways to reduce emissions from transport is converting vehicles that run on fossil fuels to vehicles that run on renewable electricity generated by zero emissions sources like wind and solar.

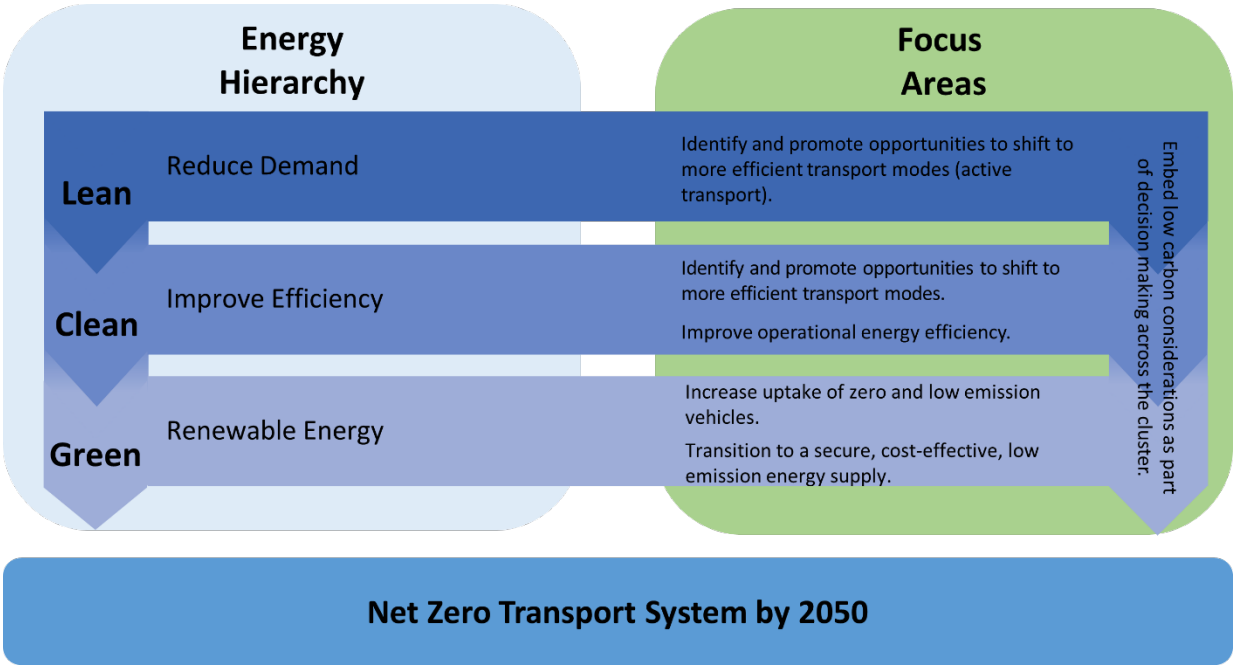


Figure 14 – Net zero transport

Lean: reduce demand

Reducing demand eliminates the need for energy in the first place. The challenge is to reduce demand for high energy consumption and high emission transport without restricting individual mobility. People want to be mobile because they cannot meet all of their needs in one place. The number of kilometres travelled is not the key measure of mobility. Mobility can be associated with long or short journeys and different transport modes. It can require much effort or little. It can result in high emissions or none.

Transport energy demand is strongly influenced by urban form. Energy consumption per capita rises proportionally as city density falls because of longer transport distances and reliance on private transport. A dense urban structure with mixed uses supports demand reduction as it involves shorter travel distances and encourages active transport such as walking and cycling.

Integrating land use and transport planning provides possibilities for people to satisfy their mobility needs without making long trips using motorised transport. Future Transport sets out how the NSW Government is integrating land use and transport planning to support community safety, health and wellbeing, and enhance community assets and local character.

Demand reduction can also be achieved through behavioural changes; for example, not making a journey and conducting a meeting virtually instead. The dramatic increase in people working remotely during COVID-19 has signalled long term opportunities to reduce the number of days with a commute.

Clean: improve efficiency

The energy efficiency of transport is the distance travelled by passengers or freight divided by the total energy used for the transport.

The objective is to improve efficiency, decreasing final energy consumption in the transport sector without restricting individual mobility.

Mode shift to more efficient forms of transport is one way of improving efficiency. For example, public transport is a more efficient form of motorised passenger transport than a single occupancy passenger internal combustion engine vehicle.

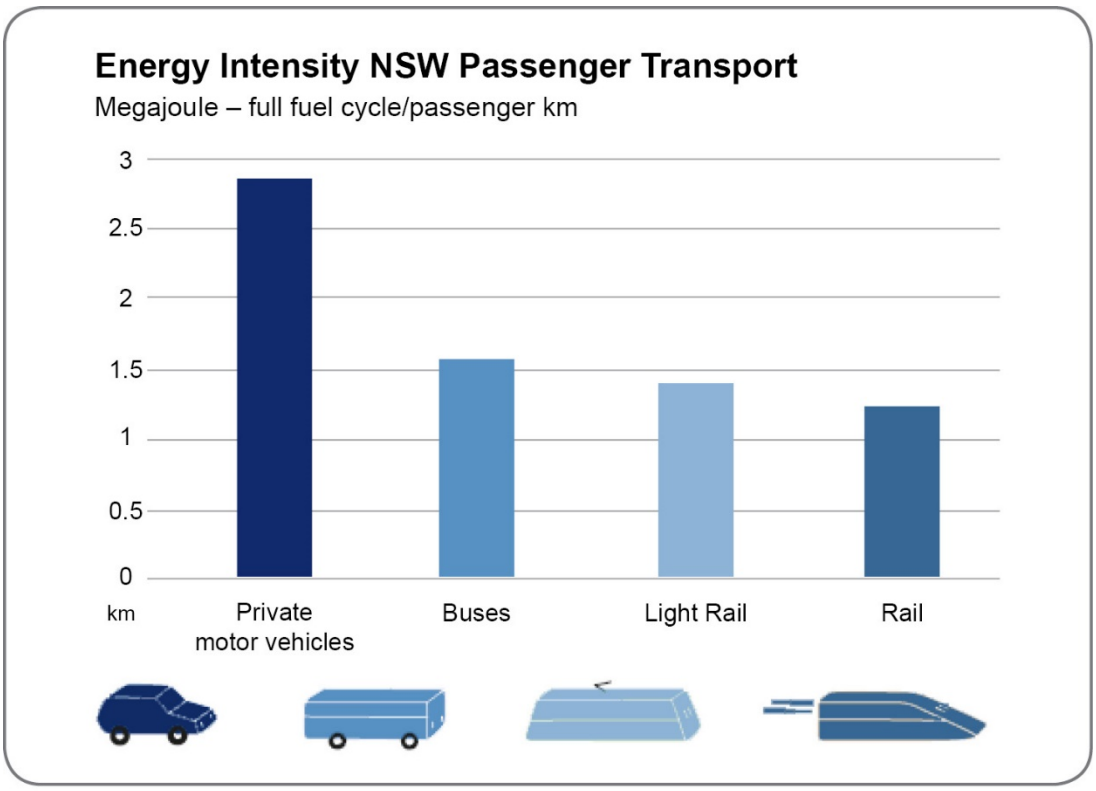


Figure 74: Energy intensity of passenger transport (prepared using data from NSW Transport Facts 2015 prepared by The Centre for Transport, Energy and Environment and Pekol Traffic and Transport)[16]

16 Full fuel cycle refers to emissions resulting from end-use energy consumption plus those resulting from feed stock extraction and refining, power generation and energy distribution.

