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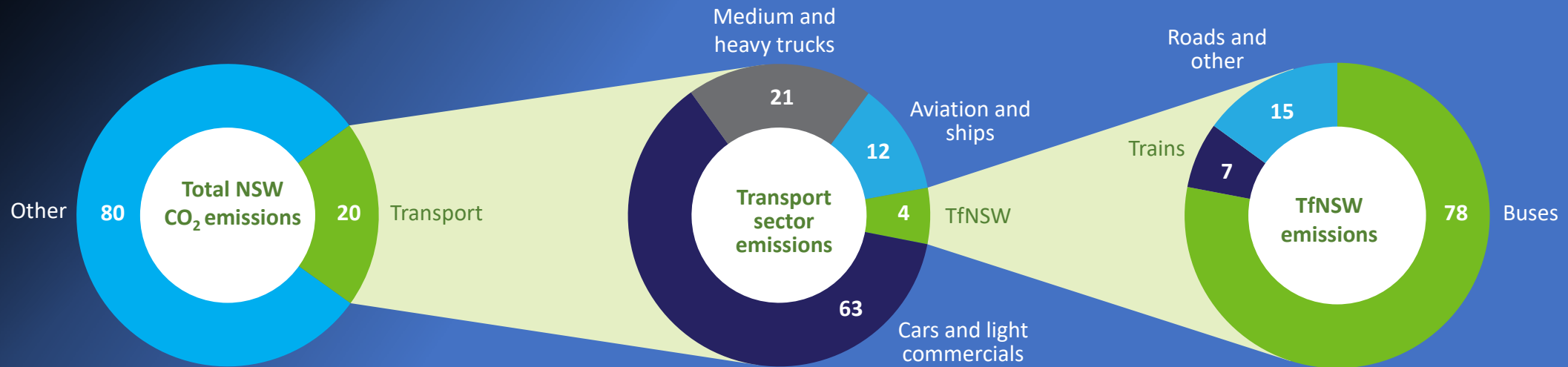
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# Zero Emission Buses Project

# Transport emissions

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The recent Sydney Trains and NSW TrainLink achievement of net zero emissions from electricity means buses are now responsible for 78% of TfNSW emissions and are the only outstanding public transport initiative that requires Capital funding.



## State economy

Transport is one of the largest contributors to emissions in NSW

## Transport sector

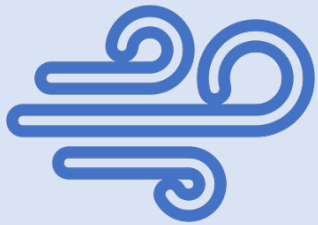
TfNSW is a substantial emitter, creating an opportunity for Government to lead the way to zero emissions

## TfNSW Modes

Buses comprise 78% of TfNSW's cluster emissions, are highly visible to the community and are key to achieving zero emissions

# Project outcomes for the environment

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## Cleaner and healthier

air quality and no harmful exhaust fumes,  
especially in urban environments

**Zero emission buses is a critical initiative which will contribute to the reduction of Greater Sydney's air pollution, which each year causes:**



