Australia's National Science Agency

Draft method and assumptions

Electric and fuel cell vehicle projections

Paul Graham | 24 February 2021

2020 Report:
https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptions-methodologies/2020/csiro-der-forecast-report.pdf?la=en

Overview of CSIRO's EV model

- Methodology unchanged from 2020 ESOO

Inputs

Inputs and Assumptions

e.g. Historical EV sales, fuel efficiency, market changes, scenario settings.

Short-term Models

Long-term Model
(Consumer Adoption & Transport demand Model)

Outputs

1) Uptake and Sales of EVs

2) Proportion of Vehicles

3) Operational forecasts

4) EV Consumption forecasts

Short and long term EV projections are modelled separately

Short term projections

- Period: monthly to two years
- Method: Regression analysis (trend)

Long term projections

- Period: 2 to 30 years
- Method: Consumer technology adoption and Transport demand model

Transport demand model

Macroeconomic drivers

Passenger – population growth	Freight – GDP growth

Mode share assumptions

Passenger – active, road, rail, air	Freight – road, rail, air, shipping

Additional sector calculations

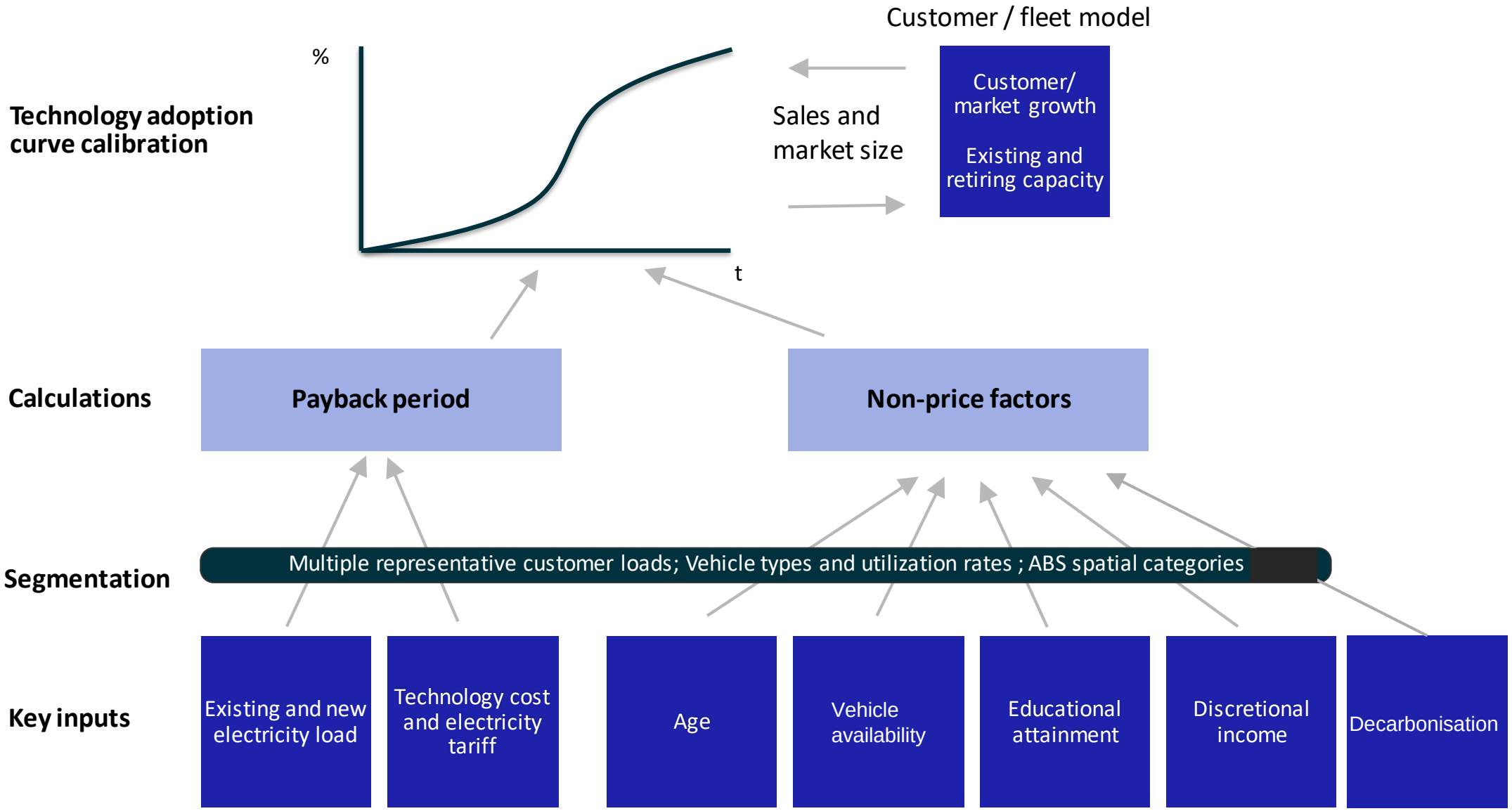
Road: Cost of travel elasticity and changes in passengers/tonnes per vehicle and trip length	Non-road: Future trends on fuel efficiency and fuel shares