Figure 15 – Energy intensity of passenger transport

Mode shift also has a role to play in freight transport. Rail freight is particularly energy efficient because of the high load factor, however, its flexibility is limited. A sophisticated logistics network, including multimodal logistics centres, can help to shift freight to more efficient modes of transport.

The transition to electric vehicles can also deliver significant efficiency gains. Conventional internal combustion engines only convert about 12 to 30 per cent of the energy stored in fuel to power at the wheels. Over 60 per cent of in internal combustion engine (ICE) vehicle's fuel energy is wasted as heat.

Battery electric vehicles (BEVs) are significantly more efficient than internal combustion engines. A BEV drive system is 60 per cent to 73 per cent efficient, depending on drive cycle. However, if the energy recaptured from regenerative braking is included, BEVs are 77 to 100 per cent more efficient[7].

BEVs also have zero emissions of traditional urban pollutants such as nitrogen oxides and GHGs from the tail pipe. However, they are not net zero until their electricity is generated using renewable energy.

[7] https://www.fueleconomy.gov/feg/atv-ev.shtml

Green: Renewable Energy

Net zero transport requires net zero energy.

Reducing demand will not eliminate the need for motorised vehicles. Efficiency improvements will not result in net zero emissions while the energy is from non-renewable sources. To achieve net zero emissions, the transport sector will need to transition to renewable energy.

Renewable electricity is currently the only mature renewable energy with the potential to power transport at scale. It can be deployed either directly (for example, battery cars, electric trains) or in the form of other energy carriers (such as hydrogen). Direct use of electricity is the preferred option where feasible as it is the most efficient use of energy. There are potentially significant energy losses when converting to other carriers such as hydrogen.

Hydrogen has some advantages over direct use of electricity, particularly its flexibility, which is on par with traditional hydrocarbon based fuels. Hydrogen can be viewed as a potential replacement for diesel in many applications. When it is produced using renewable energy or processes, hydrogen becomes a way of storing and transporting renewable energy for use at a later time. Although hydrogen is in its infancy in the market as a transportation fuel, government and industry are working toward clean, economical, and safe hydrogen production and distribution for widespread use in fuel cell electric vehicles (FCEVs). Light-duty FCEVs are now available in limited quantities to the domestic consumer market and around the world. The market is also developing for buses, material handling equipment (such as forklifts), ground support equipment, medium and heavy-duty vehicles, and stationary applications.

6.2 Identify and promote opportunities to shift to more efficient transport modes

Moving people from private vehicles to more efficient transport modes reduces congestion and the transport sector's emissions intensity, improve air quality and support community health and wellbeing.

Well planned centres and cities enables a shift from private cars to public transport and active transport modes such as walking and cycling. Sydney is working towards the delivery of three 30 minute cities, supported by a reliable 'turn up and go' mass transit service. Already, Sydney is leading the country in mass transport use per capita, and this is growing strongly[8].