**1,180**  
hospital admissions\*



**\$6.4b**  
in health costs\*

\* Based on 2015 data

### Improved passenger comfort and community experience

**vibrations  
& smoother  
ride**



**Quieter  
buses**




**up to  
254  
buses pass in the peak  
hour through Parramatta  
Interchange**

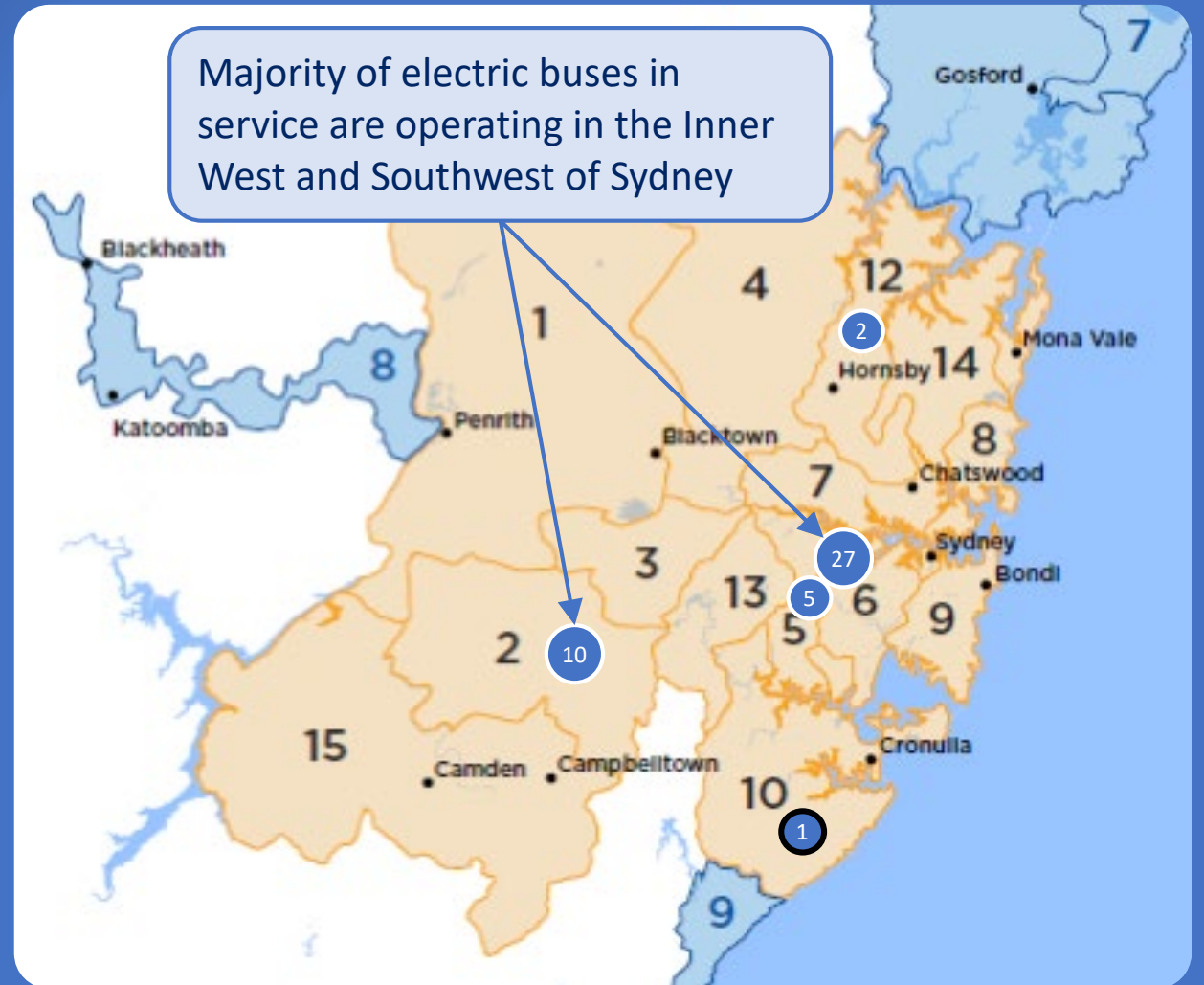
# Deployment of Zero Emission Buses

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45 electric buses are currently operating on Sydney roads across five depot regions.

- These buses are comprised from a range of manufacturers.
- TfNSW is on track to reach 102 electric buses on our roads by mid 2022.

Early deployment of **70+**  Zero Emission Buses will be in operation by the end of 2021.



# Project outcomes for our economy

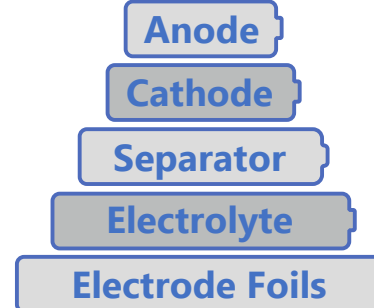
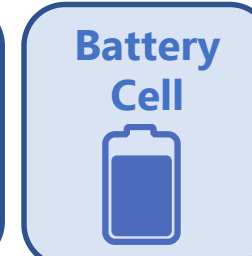
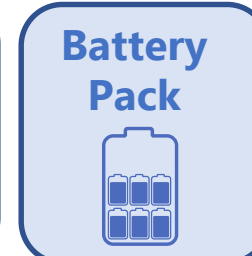
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**Investment boost**  
and new jobs, particularly  
in manufacturing  
and depot upgrades