Assumptions per scenario

Decarbonisation

CSIRO

Consumer adoption model



Impact on the electricity sector

EV electricity consumption (half hour to monthly)

- Half-hourly electricity consumption =

  No. Vehicles × ChargeProfiles × ChargeProfileShare

  (output) (assumed) (assumed)

- Monthly electricity consumption =

  No. Vehicles × km/month × kWh/km

  (output) (assumed) (assumed)

The uptake of electric vehicles is the main output from the model, but the assumptions are critical.

Draft assumptions

Most significant changes in assumptions

- Global vehicle manufacturing may not support ICE vehicle production post 2035
- Kilometres per year travelled
- Road user charges
- Inclusion of non-road transport
- Assumptions on charge profile applicability

Key assumptions of the EV model

Important before EVs are cost competitive:

- Change in upfront cost of EVs
- Any significant subsidies or taxes

Adoption is cost constrained

Important after costs approach ICE parity:

- Rate of import availability (unconstrained post 2030)
- Maximum allowable adoption rate as determined by
  - Availability of charging/fuelling to meet all circumstances
  - Social acceptance of EVs
  - Scenario setting such as strong role for hydrogen

Adoption is constrained by infrastructure or other practical matters

Exception: Collapse of ICE market and infrastructure overcomes all barriers

CSIRO

Other assumptions of EV model

- Cost Parity
  - Expected to range from 2025 to 2035
- COVID-19 impacts
  - COVID-19 has reduced vehicle utilisation, some of which is expected to be locked
- ICE Market Changes

- Non-road transport and electrification

Example model variables that impact vehicle uptake and charging behaviours

- Availability of ICE vehicles versus EVs and FCVs
- Road charges and other costs that influence cost parity outcomes
- Impact of COVID-19, assumed recovery, and impact on social acceptance of current business practices (e.g. working from home)
- Availability and cost of public and private charge facilities
- Tariff reform and cost influence of different charging preferences
- Vehicle to home technology and dynamic charging practices

ICE market, road user charges and BEV cost parity

	Lower Decarbonisation	Some Decarbonisation	Higher Decarbonisation
ICE market	ICE market remains unchanged	New vehicles unavailable beyond 2040. Second-hand vehicles follow natural retirement	New vehicles unavailable beyond 2040 and second-hand vehicles all unregistered by 2050
Road user charges	2.5c/km from 2025	2.5c/km from 2030	2.5c/km from 2035
BEV cost parity with ICE	2035	2030	2025

Utilisation of Vehicles and Covid-19

	Unchanged ways of working	Some change to working	Adopt new ways of working
Extent to which vehicle utilisation returns to pre-COVID levels	75% of difference is recovered by 2030	50% of difference is recovered by 2030	25% of difference is recovered by 2030
COVID-19 has accelerated permanent shift to greater share working from home		Somewhat changed	Yes
Climate policy ambitions encourage greater use of telepresence			Yes

Non-road transport and electrification assumptions

Scenario	Electrification commencement date		Maximum share by 2050
	Rail freight	Aviation	%
Lower Decarbonisation	2045	2045	1
Some Decarbonisation	2040	2040	5
Higher Decarbonisation	2030	2030	10

Profile share assumptions - residential

By 2050	Lower uptake	Some uptake	Higher uptake
Convenience	75%	70%	50%
Night	5%	5%	5%
Vehicle to home/grid	10%	15%	30%
Fast/highway	5%	5%	5%
Day/solar aligned	5%	5%	10%

Compared to 2020, reduced reliance on non-dynamic day time charging and increased utilisation of convenience charging. Evidence has shown home charging is presently preferred and convenience is valued. Stronger climate ambition and greater renewables implies stronger likelihood for dynamic participation

	2020 assumptions		
By 2050	Slow change	Central	Step change
Convenience	31%	33%	6%
Night	6%	8%	23%
Vehicle to home/grid	0%	0%	36%
Fast/highway	5%	5%	5%
Day/solar aligned	58%	54%	30%