[8] https://chartingtransport.com/category/mode-shift/

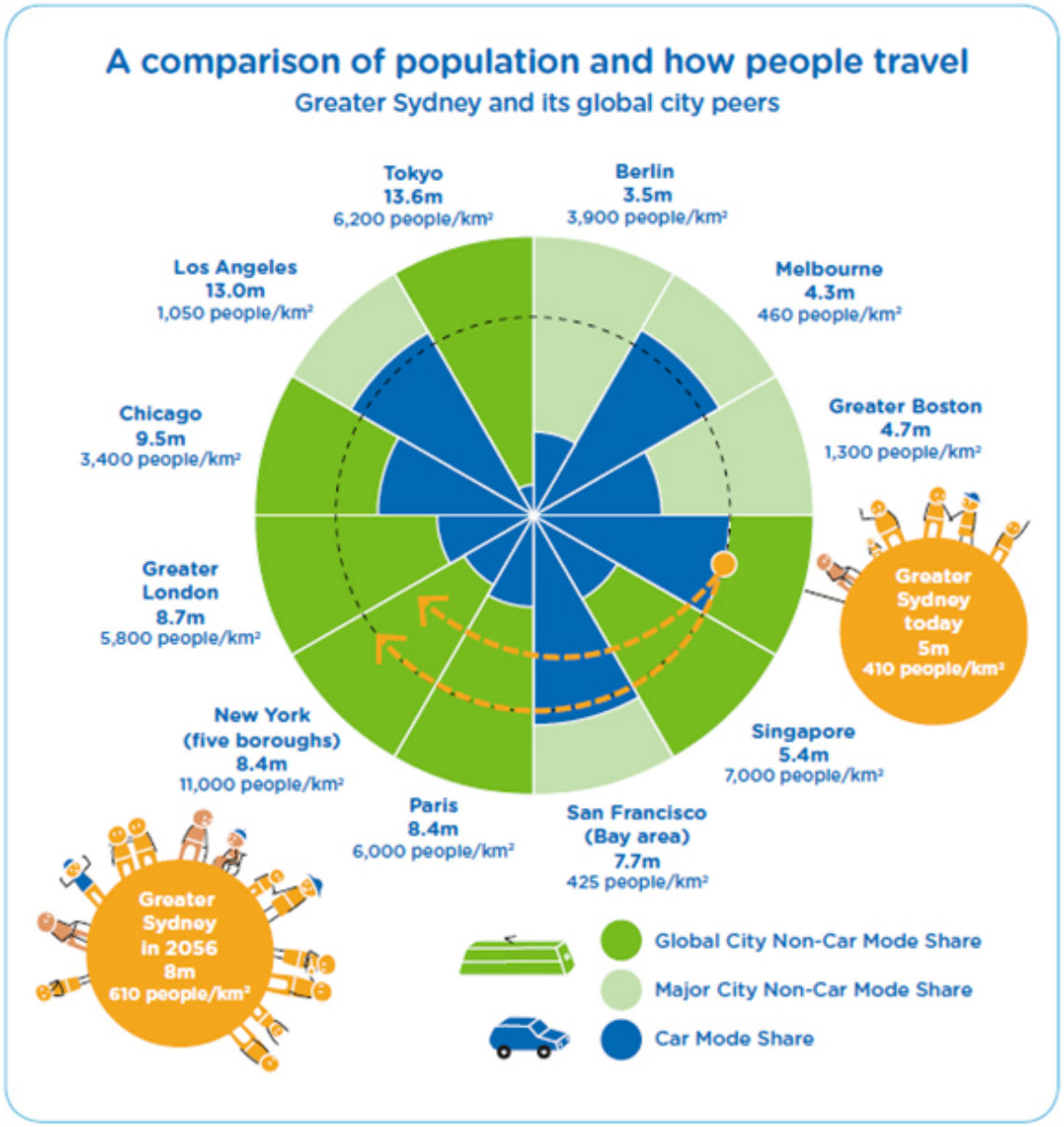


Figure 16 – Sydney's car mode share compared with other global cities

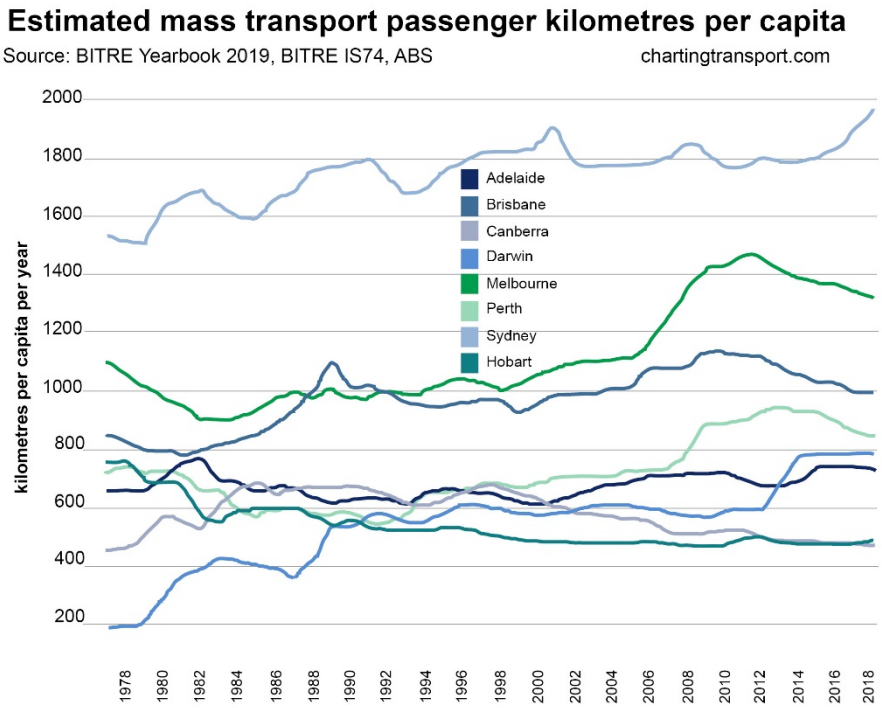


Figure 17 – Sydney leads Australian cities in mass transport statistics

The shift from private transport to more efficient public transport can be supported through technology, such as Mobility as a Service (MaaS).

Mobility as a Service describes a shift away from private modes of transportation towards combining transportation services from public and private solutions into a unified door-to-door service. The Future Transport 2056 Strategy highlights that: "the future of mobility is customer-focused, data-enabled and dynamic. In the future, personal mobility packages will bundle traditional modes with technology platforms and new service offerings like on-demand, car share, rideshare and smart parking".

Figure 18 – Example of a MaaS subscription plan[9]

[9] https://www.sydney.edu.au/business/news-and-events/news/2018/08/05/mobility-as-a-service.html

Essential to the concept is the idea of a single interface through which customers create and manage their total journey, with payment to all service providers coming from a single account and a single payment, possibly through a monthly subscription.

Transport for NSW and industry are working together to give customers improved travel options that suit individual needs and circumstances across a variety of transport routes:

- Trip Planner integrates planned and real time information, including capacity information, travel alerts and trackwork
- Trip Go is a Transport for NSW-endorsed app where users can choose to prioritise reducing CO_2 emissions when planning their journey

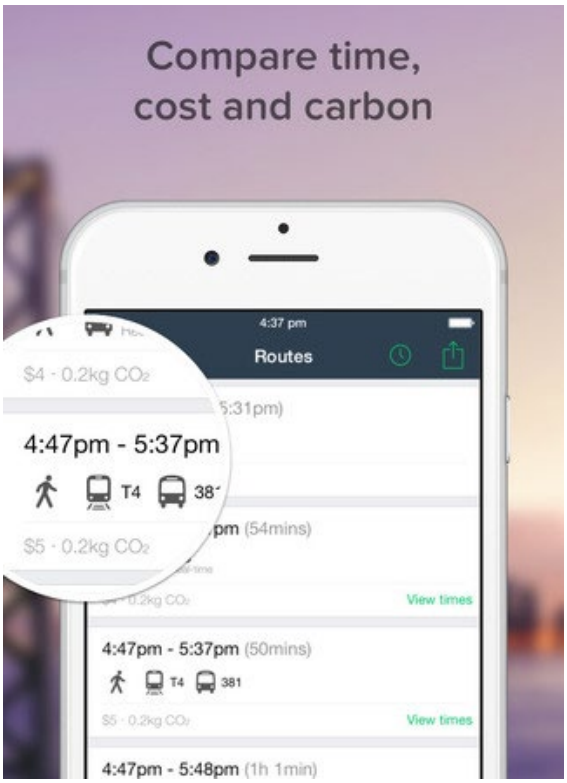


Figure 19 – TripGo app

- The Transport Digital Accelerator is a collaboration between Transport for NSW and private industry that supports MaaS pilot programs to address ways of providing a full door-to-door mobility experience by integrating mass transport with first and last mile options such as on-demand pick up and set down services.

6.3 Improve operational energy efficiency

As well as shifting to more efficient transport modes, more opportunities remain to increase the efficiency of individual modes of transport. Transport for NSW is working to improve operational energy efficiency through the following initiatives:

- Identifying and adopting new technologies that use real time information, communication and traffic control systems incorporated into and alongside roadways to improve traffic flow. Less stop-start traffic reduces fuel consumption and GHG emissions
- Adopting energy efficient lighting technology and smart lighting control systems in the road network. LED lighting has significantly lower electricity consumption, decreased failure rate and longer life cycle than incandescent and halogen lighting
- Improving the rail network's energy efficiency through energy efficient lighting and regenerative braking
- Improving the fuel-efficiency of our ferries.