Cobalt Co 27	Nickel Ni 28
Lithium Li 3	Copper Cu 29



**Recycling**

“ The Transition to ZEB is a catalytic event for new industries in NSW, including critical mineral processing and battery manufacturing. ”

- Investment NSW

# Sydney Zero Emission Bus Trials

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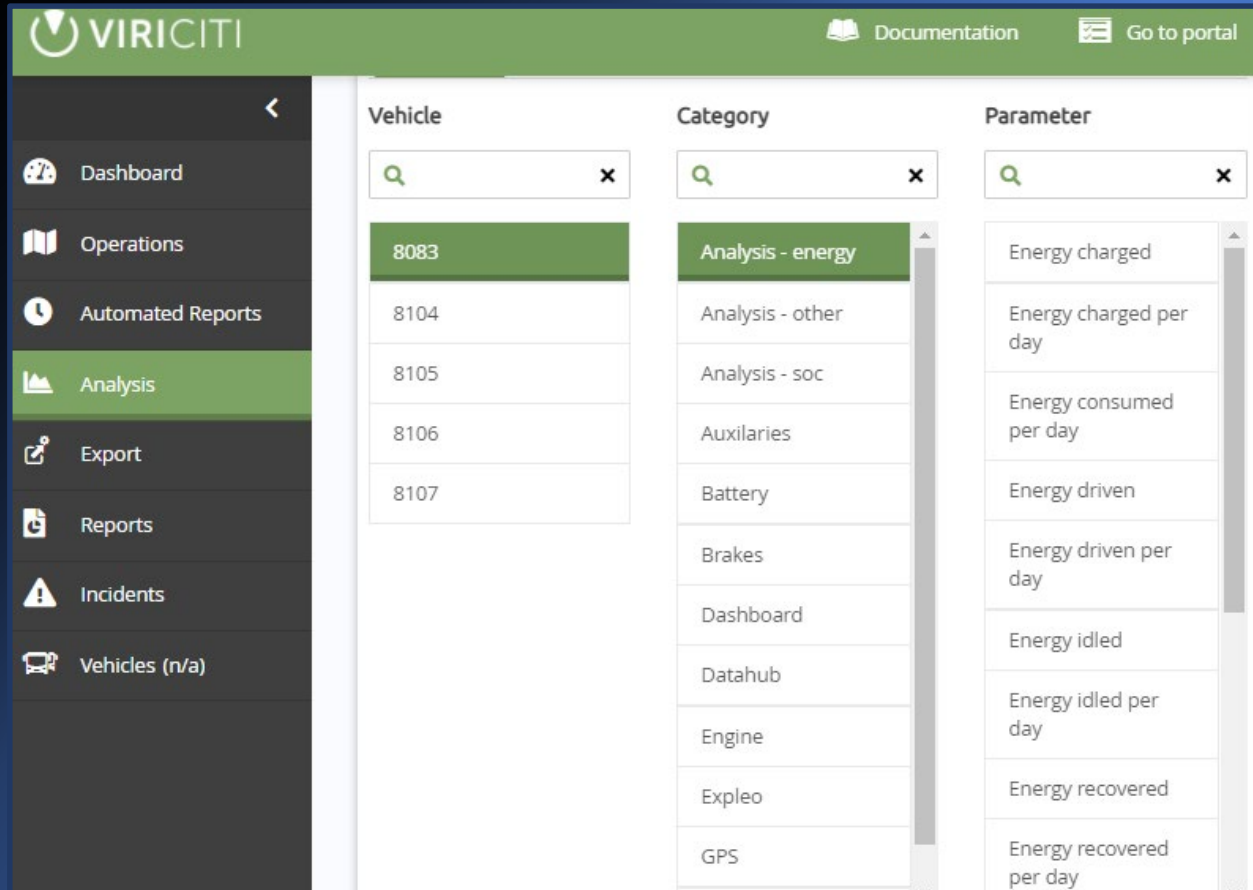


The buses exceeded expectations and employees are looking forward to the day when Zero Emission Buses become part of their day to day operations

# Zero Emission Bus Trials

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## Approach and measures



The screenshot shows the VIRICITI web application interface. The top navigation bar includes the VIRICITI logo, a 'Documentation' link, and a 'Go to portal' link. A left sidebar contains navigation options: Dashboard, Operations, Automated Reports, Analysis (highlighted), Export, Reports, Incidents, and Vehicles (n/a). The main content area displays a table with three columns: Vehicle, Category, and Parameter. Each column has a search bar with a magnifying glass icon and a close button (x). The table lists vehicle IDs (8083, 8104, 8105, 8106, 8107) and various energy-related parameters such as 'Energy charged', 'Energy consumed per day', and 'Energy driven per day'. The 'Analysis - energy' category is selected, and the 'Energy charged' parameter is highlighted in the list.