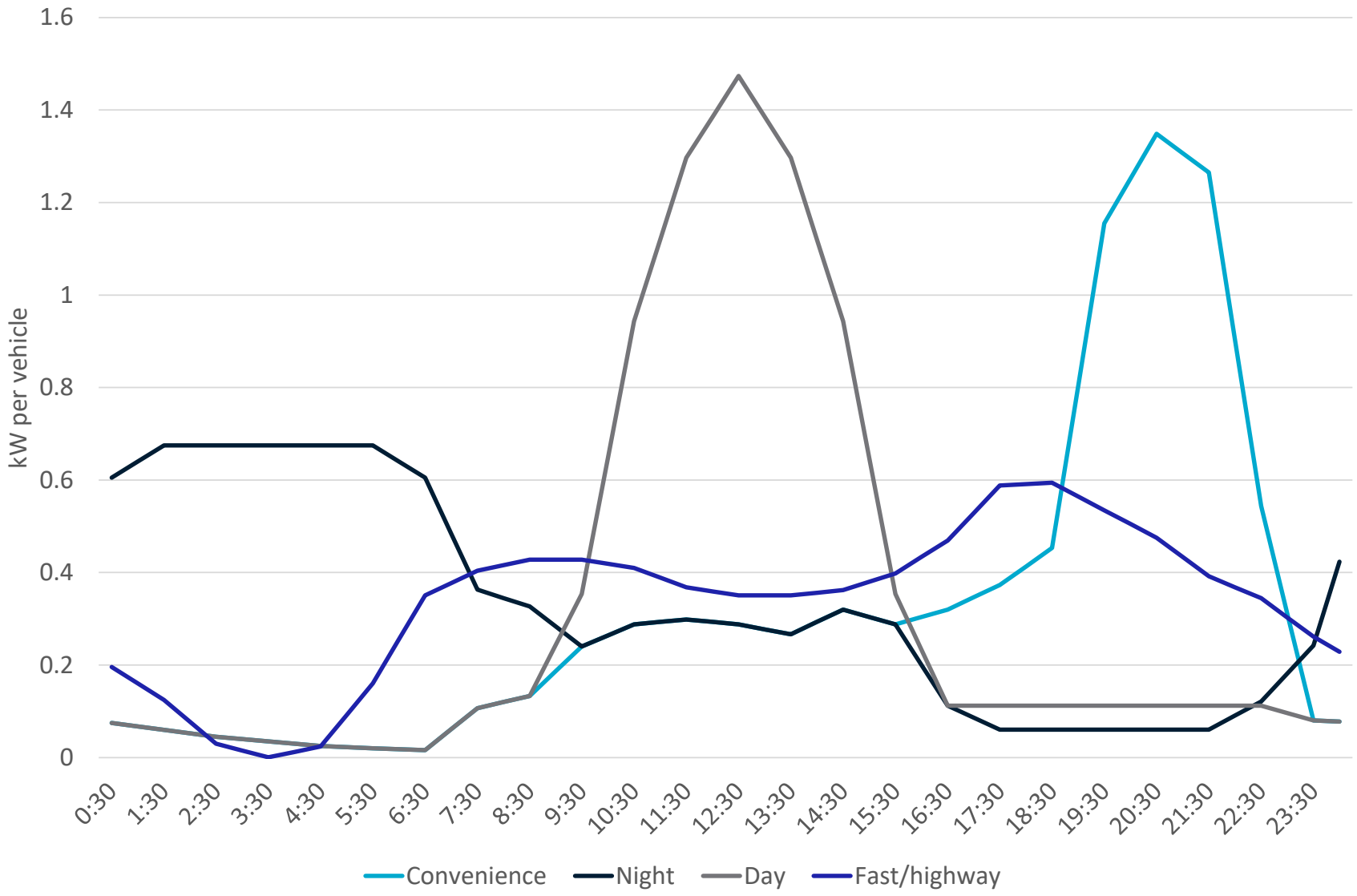
Profile share assumptions - commercial

By 2050	Lower uptake	Some uptake	Higher uptake
LCV – Convenience/night	80%	75%	60%
LCV - Day/solar aligned	10%	20%	35%
LCV - Fast/highway	10%	5%	5%
Trucks & buses – Convenience	80%	75%	60%
Trucks & buses - Day/solar aligned	15%	20%	35%
Trucks & buses - Fast/highway	5%	5%	5%