6.4 Increase uptake of zero and low emission vehicles

Even with significant shifts to other modes, road transport will continue to play a critical component in providing mobility to NSW residents. The transition to low and zero emission vehicles will play a key role in our journey to net zero emissions. This transition has already begun.

In October 2019 the Minister for Transport announced that NSW would transition the 8000 strong public bus fleet to zero emission buses to take advantage of their significant environmental, health and operational cost benefits.

In 2019, as part of the Electric and Hybrid Vehicle plan, the NSW Government set a target that at least 10 per cent of its fleet

would be either hybrid models or battery-electric models by 2020-21.

Having met this target, the NSW Government has tripled the target for new hybrid or battery-electric vehicles in the NSW government fleet.

The Net Zero Plan sets a 30 per cent procurement target for hybrid and electric vehicles by 2023, with at least 10 per cent of the government's fleet to be battery-electric vehicles.

Figure 20 – Zero emissions electric bus

6.5 Transition to a secure, cost-effective, low emission energy supply

As global demand for low emission products and services continues to grow and mature, these technologies move down the cost curve. As prices continue to fall, there will be opportunities to support economic growth, jobs, globally competitive businesses and exports.

When combined with storage technologies, such as batteries and pumped hydro, renewables are now the cheapest forms of new, reliable electricity generation. These economics are driving their deployment around the world, creating construction and maintenance jobs.

The Net Zero Plan outlines how the NSW Government is planning to deliver three Renewable Energy Zones in the Central West, New England and South West to replace retiring generators with renewable energy. Over the next 20 years these Zones are anticipated to bring up to 17,700 megawatts of cheaper, renewable power into the grid, drive up to $23 billion of private sector investment and create about 2000 construction jobs each year in regional NSW.

Figure 21 – Electricity from solar panels is helping reduce emissions on Sydney Metro Northwest

Transport is leading the way in regards to using renewable energy, with emissions from the operation of the $8.3 billion Sydney Metro Northwest fully offset with renewables through a corporate renewable power purchase agreement.

Large Scale Generation Certificates

Once renewable electricity is generated and fed into the grid, it is indistinguishable from electricity generated from fossil fuels. The only way to know that renewable energy was produced is to assign it a Renewable Energy Certificate (REC). Every megawatt hour that is produced by an accredited renewable electricity generator and fed into the grid is eligible for an REC under Australia's Renewable Energy Target (RET). The Clean Energy Regulator distinguishes between small-scale (<100kW) and large-scale (>100kW) renewable energy generation. RECs generated by large-scale generation are called Large Scale Generation Certificates (LGCs). Accredited renewable energy generators are awarded one LGC for every megawatt hour of renewable electricity generated. LGCs are separate from purchased electricity and as such can be bought and sold separately.

Sourcing Renewable Electricity from the Grid

By purchasing and surrendering a number of LGCs equivalent to the electricity you source from the grid, you offset the retired LGCs against your electricity consumption – effectively sourcing 100 per cent renewable electricity through the grid. Although technically an offset, purchasing and retiring LGCs is the mechanism for sourcing renewable electricity from the grid. This is how authorised entities (typically electricity retailers) achieve the RET.

A simplified schematic of the large scale renewable electricity market is shown in Figure 22.

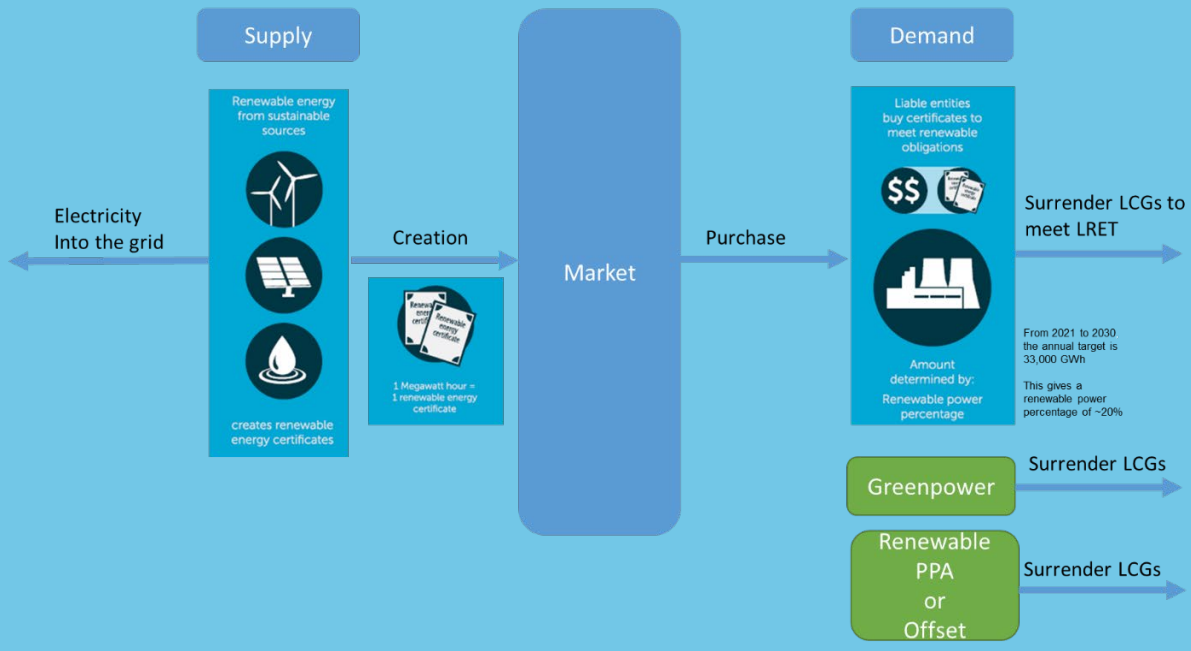


Figure 22 – Large scale renewable electricity market

The easiest way to source renewable electricity through the grid is to purchase GreenPower, renewable energy generation accredited by the Australian Government. GreenPower accredits electricity retailers to purchase and surrender LGCs when the customer purchases GreenPower. Although GreenPower comes at a premium to grid electricity contracts, it is straightforward and a good option for smaller energy users who may not be able to enter into a Power Purchase Agreement (PPA).

Larger electricity users typically source renewable grid electricity using some form of renewable Corporate Power Purchase Agreement. A Corporate Renewable PPA is an agreement for the supply and sale of electricity from a renewable source, typically for a fixed price over a longer term. A PPA can provide lower electricity prices, as well as a hedge to protect against future price fluctuations, while the energy generator benefits from certainty of revenue.