Vehicle	Category	Parameter
8083	Analysis - energy	Energy charged
8104	Analysis - other	Energy charged per day
8105	Analysis - soc	Energy consumed per day
8106	Auxiliaries	Energy driven
8107	Battery	Energy driven per day
	Brakes	Energy idled
	Dashboard	Energy idled per day
	Datahub	Energy recovered
	Engine	Energy recovered per day
	Expleo	
	GPS	

Trial buses were treated just like a diesel bus and given challenging routes and hours to operate.

Telematics data showed performance of these trial buses as being very good.



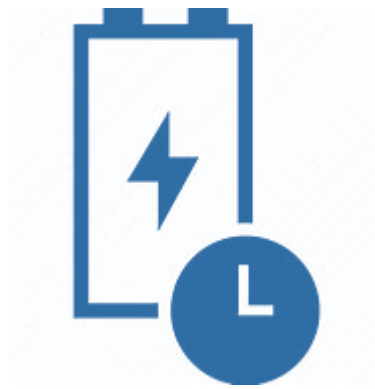
# Zero Emission Bus Trials

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## Performance statistics



Generally driving routes of 150-200 km of 11 to 12 hours with some service shifts up to 16 hours



2 – 4 hours to charge



30-35% additional charge from real driving conditions

# Zero Emission Bus

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## Driver & staff feedback

New technology has taken drivers imagination and they love it!

Need formal qualifications that operators are involved in developing

How will lack of adequate space in a depot be managed?

New training needed for mechanics

We need to collaborate through this process

Not a lot of training needed of drivers just a different approach in driving style

It's good to see what is coming next!

What happens during a power outage when all buses are electric?