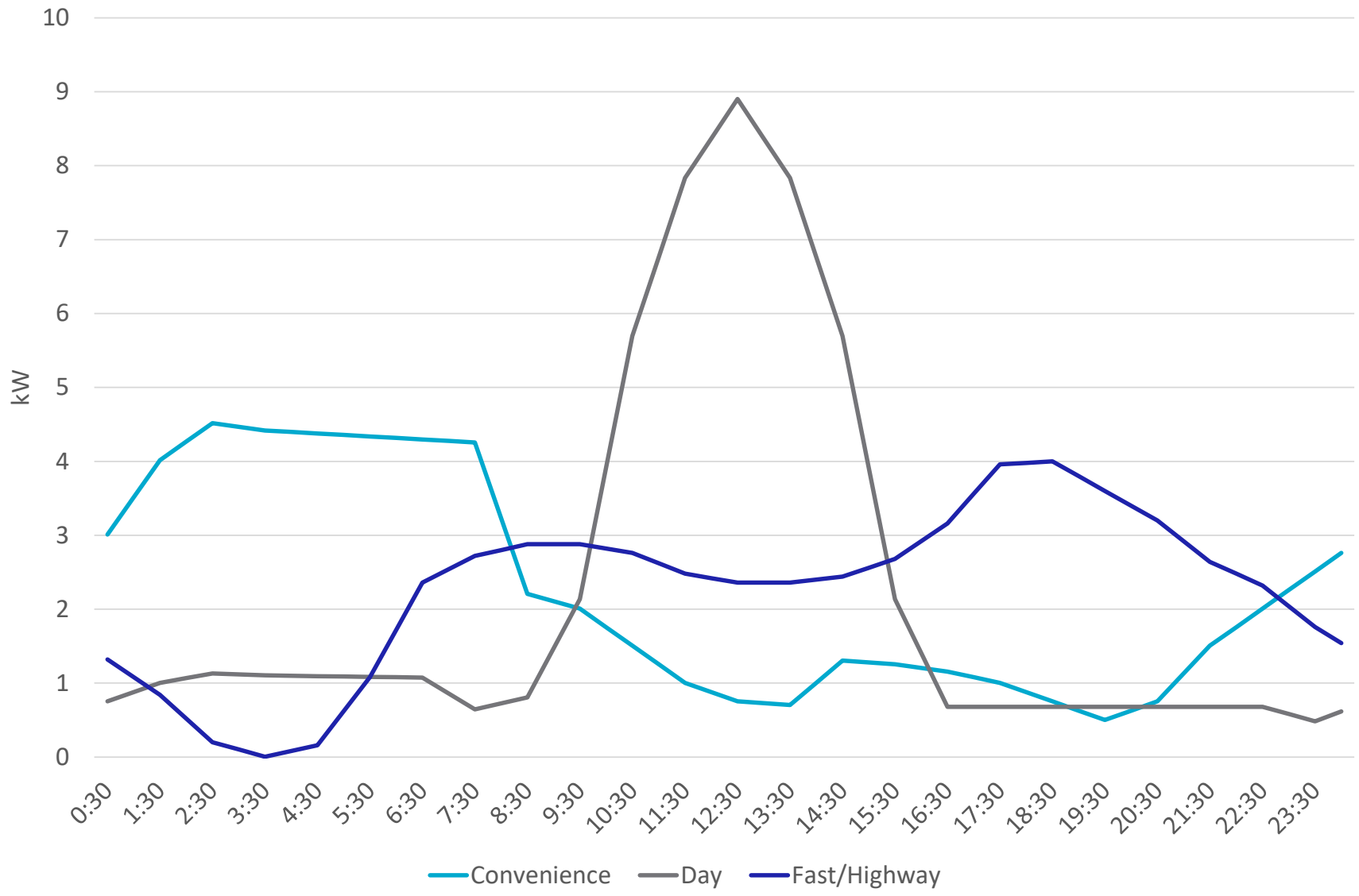
Compared to 2020, reduced preference for non-dynamic day time charging. This can lead to new midday peaks on low solar output days and lacks plausibility given vehicle duty requirements

	2020 assumptions		
By 2050	Slow change	Central	Step change
LCV – Convenience/night	79%	74%	19%
LCV - Day/solar aligned	14%	19%	74%
LCV - Fast/highway	8%	8%	8%
Trucks & buses - Convenience	81%	76%	19%
Trucks & buses - Day/solar aligned	14%	19%	76%
Trucks & buses - Fast/highway	5%	5%	5%