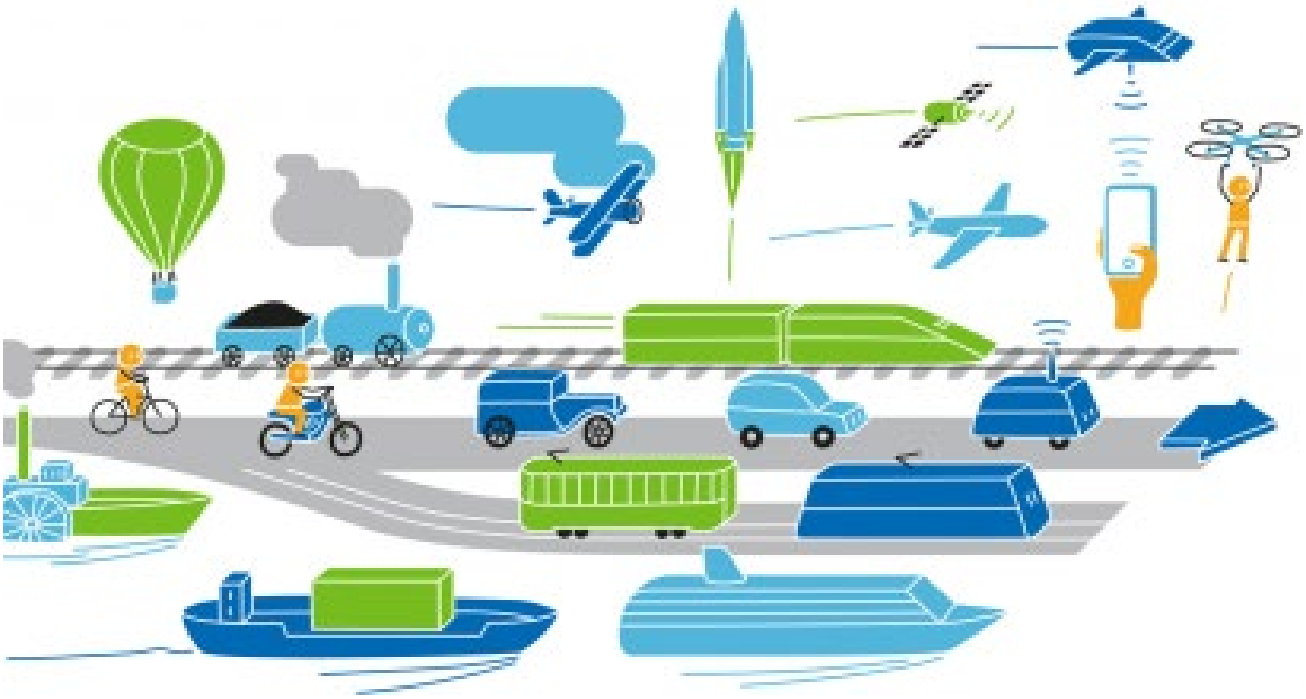
6.6 Embed net zero considerations as part of decision making across the cluster

Low emissions technologies are becoming commercially viable and new emerging technologies will potentially rapidly decrease in cost during our journey to net zero emissions.

Hydrogen may be an example of such a technology. Hydrogen can be produced from water and renewable electricity with little or no emissions. It can be used as a replacement for gas or diesel in many cases, and can be stored and transported. Research indicates fuel costs for hydrogen fuel cell vehicles are likely to fall as supply scales up. Hydrogen has the potential to transform the freight sector, with hydrogen fuel cell trucks providing zero emission freight.

In an environment of rapid change, we need to continually review our way of doing things to move early and leverage emerging opportunities to achieve net zero in ways that improve the State's prosperity.

Transport for NSW will work to embed net zero considerations into decision making so we can identify and take advantage of the rapid technological change in low emission energy.



7. Priority areas for action and headline actions

7. Priority areas for action and headline actions

To achieve net zero emissions by 2050, we need to transform the transport sector to zero emission energy, building on the Future Transport commitment to transition to a cost-effective, low emission energy supply.

Renewable electricity is currently the only mature zero emission energy with the potential to power transport at scale.

This is why the Future Energy Strategy and Action Plan has a particular focus on energy transformation, and the steps we can take now to transition the transport sector to renewable energy. These include:

1. Electrifying transport modes using renewable energy where feasible

2. Supporting demand for renewable energy.

The following section identifies priority areas for action at the cluster, transport sector and economy-wide level to build a strong foundation for the journey to a net zero transport system.

The headline actions have been developed to have a high impact on the priority areas for action. More detail on the headline actions, as well as all other actions, can be found in the Action Plan.