# NSW Bus Fleet

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 c.8,300 buses across NSW\*



**Metro**  
(Sydney)

Predominantly two door city buses for public transport

**4,039**

34 depots



Buses



Operators

**9**



Contracts

**14**



**Outer Metro**  
(Outer Sydney)

Mix of public transport and school services

**1,092**

22 depots

**11**

**12**



**Regional**

Primarily school services, plus public transport in towns

**3,055**

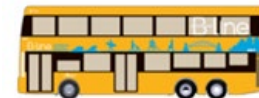
592 depots

**486**

**659**

Note: \*As of July 2021 Includes NSW TrainLink coaches and On Demand

## Sydney Metro Fleet Types

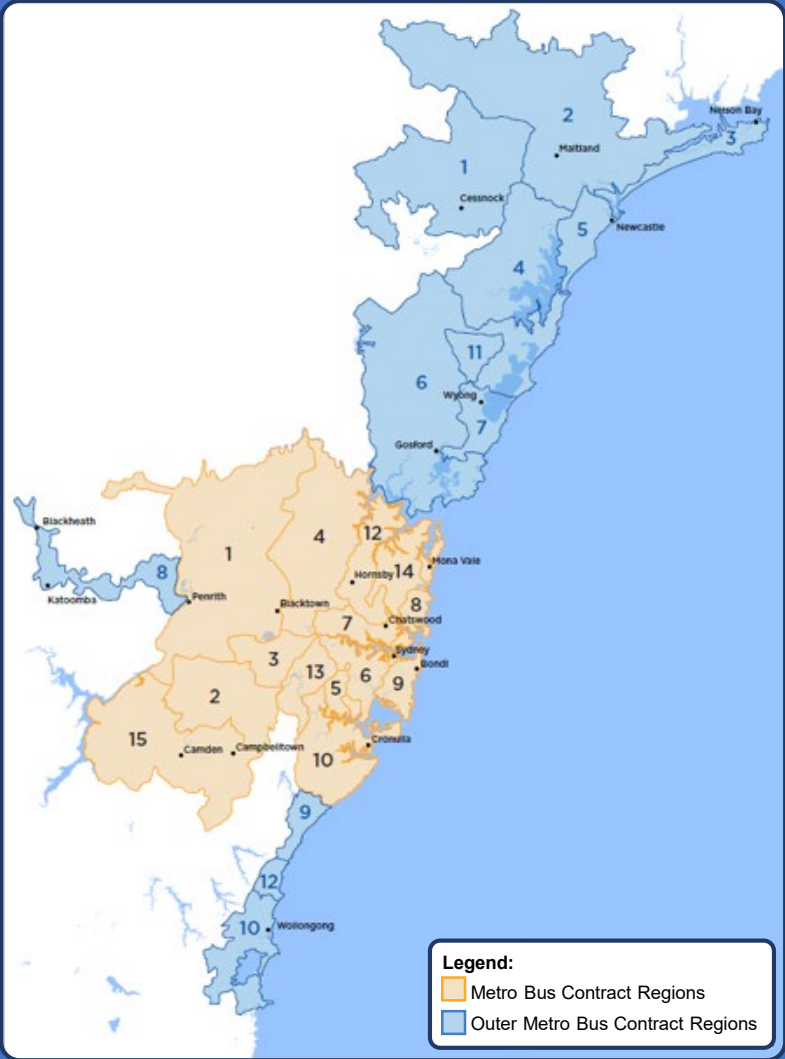
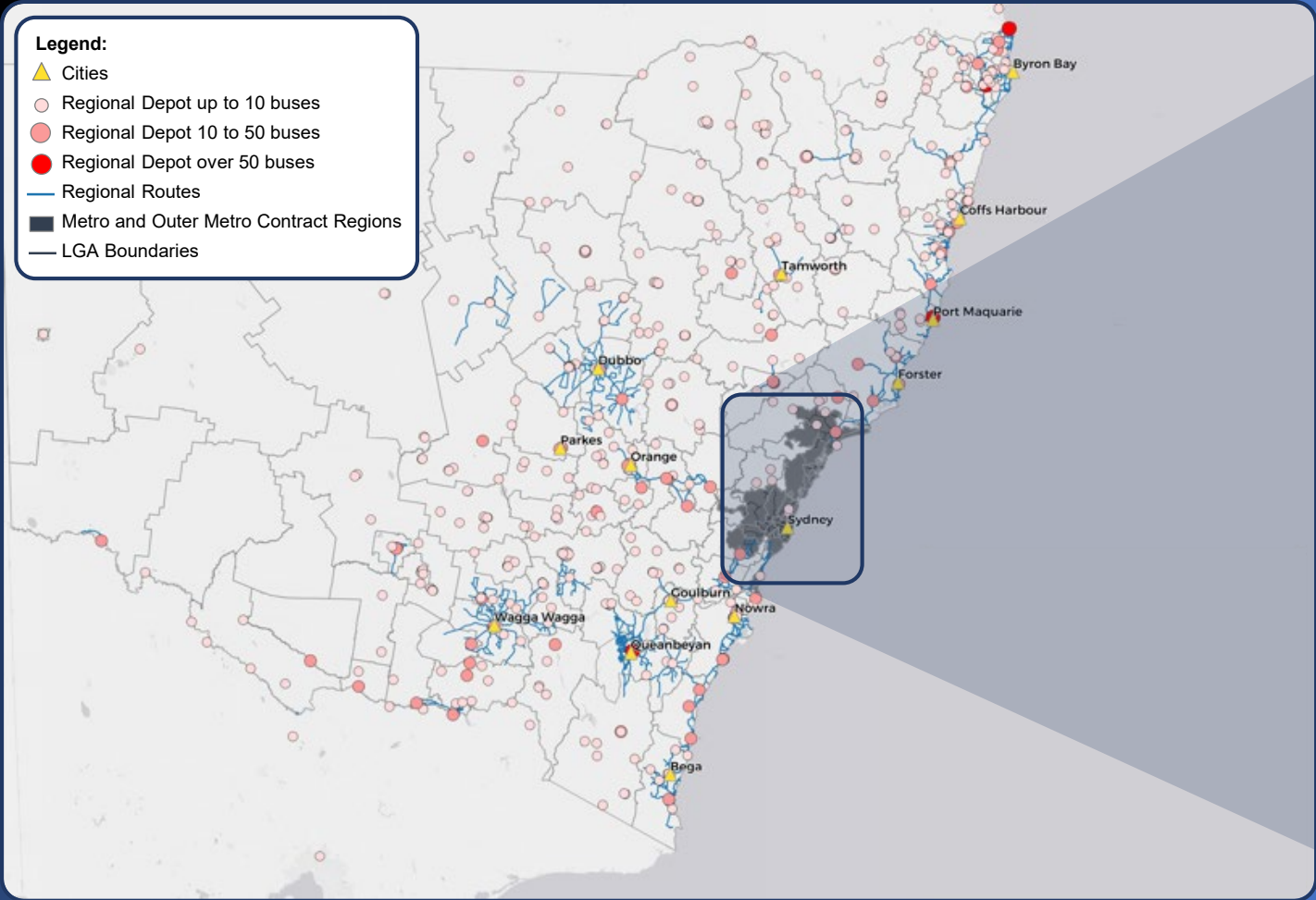