Estimated EV charge profiles: medium passenger vehicle



Estimated EV charge profiles: commercial rigid truck



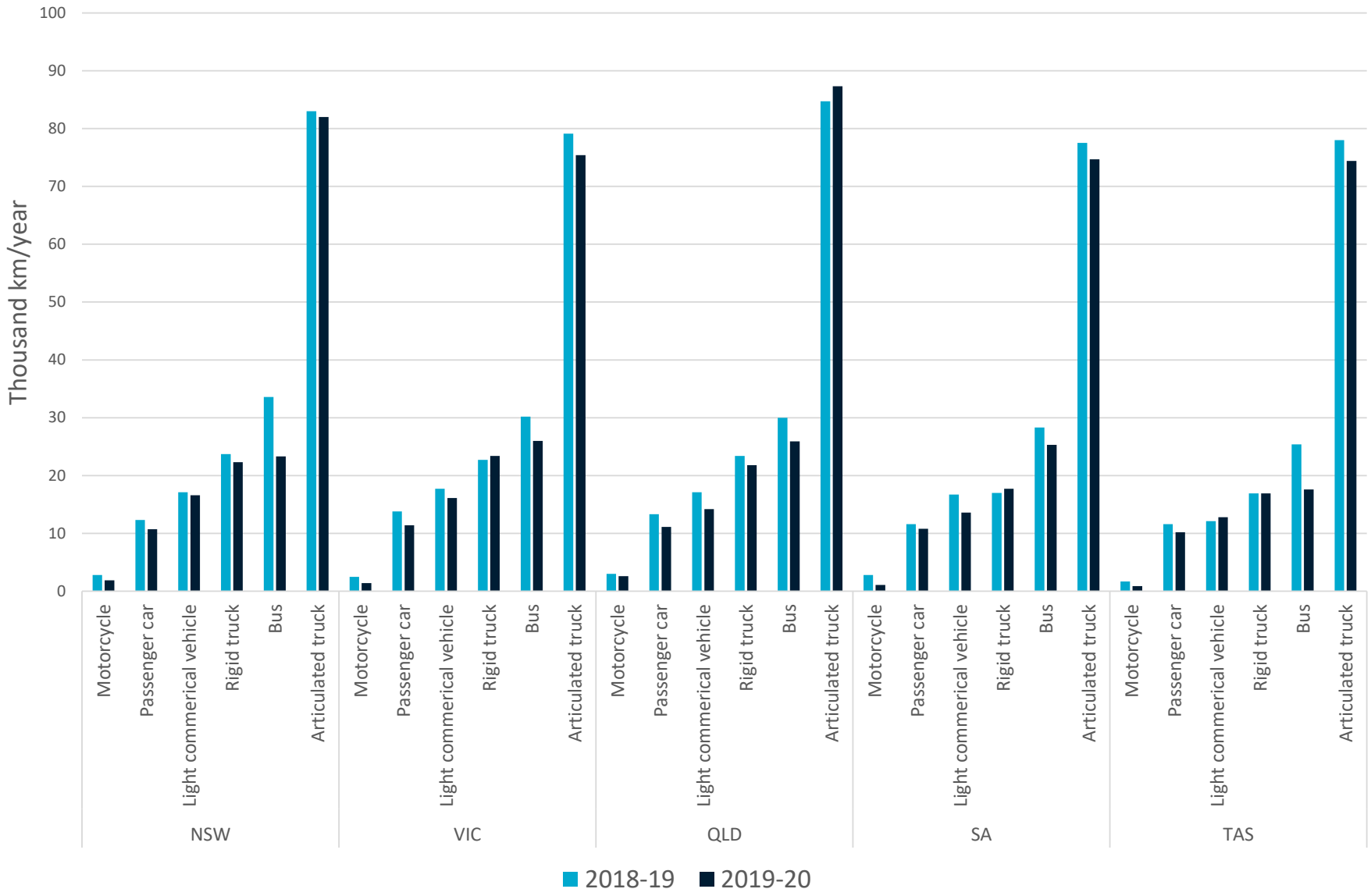
Appendix

EV input data

Key sources:

- ABS: sourced from state transport departments
  - Registration by type identifying EVs. Sales is aggregated
  - Issues with quality in the past appear to be fixed
- VFACTS: Federal Chamber of Automotive Industries member data
  - Sales focus identifying PHEV and BEV categories by mode (passenger, light commercial vehicle [LCV])
- We use a combination to the historical fleet and sales trend
  - 2020 – Conventional vehicle sales dropped 14% while EV sales grew

Kilometres per year travelled



Thank you

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