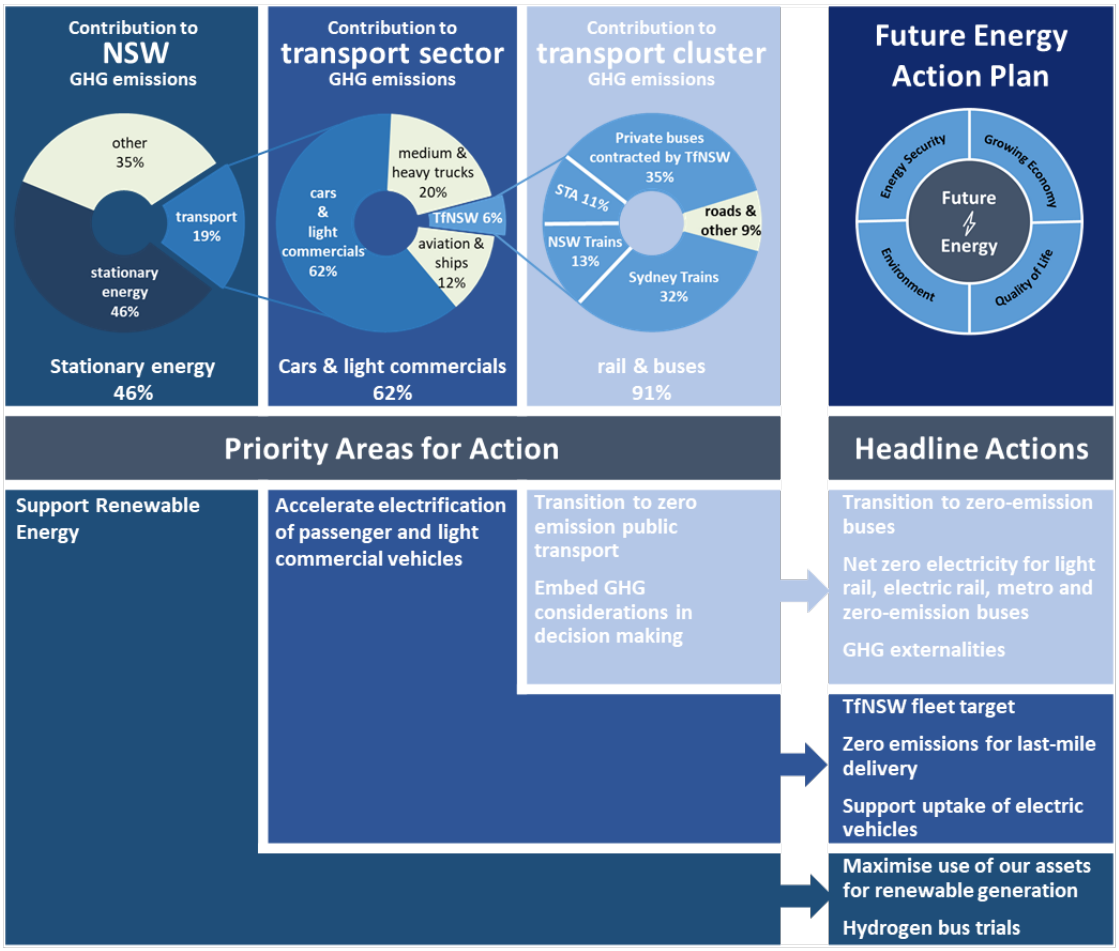


Figure 23 – Future Energy Action Plan

7.1 Cluster

As rail and buses account for 91 per cent of GHG emissions from the Transport for NSW cluster, ensuring net zero electricity is used to power rail and buses is the priority action for the cluster.

The remaining nine per cent of cluster emissions can be reduced through embedding net zero considerations in decision making and lifecycle costing for all projects.

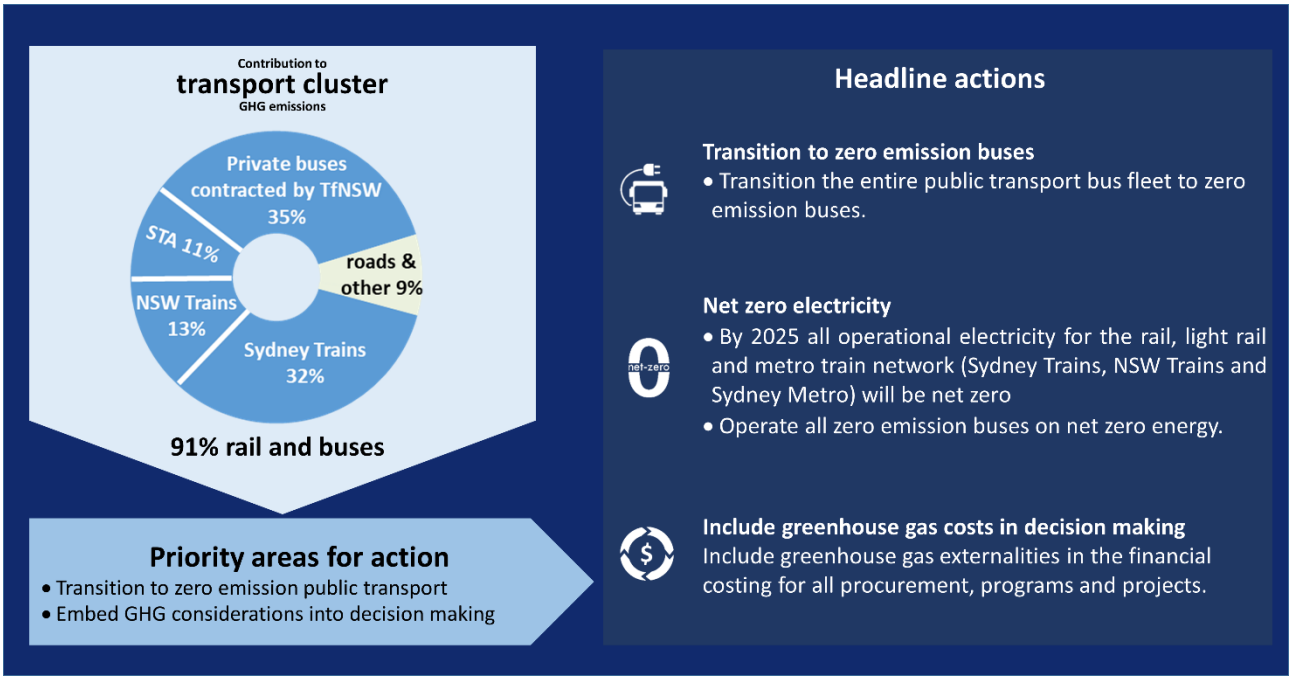


Figure 24 – Transport cluster emissions

7.2 Sector

On-road transport (cars, light commercial vehicles, trucks, buses and motorcycles) makes up 85 per cent of total transport emissions, with passenger and light commercial vehicles making up 62 per cent. Electric vehicles, especially when powered by renewable electricity, provide a pathway to significant reductions in emissions from on-road transport.

While electric passenger vehicles currently have higher purchase prices than petrol and diesel vehicles, they are forecast to cost to the same as traditional internal combustion engines by the end of the decade. A number of electric light commercial vehicles are coming to market, although the technology is not yet as mature as for passenger vehicles.

Accelerating the electrification of passenger and light commercial vehicles is a priority for the transport sector as a whole. Transport for NSW will provide initial leadership by electrifying the Transport cluster passenger vehicle fleet and updating the NSW Electric and Hybrid Vehicle Plan to support a similar uptake of private passenger electric vehicles. Transport for NSW will also support emission reduction initiatives such as last mile delivery and the development of low and zero emissions technologies for medium and heavy freight.