## Regional and Outer Metro Fleet Types



The transition of 8,300 buses to zero emissions technology is supported by bus procurement, grid and depot upgrades

# Bus service regions in NSW



# Bus service regions in NSW

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## Operational

### Scope 1: Emissions that “come out of tailpipe”

- Comprise up to 75% of total diesel bus lifetime emissions
- In addition to CO<sub>2</sub>, these can also impact the air quality of communities with particulate matter and noise pollution, depending on fuel type



## Total CO<sub>2</sub> emissions



## Energy sources

### Scope 2: Emissions that result from energy production

- Comprise up to 15% of total diesel bus lifetime emissions
- This includes emissions as a result of the end-to-end extraction and refinement of crude oil (diesel), or emissions from electricity generation which is required to power batteries or hydrogen production (via electrolysis)



## Manufacturing and asset disposal

### Scope 3: Emissions that result from the full bus supply chain

- Comprise up to 10% of total diesel bus lifetime emissions
- This includes bus manufacturing and assembly and disposal of end-of-life assets (e.g. shell, batteries, tyres)
- These type 3 emissions will be higher for imported buses

To achieve net zero, TfNSW will need to replace the existing diesel / CNG fleet with electric and/or hydrogen buses, purchase “renewable” (zero emissions) energy and work with industry to reduce emissions from manufacturing and asset disposal

# Zero Emission Bus Project Objectives

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A Zero Emissions Buses (ZEB) project team has been established to develop a business case to deliver the below objectives.



**Increase opportunities for local investment in manufacturing, assembly, training and education**



**Improve fuel security and cost certainty through removed reliance on ICEs**



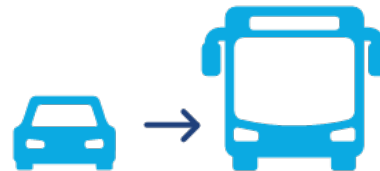
**Transition to net ZEB services through replacement of bus fleet powered by green energy sources in alignment with the Government targets**



**Improve liveability and contribute to successful places through reduction in bus noise and emissions, across the asset life cycle, supply chain and operations**









**Increase efficiencies in bus operations and maintenance**



**Increase mode shift to bus through improved customer experience**

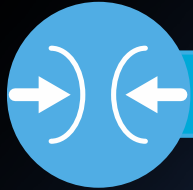
# Next steps for project development

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Categories	Deliverables to support transition
 <b>Cost and benefits</b>	Developing cost estimates and undertaking economic assessment
 <b>Energy</b>	Exploring renewable energy procurement options
 <b>Fleet</b>	Exploring and assessing Fleet technologies and supply chain readiness
 <b>Operational integration</b>	Planning for ZEB transition and integration
 <b>Depots</b>	Undertaking design and understanding depot requirements
 <b>Commercial</b>	Exploring contracting and financing models

# Key inputs and next steps for engagement

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Operational constraints during transition



Change management during the transition



Readiness for transition



Key challenges to transition



Explore opportunities this transition delivers

Transport for NSW will commence detailed engagement with operators to help inform current planning. Depot investigations and interviews will also commence with select operators which TfNSW has long term access or which have been identified for benchmarking.



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