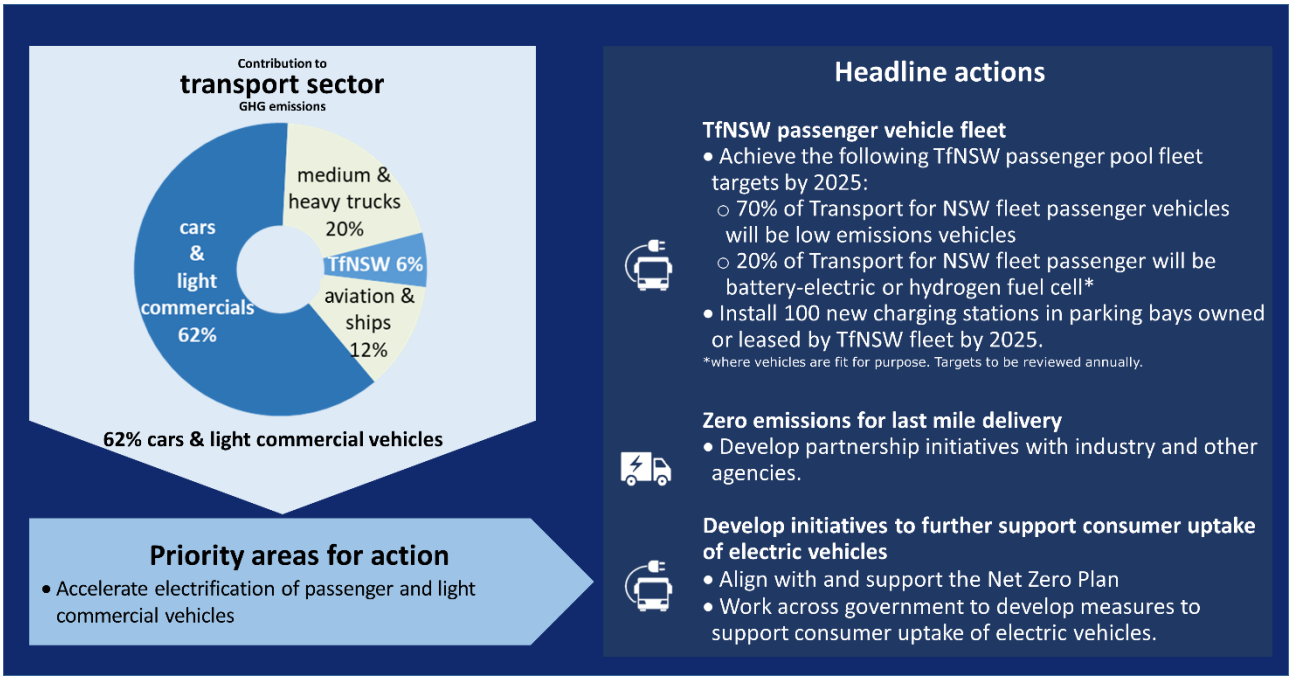


Figure 25 – Transport sector emissions

7.3 Economy wide

The transport sector is the second largest source of greenhouse gas (GHG) emissions in NSW. The sector is also a growing source of GHG emissions. In 2016-17, transport accounted for almost 19 per cent of the state's GHG emissions; an increase of 12 per cent since 2005. However, the largest source of GHG emissions is stationary energy use, which at 46 per cent accounts for almost half of all emissions in NSW. The shift to renewable energy sources is a significant economy wide priority. Transport for NSW can play an important role by undertaking hydrogen bus trials and ensuring we maximise the financially sustainable use of our assets for renewable energy generation – for example, rooftop solar.

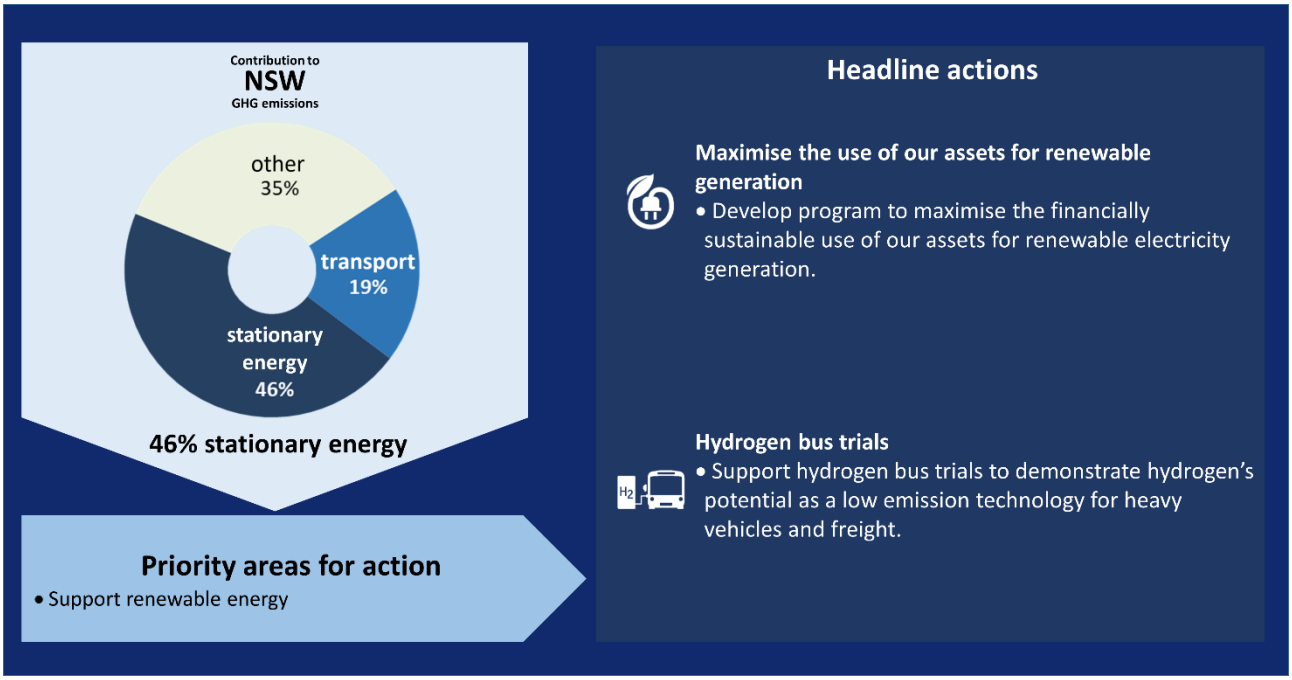


Figure 26 – NSW GHG emissions

8. Benefits of Future Energy

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8. Benefits of Future Energy

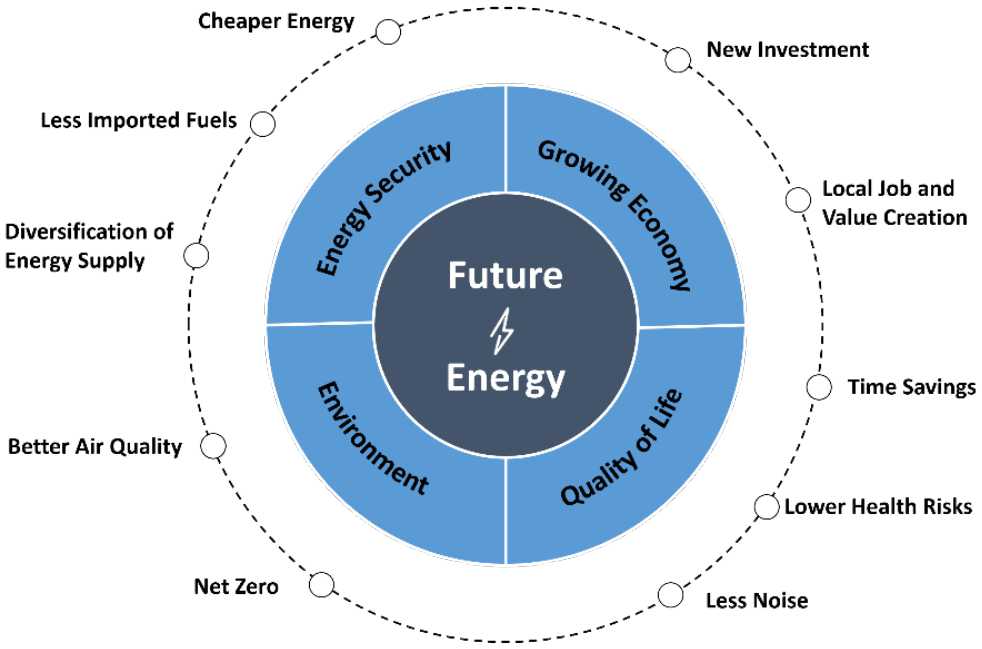

Figure 27 – The benefits of Future Energy

The prosperity of NSW depends on well-developed and extensive transport networks that move people, goods and resources domestically and offshore. Benefits of Future Energy include increasing energy security, supporting economic development, improving access to mobility, reducing traffic congestion, saving consumers money, reducing air and noise pollution and increasing public health and safety.

Reliance on liquid fossil fuels for transport is a particular concern for Australia, which imports the majority of its transport energy in the form of crude oil or refined petroleum products. A shift to locally generated renewable energy sources will improve energy security for individuals, businesses, NSW and Australia by diversifying the energy sources and reducing reliance on imported oil. Reducing fossil fuel use will also protect the NSW economy from the damaging effects of any period of rising oil prices. Embracing sustainable transport will support the economic competitiveness of NSW industry and provide opportunities for local businesses and manufacturing.

Battery-electric vehicles have zero tail-pipe emissions, improving air quality and reducing impacts on human health. A study by the American Lung Association found the widespread adoption of electric vehicles in 2030 would save US$13 billion in avoided health care expenditures and lost productivity. Electric vehicles are also considerably less noisy than internal combustion engines at low speeds. Less noise means less stress and lower long-term health risks.

Future Energy has the potential to support thousands of new jobs, many in regional areas, and create billions of dollars in economic growth between now and 2050. Much of how this opportunity will evolve remains uncertain, but there are risks in not acting early. Implementation of Future Energy will be adaptive, collaborative and flexible.

9. Delivering the Strategy

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9. Delivering the Strategy

Future Energy sets out the path towards achieving our vision where the people of NSW enjoy a world class, sustainable transport system that is efficient and powered by renewable energy. It describes how we will work to secure our transport energy needs and support the transition of the transport sector to net zero emissions by 2050.

Future Energy is supported by an Action Plan which sets out priority actions across the transport cluster. Achieving net zero emissions will require new approaches, and there will be many challenges along the way for which we do not yet have all the answers. New information and technologies will emerge during our journey which will need to be evaluated and incorporated into the Future Energy Action Plan. Implementation of Future Energy will be adaptive, collaborative and flexible. We will respond to changes and learn from experience, and regularly update the Action Plan for the first five years.

Transport for NSW will continue to collaborate across Government and with industry to find new ways of working together as we move toward net zero emissions. Emerging information and technologies will be considered as they arise to ensure Transport for NSW continues to effectively implement the strategy. The effectiveness of the actions will be evaluated as information becomes available, with progress publically available in annual updates. The Action Plan sets out the adaptive management approach and reporting framework that we will use for the implementation of Future Energy.

Figure 28 – Action Plan

Future Energy and COVID-19

Transport for NSW makes decisions that balance the needs of customers, communities and the people of NSW, both current and future. It is our responsibility to invest wisely on their behalf in the best transport solutions that serve a wide range of social and economic outcomes. We must both lead and enable innovation, creating an open and collaborative environment that entices and facilitates the delivery of new solutions into the market. To date, changes in transport trends over medium to longer term timeframes have primarily informed decision making processes.

However, the COVID-19 pandemic has presented an unexpected and globally disruptive crisis, fundamentally altering existing economic and social structures within a short period. There has been a significant decline in both private and public transport usage as a substantial proportion of workers transitioned to working remotely.

For the duration of the pandemic and beyond, Transport for NSW will lead by example in avoiding non-essential trips by continuing to support and encourage flexible work practices such as digital telepresence technologies for meetings and remote working for non-frontline workers.

The Transport for NSW Travel Choices team has also rapidly deployed the COVID-safe Travel Choices program to enable commuters to make informed and safe decisions about how and when they travel.

Without intervention, it is possible that the transition of transport systems to lower emission modes could be delayed or even return to emission intensive modes post-crisis. For example, as all activities of the automotive industry have been delayed, with practical constraints on access to car retailers and purchases deferred, production and sales have fallen across the entire car market – including electric vehicles. There is a need for flexibility where commitments have been made based on projected (pre-COVID) passenger numbers, trips and sales figures.

Transport for NSW recognises that there is now a unique opportunity to provide additional support for the transition to zero emissions, to both influence and respond to changing economic and social conditions that have occurred during the pandemic, including:

- embedding the shift to energy sourced from local, renewable sources to protect against international energy supply and price fluctuations
- stimulating the electric vehicle market through an ambitious electric vehicle fleet and charging infrastructure procurement program.

With a cohesive, whole of government approach, the NSW Transport sector will continue towards net zero in the post-COVID environment.

10. References

10. References

Australian Government (2015) *National Climate Resilience and Adaptation Strategy*, Australian Government, Canberra.

Council of Australian Governments (COAG) Energy Council (2015) *National Energy Productivity Plan 2015–2030*, COAG Energy Council, Canberra.

Department of the Environment and Energy (2018) *State and Territory Greenhouse Gas Inventories 2017*, Department of the Environment and Energy, Canberra.

NSW Department of Planning, Industry and Environment (2020) *Net Zero Plan Stage 1: 2020–2030*, NSW Department of Planning, Industry and Environment, Parramatta.

NSW Office of Environment and Heritage (2019) *NSW Government Resource Efficiency Policy*, State of NSW and Office of Environment and Heritage, Sydney.

NSW Trade and Investment (2013) *NSW Renewable Energy Action Plan*, NSW Trade and Investment, Sydney.

Transport for New South Wales (2018) *Future Transport Strategy 2056*, Transport for New South Wales, Chippendale.

Transport for New South Wales (2019) *NSW Electric and Hybrid Vehicle Plan*, Transport for New South Wales, Chippendale.

United Nations Framework Convention on Climate Change (2015) *Paris Agreement*, United Nations, Bonn, Germany.

Future Energy Strategy

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